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Summary of 3.4.3

Number of research papers per teacher in CARE Journals notified on UGC website during the year

Year	**2021**	**2022**
Number	48	51
Total	99	
No. of Teachers	312	325
Avg. No. of Teachers	318.4	
No. of papers per Teachers	0.31	

Supporting Documents

1. Proof of Papers in the Journals notified on UGC website

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Proof of Papers in the Journals 2021

Udaysingh Patil et al. • Sustainable building materials using textile effluent treatment plant sludge: a review
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Research Article
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Keywords: material characterisation/mechanical properties/sustainable materials

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Sustainable building materials using textile effluent treatment plant sludge: a review

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A huge quantity of textile effluent sludge is generated from 21 076 textile units of India and dumped in large areas, leading to contamination of soil, surface water and groundwater. Hence, effective management of this sludge is important for its reuse and safe disposal. Considering the utilization of this waste in construction activities, the current paper explores the potential of textile sludge produced from textile industry effluent treatment plants. Many researchers have attempted to reuse this sludge for the development of sustainable construction materials and suggested its optimum usage as a partial substitution for fine aggregate, cement and clay with or without additives for the manufacturing of non-structural building components. This paper provides a critical review of the production of non-structural elements – namely, sustainable building blocks, clay bricks, mortar and paver blocks – using textile effluent treatment plant sludge and recommends optimum ranges of 5–30, 5–40, 5–50 and 20–40%, respectively. The prominent gaps are suggested as the outcome of studies such as techno-economic feasibility of the product, thermal and energy building simulation along with the life-cycle assessment and fatigue life assessment of the developed paver blocks.

1. Introduction

Due to rapid industrialization in developing countries and subsequent increase in human activities, there is a continuous accumulation of industrial wastes, which are becoming difficult to manage day by day. A great area is utilized in dumping these industrial wastes, which may lead to contamination of soil, surface water and groundwater.[1] Hence, recycling these wastes into an innovative material could be a practical solution to the problem of landfilling and reduce its impact on the environment. Also, urbanization in urban rural areas has increased the demand for construction materials, and thus, the demand for new construction materials that are economically feasible is increasing exponentially. According to a report, there will be a galloping demand for construction materials to alleviate the housing shortage.[2] As per the report of the Ministry of Urban Housing and Poverty Alleviation (technical group) of an estimation of the urban housing shortage[3] and the report of the working group on the rural housing shortage,[4] in 2012, India's total urban housing shortage was 18.78 million, while the rural housing shortage was projected to be 43.9 million (Figure 1(a)).[3,4] It is worth noting that 90% of this shortage pertains to the socially deprived and the lower-income classes of the society. This massive number is a cause for concern. One of the reasons behind it is the high cost of building materials. Thus, an economically weaker sector cannot afford the high construction cost. To meet these demands, there is a need for an increase in the production of material, which leads to another issue – namely, carbon dioxide (CO_2) emissions. Figure 1(b) shows that the production of steel, cement, bricks and lime has increased from 2000 to 2020. Hence, increases in the consumption of energy and carbon dioxide emissions can therefore be seen (Figures 1(c) and 1(d)).[2] In India, the construction sector emits around 22% of the total emission of carbon dioxide annually, out of which 80% results mainly from the industrial processes involved in the production of steel, cement, bricks and lime. Therefore, there is a need to develop sustainable, economically viable and modular construction material to meet the ever-increasing demand for construction material without exploiting the available natural resources. This will help reduce carbon dioxide emissions and provide an alternative solution for solid waste management. Many researchers have incorporated various wastes to develop sustainable construction material, such as ladle furnace slag, blast slag, iron (Fe) tailing, zinc (Zn) tailing and several sewage sludges. Such wastes end up being a sustainable solution to disposal and environmental issues.

India is the world's second largest manufacturer and exporter with a huge unrivalled raw material base and strength. India accounts for 5% of the world's clothing and apparel trade. The textile industry accounts for 2% of the gross domestic product and 15% of the nation's export earnings.[5] About 21 076 textile units are spread all over India.[6] A large quantity of water is being utilized by textile industries during the production of textiles. As a result, a significant quantity of industrial wastewater is produced, which needs to be treated appropriately before its safe disposal. This industrial wastewater is treated in effluent treatment plant units.

During this effluent treatment process, a large amount of sludge is generated in various stages or processes – namely, chemical coagulation (i.e. addition of chemical coagulants), flocculation (i.e. formation of flocs) and liquid or solid separation.[1] It is estimated that in India the textile industry generates an abundant quantity of textile effluent treatment plant (TETP) sludge – namely, around

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Effect of Fillers and Autogenous Welding on Dissimilar Welded 316L Austenitic and 430 Ferritic Stainless Steels

Chetan Tembhurkar, Ravinder Kataria, Sachin Ambade, Jagesvar Verma, Anand Sharma, and Saurabh Sarkar

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This experimental study examines the effects of dissimilar welding of 316L austenitic and 430 ferritic stainless steels, welded with gas tungsten arc welding process with (ER316L and ER309L) and without fillers (autogenous). Microstructural examination was performed by optical and scanning electron microscopy. ER316L and ER309L fillers welds illustrated equiaxed and columnar grains; ER309L weld showed higher Cr_{eq}/Ni_{eq} ratio than that of ER316L weld, produced vermicular ferrite, while autogenous weld shows lathy ferrite and martensite. Chromium carbide precipitate was also observed in autogenous weld. The mechanical properties were measured and higher hardness was obtained in autogenous weld compared to ER316L and ER309L filler weld. Higher tensile and impact strength was measured in ER316L filler weld as compared to ER309L filler and autogenous weld. The corrosion resistance of the joints was carried out by double loop electrochemical potentiokinetic reactivation and potentiodynamic polarization test to assess the sensitization and pitting resistance, respectively. Higher degree of sensitization and pitting were observed in autogenous weld as compared to ER316L and ER309L filler weld due to precipitation formation, but the pitting corrosion was found to be lower for ER309L filler weld as compared to ER316L filler and autogenous weld due to the effect of mode of solidification.

Keywords austenitic stainless steel, dissimilar welding, ferritic stainless steel, microstructure, pitting corrosion, sensitization, tungsten inert gas welding

1. Introduction

Dissimilar welding is more popular in various industries such as chemical, petrochemical, oil, gas, shipbuilding, defense, railways and nuclear industries to provide high strength at low cost (Ref 1); among these industries most widely used stainless steel (SS) is austenitic-based 304L and 316L. Austenitic 316L SS possess higher strength and corrosion resistance as compared to 304L SS (Ref 2). However, 316L contains higher amount of nickel (Ni) (Ref 3), which is drastically shooting the price toward the higher side day to day (Ref 4) breaking the backbone of manufacturers and consumers (Ref 5). Among above-mentioned industries ferritic stainless steels (FSS) are being used which shows high heat resistant and good sustainability in chloride environments and also shows an economic alternative than austenitic SS (ASS). However, some of the applications require joint integrity of FSS and ASS (Ref 6), but FSS shows a low weldability and grain growth in the WZ and HAZ causing low toughness and ductility, due to the absence of phase transformation. Therefore, a careful selection of filler and processes is more important to provide sound weld joint (Ref 2, 6).

Few studies had been done on both 316L and 430 FSS and from the studies both can be welded by any of the fusion processes such as GTAW, SMAW and GMAW, but the process parameters and fillers play an important role for sound weld joint (Ref 7-9).

The study on dissimilar (316L ASS and 430 FSS) weld by using SMAW process with fillers E309L and AWS E2209-16 SS demonstrated that the higher heat energy of process mainly affects the size of HAZ and weld microstructure. Grain growth in ferritic 430 FSS HAZ side was larger, whereas lesser grain growth in 316L side in both filler cases; this is attributed due to high heat input and variation in thermal conductivity. The composition of the filler metal (E2209-16), where chromium and nickel equivalent ratio (Creq/Nieq) is low increases the delta-ferrite content in the weld compared to E309L filler (Ref 6). AISI 316L and AISI 430 joint produced by adopting current continuous (CCGTAW) and pulsing current (PCGTAW) using ERNiCu-7 fillers and it is suggested that the welds produced from ERNiCu-7 fillers were free from detrimental Laves phase formation. Weld grain boundary retains the elements like Cr and Mo which controlled laves phase formation and increased the strength (Ref 8). Dissimilar 430 FSS and 304 ASS welded by CO_2 laser beam welding (LBW) process with helium and

Abbreviations

GTAW	Gas Tungsten Arc Welding
WZ	Weld Zone
HAZ	Heat Affected Zone
UMZ	Unmixed Zone
GMAW	Gas Metal Arc Welding
EDS	Energy-Dispersive Spectroscopy

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ARTICLE

Estimation and control of surface quality and traverse speed in abrasive water jet machining of AISI 1030 steel using different work-piece thicknesses by RSM

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ABSTRACT

Abrasive water jet machining (AWJM) is an unconventional cutting method used in different industrial applications. The motive of this paper is to investigate the effect of traverse speed on surface roughness for a particular workpiece thickness. Three different plates of AISI 1030 steel as work-piece with thicknesses 4 mm, 6 mm and 8 mm are used to evaluate surface quality of cutting. Three response models for respective thicknesses are generated and checked on the basis of their prediction ability. It showed 8.71%, 8.11% and 7.83% error for surface roughness for three different thicknesses, respectively. Post validation, desired surface roughness values are placed in the response models for prediction of respective traverse speeds for three different thicknesses and represented in a graphical manner. This paper will help the AWJ machining operator to find out the precise cutting speed for achieving desired surface roughness.

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KEYWORDS
Abrasive water jet machining; Taguchi method; surface roughness; response surface methodology

1. Introduction

Abrasive water jet machining (AWJM) is used for cutting various components of machines used in industrial as well as domestic applications. In the AWJM process, material is eradicated through excising and distorting erosive wear method, wherein the work material is collided by a high velocity of water jet with accelerating abrasive particles (Dumbhare et al. 2018). Here, every hard abrasive particle works as a cutting tool. It is ordinarily used in cutting of ferrous, non-ferrous alloys, glass, granite, etc. because it offers very small-sized heat-affected zone with negligible distortion and burrs (Liu et al. 2004). AWJM has many advantages over other cutting methods such as high flexibility, no thermal damages, high machining adaptability with and minimum cutting forces (Wang 2010). The greatest advantages of AWJM over other cutting methods are higher material removal rate with minimal thermal defects and no hazardous slag (Ramulu et al. 2015; Mayuet et al. 2015; Kartal and Gokkaya 2013)

In AWJM, due to fine abrasive particles and lesser cutting forces and deformations, good surface quality is achieved even at low thickness of material and low cutting speed. Due to demand of good surface quality for thinner components, this becomes an important factor in selecting the process and to control the manufacturing cost (Dumbhare et al. 2018; Çaydaş and Hascalık 2008; Selvakumar, Prakash, and Lenin 2018). Researchers have used various techniques for estimation and optimisation of surface roughness using AWJM process parameters. The literature study in this regard is discussed in following paragraph.

Selvan et al. (Selvan, Raju, and Sachidananda 2012) studied the effect of process parameters such as water pressure, flow rate of abrasive, traverse speed and stand-off distance on surface roughness in AWJM. Design of experiment was carried out using Taguchi method. They have recommended high water pressure, high flow rate of abrasive and minimum traverse speed and stand of distance for getting smooth surface. Begic-Hajdarevic et al. (Begic-Hajdarevic et al. 2015) studied AWJ machining of aluminium and reported the consequences of mass flow rate of abrasive, traverse speed and material thickness on the surface roughness. They assessed that traverse speed is major influencer of the surface roughness at the bottom portion of the cut. Aultrin et al. (Aultrin 2014) performed the machining of aluminium alloy. They established a second-order polynomial model considering the water pressure, standoff distance, orifice diameter, flow rate of abrasive and focusing nozzle diameter for prediction of surface roughness and material removal rate (MRR) using RSM. The

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Performance and exhaust emission characteristics investigation of compression ignition engine fuelled with microalgae biodiesel and its diesel blends

Bhojraj Kale, Sewan Das Patle, Vijay Khawale & Sandeep Lutade

Environmental Science and Pollution Research (2021)

Abstract

Biofuels extracted from plant biomass can be used as fuel in CI engines to lower a hazardous atmospheric pollutant and mitigate climate risks. Furthermore, its implementation is hampered by inevitable obstacles such as feedstocks and the crop area required for their cultivation, leading to a lack of agricultural land for the expansion of food yields. Despite this, microalgae have been discovered to be the most competent and unwavering source of biodiesel due to their distinguishing characteristics of being non-eatable and requiring no cropland for cultivation. The objectives of this paper was to look into the potential of a novel, formerly underappreciated biodiesel from microalgae species which could be used as a fuel substitute. Transesterification is being used to extract the

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RESEARCH ARTICLE

Effect of filler and autogenous welding on microstructure, mechanical and corrosion properties of low nickel Cr-Mn ASS

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ABSTRACT

This experimental study investigates the effects of welding low nickel Cr-Mn austenitic stainless steel with gas tungsten arc welding process with and without filler (autogenous) weld by varying the welding currents (120A, 130A and 140A). The microstructural examination of weld has been carried out with optical microscope and mechanical properties with Vickers microhardness and tensile tester. The corrosion behaviour of the welded joints are analysed by double loop electrochemical potentio-kinetic reactivation test to obtain degree of sensitisation. The microstructural examination of welded joints revealed that, as the welding current increases, the inter-dendritic spacing as well as the dendrite size increases. The tensile strength and hardness decrease with increasing welding current for 308 L filler and autogenous weld. The degree of sensitisation increases with increasing welding current for both the welds. The results reveal that the autogenous welds have higher tensile strength, higher hardness and lower degree of sensitisation as compared to welds with 308 L filler.

ARTICLE HISTORY
Accepted 18 August 2021

KEYWORDS
Cr-Mn stainless steel; gas tungsten arc welding; welding current; microstructure; hardness; tensile strength and sensitisation

1. Introduction

In today's manufacturing world, Cr-Mn ASS (Chrome Manganese austenitic stainless steel) (200-series) is seen as the better economical and replacement of austenitic stainless steel (300-series). Many industrial applications such as aircraft, automotive, nuclear and food industry use 300-series austenitic stainless steel [1] due to its high tensile strength and corrosion resistance properties [2]. However, stainless steel (300-series) contains more nickel and the price of nickel is increasing drastically, breaking the backbone of manufactures and buyers [3]. So many mentioned industries are searching for alternative stainless steel which are cheaper and have reasonably good corrosion resistance and strength. Cr-Mn ASS grades containing manganese are seen as a substitute for nickel to balance the austenite phase [4]. The problems associated with welding in the austenitic stainless steels (ASS) are the sensitisation of the heat-affected zone of the weld, the weld

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Catalysis

Exciton Dissociation on Double Z-scheme Heterojunction for Photocatalytic Application

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Constructing heterojunction is one of the promising approaches to obtain desired photocatalysts with enhanced photocatalytic activity. Herein, we have fabricated a Fe_2O_3-$PrFeO_3$/g-C_3N_4 ternary heterostructure by a simple wet chemical method to improve the photocatalytic activity of pristine g-C_3N_4. The as-prepared catalyst has shown 7.8 times higher photocatalytic degradation of dye acid violet 7 and generated 379.29 μmolL^{-1} h^{-1} of ammonia under visible-light irradiation. The ternary heterojunction was found to form a double Z-scheme heterojunction that facilitates interfacial electron transfer, promotes the separation of photogenerated charge carriers, and also enhances light harvesting property. The enhanced photocatalytic performance of the catalyst is ascribed to the formation of double Z-scheme heterojunction, which offers low charge transfer resistance thereby lowering the recombination of photoexcitons and increasing the lifetime of photoexcitons.

1. Introduction

The semiconductor-driven photocatalysis is regarded as a potential advanced oxidation process (AOP) to surpass the ever-increasing energy demand and tackle environmental contamination using inexhaustible solar energy.[1] In this regard, a plethora of semiconductors have been utilized for various solar-to-energy conversion and environmental remediation applications.[2] Amongst, the metal-free graphitic carbon nitride (CN) is a promising environmentally benign photocatalyst that has grabbed great attention after the potential report for photocatalytic water splitting by Wang et al. owing to its outstanding thermal and chemical stability, absorption of visible-light, and appropriate band alignment.[3] However, it shows moderate photocatalytic activity due to limited light absorption, low surface area, and rapid recombination of photoexcitons.[4] Therefore, many modification strategies have been employed to improve its photocatalytic performance, such as nanostructure engineering,[5] doping,[6] co-catalyst loading,[7] and heterostructure construction.[8]

Formation of heterostructure is regarded as a promising approach to facilitate the separation of photoexcitons, inhibit charge-carrier recombination, and extend the optical absorption.[9] In this regard, CN has been coupled with various semiconductors to construct binary heterojunctions (type II or Z-scheme) with enhanced photocatalytic performacne due to inverse interfacial transfer of photogenerated electrons and hole pairs.[10] Perhaps, some of the reduction and oxidation potential of charge carriers are wasted during their migration towards lower conduction band (CB) and higher valence band (VB) energy levels.[11] To address this shortcoming, introduction of a third component in the heterostructure to increase the CB potential can be an effective strategy. In this context, numerous ternary systems such as ZnO/$ZnWO_4$/CN,[12] NiL/NiO_x/CN,[13] Ag-rGO/CN,[14] CN/MoS_2/Ag_3PO_4,[15] etc. have been constructed and their optimization displayed high light-harvesting, utilization, and improved charge separation efficiency with enhanced photocatalytic performance. The enhancement in the photocatalytic activity in these ternary systems is attributed to the synergistic effect of multicomponent that enables the migration and separation of photoexcitons and provided charge carriers with outstanding oxidation and reduction potential. Furthermore, in comparison to the binary heterostructure, the appropriate band gap position in ternary heterostructure systems enables efficient separation of photoexcitons, increses light absorption, and prolongs lifetime of photoexcitons.

Hematite (Fe_2O_3), an intrinsic n-type semiconductor is widely used for solar-driven applications due to its earth abundance nature, low-cost, non-toxicity, high chemical stability, and visible light active with a band gap of 2.2 eV.[16] Nevertheless, high charge-carrier recombination rate, and lower exciton lifetime impedes its photoconversion efficiency.[17] Likewise, iron-based perovskite-oxide, $PrFeO_3$ is a new type of semiconducting material with band gap of 2.08–2.4 eV, and has

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Steel Slag Utilization in Pavements

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Abstract-India, being the world's second largest steel producer also faces the challenges of safe and gainful disposal of 18.5 million tons of steel slag generated annually in India from various integrated steel plants.The biggest a part of generated metallic slag nevertheless ends on frequently non-regulated landfills as commercial waste in adjacent areas. Disposal of metallic slag as landfills results in severe pollutants to the environment. Steel slag is the major waste product of metallic enterprise and the contemporary usage of metallic slag is much less than 30%, a long way in the back of the advanced countries. The sustainable improvement idea calls for a extra green control of waste substances and renovation of environment. Steel slag may be used probably as a sustainable fabric in creation of pavements as India has global's second biggest street community in phrases of period with a complete street period of 4.24 Million Km. Large scale toll road creation in India, emanating from speedy improvement has brought on large depletion of scarce herbal aggregate.Utilisation of Steel slag aggregates as a substitute of natural aggregate in road construction will reduce the unsustainable quarrying and mining of natural aggregates and will also reduce the emission of Greenhouse Gases associated with road construction activities.This paper gives a top level view on the global usage of metallic slag to clear up this trouble and additionally the essential routes and vital troubles for large-scale usage of metallic slag have been proposed.

Keywords –Steel slag, sustainable development, pavements.

I. INTRODUCTION

Sustainability is a primary focus of 21st century engineering, and therefore, the use of sustainable materials has been investigated for their economic, environmental, and social benefits. Preventing the exhaustion of natural resources and enhancing the usage of waste materials has become a significant problem of the modern world. Accordingly, today the emphasis is on the avoidance of waste generation, recycling and reuse of waste, and minimizing the adverse impact of disposal on the environment. Among all the solid/liquid wastes, slag generated at iron making and steel making units are created in the largest quantities. India is the 3rd largest steel producer in the world with total steel production of 95.6 MT per annum [1]. Steel slag is solid waste which is produced from the further refining of iron in a basic oxygen furnace or from the melting of scrap in an electric arc furnace [2]. Approximately 250-300 kg of slag is produced per ton of pig iron and conversion of pig iron into steel yields further 120-150kg of slag per ton of steel. With increasing capacities, disposal of large quantities of slag becomes a big environmental concern and a critical issue for steel makers [3]. The current utilization of steel slag is less than 30%, far behind the developed countries like United States, Japan, France and Germany of which rates of utilization have been close to 100%. And also India has world's second largest road network in terms of length with a total road length of 4.24 Million Km. Large scale highway construction in India, emanating from rapid development has caused massive depletion of scarce natural aggregate[4]. Therefore improving the rate of utilization of steel slag as an substitute for natural aggregate is an imperative way for the steel enterprise to realize sustainable development. In this paper the research progress of steel slag utilization in pavements is overviewed.

A Lightweight Provably Secure Digital Short-Signature Technique Using Extended Chaotic Maps for Human-Centered IoT Systems

Chandrashekhar Meshram, Mohammad S. Obaidat, *Fellow, IEEE*, Jitendra V. Tembhurne, Shailendra W. Shende, Kailash W. Kalare, and Sarita Gajbhiye Meshram

***Abstract*—Internet of Things (IoT) consists of numerous smart devices for sharing sensed data through the availability of online services. Direct communication by smart devices with people to identify parameters of healthcare and send them to a central repository is crucial. There is a need to secure messages among the sender and recipient during data exchange in order to tackle the malicious attacks by human. To provide secure communication, various signature-based schemes are presented in the literature. However, smart devices require lightweight tasks by guaranteeing essential security strengths. The main difficulty in signature-based methods is more computational cost incurred for signature and verification stages involving large numbers. This article introduces a lightweight provably secure short digital signature technique for safe communication amongst smart devices in human-centered IoT (HCIoT), the security of which is closely related to an extended chaotic maps assumption in a random oracle model (ROM). Moreover, we used less comprehensive operations to accomplish processes of verification and signing, similar to human signing on legitimate documents and then check as per witness. The proposed technique provides a stronger guarantee of protection than existing signature techniques. The key advantage of the presented technique over the DSA techniques is that it takes less computation in the verification stage and signing length; it retains the degree of protection. The presented short signature takes less bandwidth for communication, storage, and computing resources.**

***Index Terms*—Confidentiality, digital signatures, extended chaotic maps and probability security analysis systems, Internet of Things (IoT) complex systems.**

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List of Notations

u	Private key.
v	Public key.
$\mathcal{T}$	Chebyshev chaotic maps.
r	Random number per message.
$\hbar_1, \hbar_2$	One Way Hash Functions.
$\mathcal{M}$	Message.
$\mathcal{B}$	First parameter of signature.
$\mathcal{s}$	Second parameter of signature.
σ	Digital signature.
q	Large prime number of bit length.
p	Large prime factors of $q-1$.

I. Introduction

TODAY is the era of Internet of Things (IoT) wherein different types of devices are connected to the Internet. These devices can be home appliances, agricultural equipment, manufacturing devices, industry tools, energy meter, mining sensors, healthcare monitoring instruments, environment equipment, surveillance systems, smart homes, smart cities, and smart grids among others, which comprise the machine-to-machine (M2M) model. With the advent of IoT-enabled devices, it is very easy to monitor or control various kinds of systems on the finger tips. IoT devices are smart enough to share and exchange data over public Internet to store on cloud. IoT is a powerful tool to apply on varieties of domains and proves the vital role by providing significant advantages. Ashton presented the notion of "*IoT*" and IoT devices came into existence in 2005. Since then tremendous evolution in IoTs has been reported; starting from the invention of basic smart devices to human centered sophisticated devices [1]. Thus, IoT devices received wide acceptance to use in various areas such as smart environment and human-centered design. The different methodologies have been adopted by the researchers to develop and experiment with IoT-enabled systems in a wide range of applications [2]. In addition, the architectures presented to investigate real-world problems are developed using the notion of IoT [3]. This motivates the research in IoTs to explore more possibilities in order to utilize the tremendous power of IoTs.

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A Provably Secure Lightweight Subtree-Based Short Signature Scheme With Fuzzy User Data Sharing for Human-Centered IoT

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ABSTRACT Internet of Things (IoT) is made up of various smart devices for the exchange of sensed data through online services. Direct contact with people through smart devices to define parameters for healthcare and send them to a centralized repository. At the time of data exchange, messages need to be secure between a source (sender) and target (receiver) in order to confront human malicious attacks. Various signature-based schemes are presented in the literature to provide secure communication. Smart apps, however, require lightweight activities by maintaining critical security strengths. The key challenge in signature-based methods is more incurred computational expense for signing and checking process involving large numbers. In this article, a new lightweight provably secure partial discrete logarithm (DL) based subtree-based short signature with fuzzy user data sharing for human-centered IoT systems is introduced and it's security analysis is demonstrated on random oracle (RO) model. The presented scheme provides assurance of better security than other standing short-signature schemes. For low-storage, low-computation environments and low-bandwidth communication, the presented new provably secure and lightweight subtree-based short-signature scheme is needed. The results demonstrate the strength of proposed scheme, as opposed to existing works.

INDEX TERMS Fuzzy user data sharing, IoT, identity-based signature scheme, partial discrete logarithm, probability security analysis, subtree.

I. INTRODUCTION

In the past, we had witnessed so much development in the security aspects related to numerous domains such as e-commerce, healthcare, IoT, industrial IoT, and cloud computing, etc. Variety of cryptographic algorithms are presented in various domains to satisfy the essential security needs by the users or organizations. Initially, public-key cryptography (PKC) was adopted to offer the security wherein public-key is shared amongst all the users. The message exchange is stared after the generation of key pairs (*encryption, signature*), the certificate request is submitted with identity proof to CA (certificate authority), and hence receive certificates signed by CA for authentication to exchange messages in

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A robust smart card and remote user password-based authentication protocol using extended chaotic maps under smart cities environment

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Abstract

The idea of an internet of things (IoT)-based smart city evolves with the aim of improving the quality of citizens' lives through the practice of data and announcement (such as email, connection, etc.) tools. The idea of smart cities is believed to be feasible through the incorporation of new technologies such as IoT, automation and machine learning in which IoT plays a key role. When billions of slight strategies drive online and start sharing their information, confirmation has already described as a major security issue nearby the IoT. To exacerbate things, as internet technology advances, advanced hacker methods and new forms of threats arise after each other. It is, therefore, necessary to create efficient

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METHODOLOGIES AND APPLICATION

A robust smart card and remote user password-based authentication protocol using extended chaotic maps under smart cities environment

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Keywords Mutual authentication · Session key · Smart card · Extended chaotic map · Perfect forward secrecy · Hash function · BAN logic · IoT · Smart city

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SIFK based Isobeta Cryptosystem

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Abstract *— The current effort takes the unique technique to construct is beta cryptosystem, whose security is established on santilli'sisofields first-kind* ($\mathcal{SIFK}$)*, generalized discrete logarithm problem* ($\mathcal{GDLP}$) *and integer factorization problem* ($\mathcal{IFP}$) *in the isomultiplicative isogroup of finite* $\mathcal{SIFK}$*. The attacker have to find isoelement from* $\mathcal{SIFK}$ *and simplify both distinct* $\mathcal{GDLP}$ *and* $\mathcal{IFP}$ *together in the isomultiplicativeisogroup of finite* $\mathcal{SIFK}$ *in order to get back comparable massage from the secured cipertext and so this technique is probable to achieve a higher level of security.*

Keywords *— Public Key Cryptosystem* ($\boldsymbol{\mathcal{PKC}}$)*,* $\boldsymbol{\mathcal{SIFK}}$*,* $\boldsymbol{\mathcal{GDLP}}$ *and* $\boldsymbol{\mathcal{IFP}}$*.*

I. INTRODUCTION

The technique of $\mathcal{PKC}$ suggested in article "New Directions in Cryptography" by Diffie-Hellman [1]. After that several $\mathcal{PKC}$ were suggested. Among these $\mathcal{PKC}$ techniques based on hard mathematical problems, which security be dependent on the impracticable of factoring a large integer. Among these $\mathcal{PKC}$ techniques based on hard mathematical problems, which security be dependent on the impracticable of factoring a large integer [2] and the complexity of derive the square root modulo a massive composite integer [3]. ElGamal offered an efficient $\mathcal{PKC}$ based on $\mathcal{DLP}$, which is too hard to simplify as deal with prime field or elliptic curve defined over a finite field [4]. All $\mathcal{PKC}$ based on $\mathcal{DLP}$ and $\mathcal{IFP}$ are not reliable if mathematical structure for $\mathcal{DLP}$ and $\mathcal{IFP}$ are solved. The techniques build on a single mathematical structure have security issues, so researchers proposed $\mathcal{PKC}$ based on multiple hard mathematical structure. Various $\mathcal{PKC}$ have been built on together $\mathcal{DLP}$ and $\mathcal{IFP}$ [5-22]. Some $\mathcal{PKC}$ have been built on dihedral group and suzuki-2 group [23-25]. At the latest, Meshram A. suggested key exchange protocol based on ring isopolynomials with isointeger coefficient [26]. Dani M. offered santilli'sisofields second-kind based key exchange protocol for secure communication[27]and key exchange protocol based on $\mathcal{SIFK}$[28].

Regrettably, we observed that $\mathcal{DLP}$ and $\mathcal{IFP}$ based unified presented $\mathcal{PKC}$ cannot be considered as secure. Hence, we construct a unique beta cryptosystem based on $\mathcal{SIFK}$, $\mathcal{GDLP}$ and $\mathcal{IFP}$ along its assured security, we additionally demonstrated that it is extremely capable to be enforce in the physical world applications.

The rest of this article summarize as below; in section-II, we explained $\mathcal{SIFK}$, offered beta cryptosystem based on $\mathcal{SIFK}$ in section-III, supporting example for confirmation of suggested cryptosystem in section-IV, security investigation and efficiency performance examine in section-V and in final section-VI we conclude the article.

II. $\mathcal{SIFK}$

Santilli [29] offered the generalization of arithmetic operations $\langle +, -, \times, \div \rangle$ termed as isomathematics. $\mathcal{SIFK}$ is the ring $\hat{\mathfrak{F}} = \hat{\mathfrak{F}}(\hat{y}, +, \hat{\times})$ along with isonumbers $\hat{y} = y\hat{I}, y \in \mathfrak{F}, \hat{I} = \frac{1}{\hat{r}} \notin \mathfrak{F}$ along with arithmetic operations $\langle \hat{+}, \hat{-}, \hat{\times}, \hat{\div} \rangle$, $\hat{y} + \hat{x} = (y + x)\hat{I}$an isosum, with additive unit $0 = 0\hat{I} = 0$, $\hat{y} + 0 = 0 + \hat{y} = \hat{y}$ and isoproduct $\hat{y} \hat{\times} \hat{x} = \hat{y}\hat{T}\hat{x} = y\hat{I}\hat{T}x\hat{I} = (yx)\hat{I}$, where, the left and right new unit $\hat{I}$, $\hat{I} \hat{\times} \hat{y} = \hat{y} \hat{\times} \hat{I} = \hat{y}$ is called isounit and $\hat{T}\hat{I} = 1, \hat{T}$ is called inverse of isounit $\hat{I} \neq 1$.

III. ISOBETA CRYPTOSYSTEM BASED ON$\mathcal{SIFK}$

The mechanism for isobeta cryptosystem involves three steps;

Step-A: Key Formation Algorithm

Client-1 runs following algorithm for key formation;

i. Select two large isoprimeisonumbers$\hat{\mathcal{A}}$ and $\hat{\mathcal{B}}$ of the same size.

ii. Numerate the IsoEulerphi function $\varphi(\hat{\mathcal{N}}) = (\hat{\mathcal{A}} - 1)(\hat{\mathcal{B}} - 1)$ for isointeger $\hat{\mathcal{N}} = \hat{\mathcal{A}} * \hat{\mathcal{B}}$.

iii. Pick an arbitrary isointeger $\hat{q}$, $1 \leq \hat{q} \leq \varphi(\hat{\mathcal{N}})$ such that, $\gcd\left(\hat{q}, \varphi(\hat{\mathcal{N}})\right) = 1$.

iv. Pick an arbitrary isointeger $\hat{w}$ such that $2 \leq \hat{w} \leq \varphi(\hat{\mathcal{N}}) - 1$.

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MEDICAL IMAGE PROCESSING AND ANALYSIS USING DEEP LEARNING APPROACH

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ABSTRACT

The use of profound having to learn techniques within therapeutic imagery treatment but also assessment having had overall huge consequence. Imaging identification, imaging augmentation, including classifier but rather modeling are common procedures throughout therapeutic visual handling but instead interpretation using profound network techniques. This same absence of appropriate labeled experimental datasets has been commonly highlighted as significant difficulty towards supervising profound understanding. Humans seek help solve fundamental challenges to developing global massive neuronal architectures utilizing either relatively minimal volume available labelled material within these study. Using the profound dynamic learned approach, researchers provided a flexible architecture to healthcare picture cleaning & evaluation.(1) Implementing software sophisticated energetic learners

IDENTIFYING FREQUENT ITEMSETS FROM DATABASE USING FREQUENT PATTERN MINING

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ABSTRACT

Now a day, a huge amount of data is generated. But, to handle that data andgetting important information from that huge amount of data is becoming a complex thing. In data mining there are various possible ways to mine data. Among those ways the algorithms of association rule mining are important one. The basic algorithm of association rule miningI.e. Apriori algorithm has some limitations i.e. Number of candidate sets generation and multiple database scans which results huge memory consumption, etc. So, to do improvisation in the basic apriori algorithm for finding frequent itemsets the hybrid apriori algorithm is proposed and it combines the positive approaches of each weighted and HashTapriori algorithms. The benefits of both the algorithms reduce the candidate set generation with multiple scanning of database , optimization and data integrity are also taken care of which are all important in the data mining algorithms.Here, by using the transactional database for getting frequent itemsets with evaluating the computation time, space and accuracy of frequent itemsets and comparing the existing versions of apriori algorithm to our proposed approach.

Keyword *- Association Rule Mining; Frequent itemsets; Apriori Algorithm*

1. Introduction

With the fast development of IT companies are applying the data warehouse systems and using the data mining tools to detect and predict customer behavior. There are a number of successful companies which are earning more profits and higher values byusing data mining tools. For example, Tesco is one the most useful tool to analyze the transactions, develop strategies to each group of members and profile of their members in data mining. So, the data mining is a very useful term to gather important information from huge database.In data mining the association rule shows the correlations between the groups of objects in the database. It is used to showcase the interesting or relevant connection between a large numbers of data items. Beside this, it has thelarge number of data that continuouslycollected and stored in database. So, many industries areinterested in mining association rules from the larger databases. This process helps industries in decision making for the future use, such as cross-marketing, market-basket analysis and loss-leader analysis. For discovering association rules, there are two main steps shown in figure 1.

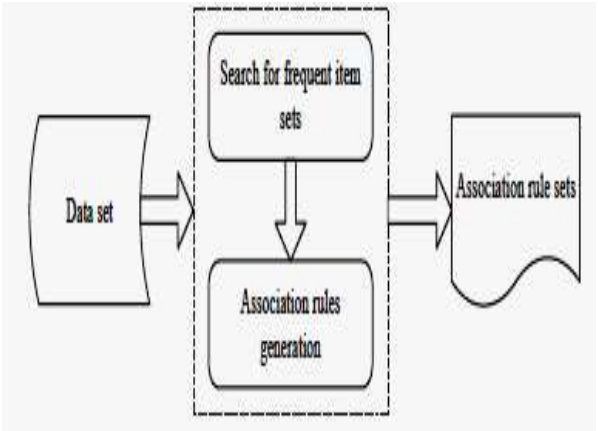

Figure 1: Steps of association rule mining

a. Finding the frequent itemsets with support count is greater than equal to the minimum support.
b. Generate the strong association rules from frequent itemsets. Association rules that satisfy minimum support and minimum confidence are strong association rules.
Association rule mining simply gives the set of itemsets (the transactions that each individual purchases in retail markets),apriori uses a "bottom up" approach for finding the frequent itemsets, where frequent subsets are generated at each pass called candidate sets and groups of 1-candidates are generated. The algorithm ends when there are no such extensions are found.

Support: A minimum **support** threshold in apriori algorithm is applied to find all frequent itemsets in a database.

$$Support(X \Rightarrow Y) = Support\ (X \cup Y) = P(X \cup Y)$$

Confidence: A minimum **confidence** constraint in apriori algorithm is applied to these frequent itemsetsin order to form rules.

$$Confidence\ (X \Rightarrow Y) = \frac{support\ (X \cup Y)}{support\ (X)} = P\left(\frac{Y}{X}\right)$$

In data mining, frequent itemsets are having the correlations among the number of fields of larger databases. The frequent mining is the concept of accepting items whose frequency of occurrence is equal or greater than a specific given minimum support. So, the many algorithms are introduced for frequent itemset and association rule mining. The apriori algorithm is used for association rule mining.
In the computer science and the data mining, the apriori is a classic algorithm for findingassociation rules. Apriori is designed to operate on databases with transactions (like, retail market transactions, shopping mall transactions, share market data, *etc.*). With the generation of apriori there are so many inventions of researchers that do improvisation in apriori algorithm. Apriori algorithm is abreadth-first search algorithm and having atree structure to count candidate itemsets efficiently. It generates the candidate itemsets of length k from itemsets of length $k - 1$. Then it prunes the candidates which have an infrequent itemsets. And according to the downward closure property, the candidate set are contains all frequent k-length itemsets. After that, it scans the transactions database and finds candidates sets among them.The remainder index of this paper is organized as follows: with describing introduction here, In Section 2 revised some existing approaches of apriori algorithms; Section 3 describes the work done on association rule mining. Section 4 shows the experimental results on transactional datasets with comparing existing approach with proposed one also in terms of computational time.Section 5 gives the conclusion on study of existing approaches with the proposed work and finally the paper ends with the future scope followed by references.

2. Apriori Algorithms

For the growth of business the frequent itemsets are very useful. This areimportant for business purpose like banks, stock markets,supermarkets, malls,etc., for finding frequent itemsets from algorithms of association rule mining like Apriori algorithm, FP-growth algorithm and improved versions of Apriori algorithms etc., this paper is mainly focuses on basic traditional Apriori algorithm.
Apriori algorithm require more database scans and generate the number of candidate sets. And it works on transactional databases. In every transaction there is set of items called itemsets. And it results frequent itemsets as support, confidence, strong rules and closed itemsets. Also it finds level-wise itemsets in the database. The Apriori algorithm is processed by two important steps like:

(1) **join**: making possible combinations of itemsets with their respective support counts and

(2) **Prune:**In this step check whether the value of support count is greater than or equal to the user-defined support threshold. Iftransaction is not found in database then delete that transaction from database otherwise, the transaction is added to database and perform the next steps to find frequent itemsets. Traditional apriori algorithm is very simple and clear algorithm in data mining. Joining and pruning are the most importantsteps in apriori algorithm to find frequent itemsets. But apriori algorithm also has some limitations.Section 4 is followed by the experimental results of the apriori algorithm.

2.1 Example

Apriori Algorithm is very basic algorithm in association rule mining for finding frequent itemsets. Among the transactional databases we get the frequent itemsets by applying two basic rules of apriori i.e., joining and pruning steps by generating possible combinations of itemsets we are able to join items and taking the items with greater than equal to supports value of items and eliminating other according to the minimum support value. To know its

working more take one basic example of apriori algorithm as follows:

Table 1 shows the simple database for apriori algorithm with TID as transactional id with their respective transactions. Each item corresponds to a goods such as "butter" or "bread".

Table 1: Database

TID	Items
100	1 3 4
200	2 3 5
300	1 2 3 5
400	2 5
500	1 3 5

In table 2, first pass build the list of frequent items from that data and count the frequencies i.e., support count of each item in the given database. For this example, let minimum support = 2. Therefore, the item which have less support count than minimum support are eliminated and rest are taken for the further pass so in this example item {4} has support count 1 so this is eliminated and the remaining one are the frequent items of first pass 1-candidate sets.

Table 2(C1, F1):Generating frequent 1-itemsets

C1

Item	Support
{1}	3
{2}	3
{3}	4
{4}	1
{5}	4

F1

Item	Support
{1}	3
{2}	3
{3}	4
{5}	4

In the next pass in table 3, it generate a list of 2-candidate of the frequent items. Here only take reference of previous pass frequent items. And make their respective 2-pair combinations where order doesn't matter only combination is required. And after joining do pruning on itemsets with minimum support = 2 so, according to it pruning of items is done. In this pass {1,2} itemset having the less count 1 so eliminate that one and take other itemsets as frequent itemsets of 2-candidate itemsets.

Table 3 (C2, F2): Generating frequent 2-itemsets

C2

Item	Support
{1,2}	1
{1,3}	3
{1,5}	2
{2,3}	2
{2,5}	3
{3,5}	3

F2

Item	Support
{1 3}	3
{1,5}	2
{2,3}	2
{2,5}	3
{3,5}	3

Table 4, in the third pass generates a list of all 3-candidate itemsets of the frequent items. In the example, contains 4 sets of 3-candidate sets frequent items but itemsets {1, 2, 3} and {1, 2, 5} support is smaller than our minimum support so here only 2 itemsets to be frequent in 3-pairs i.e., {1,3,5} and {2,3,5} with min support as 2 and having subsets of itemsets also be frequent.

Table 4 (C3, F3): Generating frequent 3-itemsets

C3

Item	Support
{1,2,3}	1
{1,2,5}	1
{1,3,5}	2
{2,3,5}	2

F3

Item	Support
{1,3,5}	2
{2,3,5}	2

In next pass build 4-pairs of frequent itemsets. So here we get {1, 2, 3, and 5} as 4-pair itemset as but with less count than minimum support so this is not the frequent itemsets. Therefore at last pass are obtained and it is considered being the output of applying apriori algorithm.At last, the final set of frequent itemsets are {1, 3, 5} and {2, 3, 5} with min support value as 2.

Limitations of Apriori Algorithm:

1) For generation of candidate sets, Apriori algorithm requires number of scans over the database.

2) Multiple scanning of databases takes lots of time to execute and increases I/Oload.

2.2 Hash-T Apriori Algorithm

HashTApriori algorithms implementation directly represents a hash table. This algorithm overcoming some of the drawbacks of traditional apriori algorithm by reducing the number of candidate k-itemsets. In the 2-itemsets is the key to improve performance of an algorithm. This algorithm uses a hash functions the hash value assigning to each individual item as per its occurrences to reduce the number of candidate itemsets.

This algorithm counts all the 1 candidate itemsets for each transaction at the same time. All the 2 candidate itemsets in the current transaction are store in a hash table. Moreover this algorithm uses a hash table to reduce the number of candidate itemsets. When the items of transactions satisfy the condition of minimum support then they generate the frequent itemsets. Hash based apriori algorithm generates the candidate itemsets same as the apriori algorithm.

Limitations of HashTApriori Algorithm*:*

1) Required more computational time.
2) Memory utilization is more
3) Requires more time to compute node processing.

2.3 Weighted Apriori Algorithm

In a basic apriori algorithm the number of frequent itemsets exist which have no meaning although they increase the database scans and require a lot of storage space. But, in weighted divide itemsets into number of categories and then assign values to those categories. Due to less number of categories, it is easy to set and adjust the weights. After dividing into the categories calculate the weighted supporting degree, and find the association rules from that who'sweighted supporting degrees to make effective marketing strategy using calculated weighted support and calculatedweighted confidence. The next step is like pruning and selection can make according to minimum weighted support and minimum weighted confidence. The same steps are following while calculating traditional apriorialgorithm but the only difference is that instead of all items groups are formed and algorithm is applied on that. Due to this the scan makes faster and less no of space is required as compared to traditional apriori algorithm. But, for making groups it requires a lot of analysis. If analysis made improper groups it would results into invalid association rules.

Retail markets are collect data and store them in the database. Divide the goods into number of categories according to the type of goods, respectively named A1, B1, C1, D1, each category has several kinds of goods, for example: A1 stands for drinks class, A11 indicates milk, A22 indicates Coke; B1 stands for food class, B11 indicates the bread, B22 indicates biscuits; C1 indicates fruit, C11 indicates apple.D1 stands for electrical class, D11, indicates rice cooker; Likewise all the goods are categorized and assigned their respective weights to them. And calculate the weighted supporting degree, for each frequent item of association rule.

Limitations of Weighted Apriori Algorithm*:*

1) Combinations of itemsets will be generated frequently and the candidate itemsets will be increases it.
2) For each transaction of weight computation it will take more time to execute
3) No dependency on data deviation

3. Work Done

In the proposed work methodology with taking the new concept, the existing work methodologies are reviewed and experienced to know it in more detail.The main approach of this proposed work is to combine the weighted value and HashTapriori algorithm to propose anew hybrid apriori algorithm. The figure 2 shows the flow of the proposed approach.

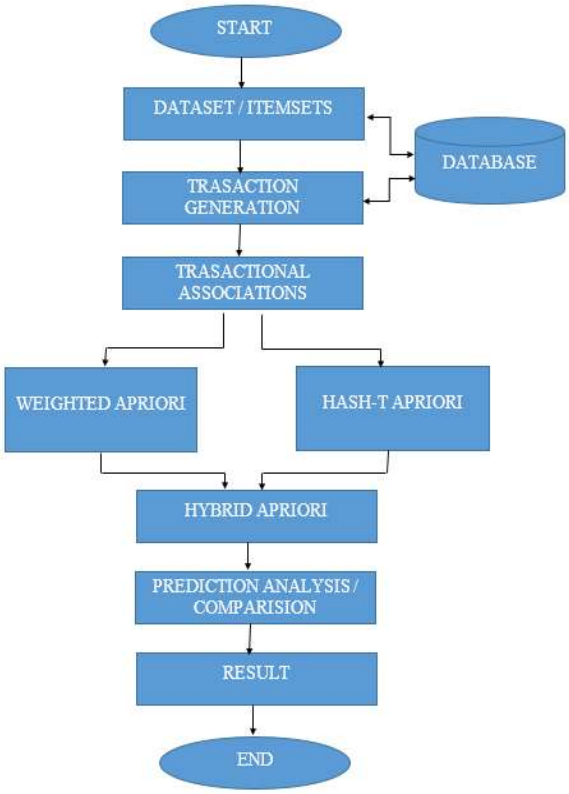

Figure 2: Flowchart of Proposed work

Firstly, Add items to the list and generate transactions from these items. There isalso one option of saving transactions in database so; it can be used in future. After generating transactions apply apriori algorithm on those transactions by providing minimum support and confidence as input to algorithm. From this the transactional associations frequent itemsets, closed itemsets, strong rules and maximal itemsets are generated. Frequent itemsets are those itemsets which repetitively come in number of transactions by satisfying minimum threshold condition. With this the strong rules are defined as those rules which satisfy the condition of minimum support and minimum confidence. The closed itemsets are those itemsets whose super proper itemsets do not exist and still those itemsets need to be frequent and closed are known as closed itemsets. Along with the closed itemsets maximal itemsets are those who do not have super itemsets.Through these transactional associations of apriori algorithm the weighted apriori and HashTapriori algorithm are calculated. For calculating weighted value itemsets mainly frequent itemsets are used to make it easier and in addition to this for giving parent child relationship to hash tree strong rules are used. The hash tree mainly uses the breadth first search for apriori with bottom up approach to find frequent itemsets steps in level wise manner. From the output sorting of both these algorithms one new hybrid apriori algorithm is proposed. Do the parallel executions of both versions of apriori algorithm i.e., weighted and HashT with the help of frequent itemsets and strong rule sets and at last do the prediction analysis and comparison of proposed approach to the existing ones.

In the initial phase the analysis of number of association mining algorithms especially apriori algorithm is start. In which it finds that the weighted and hash-t apriori perform well as compared to traditional apriori algorithm. The proposed work concentrates on deriving a new apriori algorithm which performs mining of frequent itemsets on frequent pattern mining for achieving computation of less memory usage and less computational time.When the proposed approach is implemented in a distributed environment it improves performance

The first design module of the proposed work includes the collection and study of relevant data set. For the said work the relevant data set is the record of daily transactions of supermarket. Hence the required data set is collected and studied successfully. Since the collection consists of clusters like milk, bread, butter, jam and pen pencil, sharpener, etc. On this sets the number of transactions are generated and savedin database. The analysis of apriori generates the result according to the applied methodologies.At the initial phase of proposed approach first add items to the item lists and make transactions from that. After generation of transactions make the transactional associations like support, confidence, closed itemsets and frequent itemsets. Now, applying the weighted value and HashT algorithm individually to get the efficient results, but individually this algorithm may not be more efficient to give the properoutputs. The positives approaches of both the algorithms are not able to archive efficient results,Because of that the new algorithm is invented with the benefits of both weighted apriori and HashTapriori algorithms. To overcome the limitations of both the algorithms a new hybrid approach is being introduced in the proposed work. So, the

hybridization of both these algorithm is essential. The combination of both these algorithm creates new hybrid apriori algorithm of better efficiency and it archives the frequent itemsets and reduces the computational time and space as well.

4. Experimental Results

While implementing algorithms to find frequent itemsets here retail market datasets are used. The retail market data comes in terms of transactions and to implement apriori algorithms and its said versions we also needs those transactional databases. While observing those transactions analyze the buying habits of customers and frequently bought itemsets. In this process it is observed that the existing apriori approaches consuming maximum computational time and memory space. So, it find that the existing apriori algorithms are not that efficient for the larger datasets. Hence there is a need of efficient algorithm which will consume less computational time and space to give frequent itemsets. Therefore a hybrid approach of apriori algorithm using some versions of apriori algorithms is proposed

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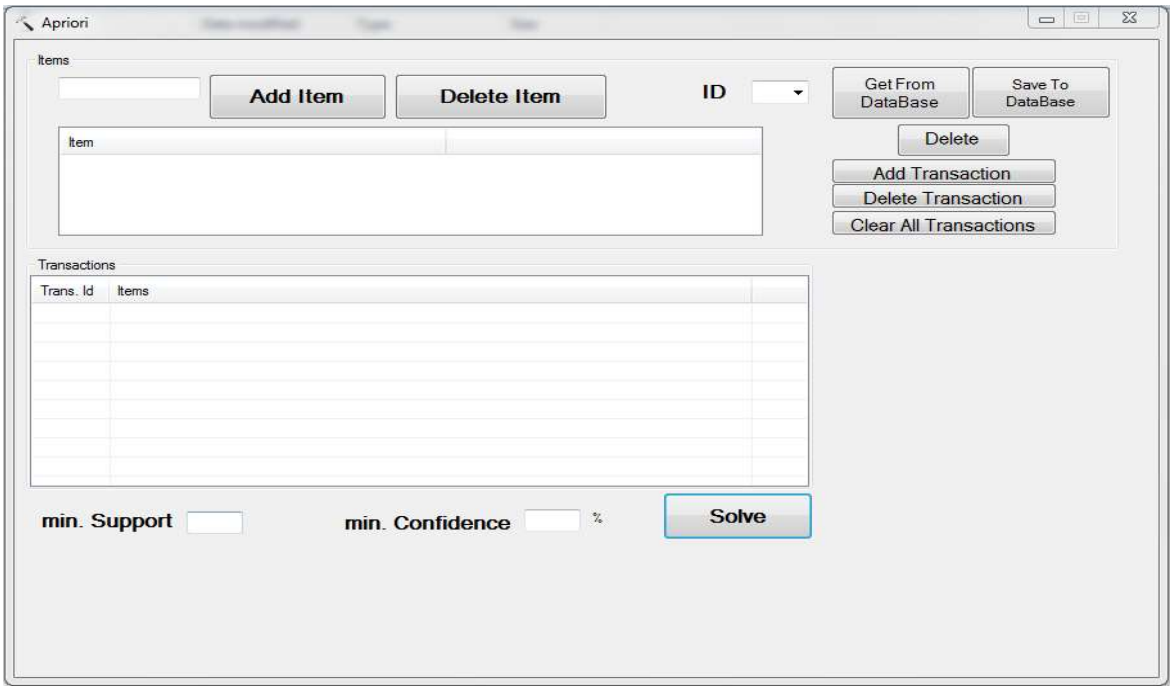

Figure 3: Main Form for Applying Apriori Algorithm

Figure 3. Simply illustrations the UI of generating transaction from itemsets. These UI facilities us to get items and generate transactions from which also those transactions can be saved in database and use in future. Even the transactions can be deleted and cleared. Also provide the minimum support and the minimum confidence to apriori in range of the percentage as input and solve button gives us the required output of apriori algorithm.

Figure 4, shows how to add items in list and generate transactions from those items in any order. Also here provide minimum support and minimum confidence for calculating frequent itemsets here provide 2 as minimum support and 60% for minimum confidence these values are given according to user but, as the values of minimum support and minimum confidence get frequent itemsets also change. Here we take a simple example of daily supermarket buying products like milk, bread, butter, etc. so from those items in transaction list generate their transactions. While for example support indicates that how many times the milk and bread was brought together and confidence shows the percentage of items if someone buys milk they will definitely buy bread so, displaying both of them together increases sell of bread more. These are the simple strategies of retailers to sales their products. While giving discount they also increase their sale. This undergoes the market basket analysis.

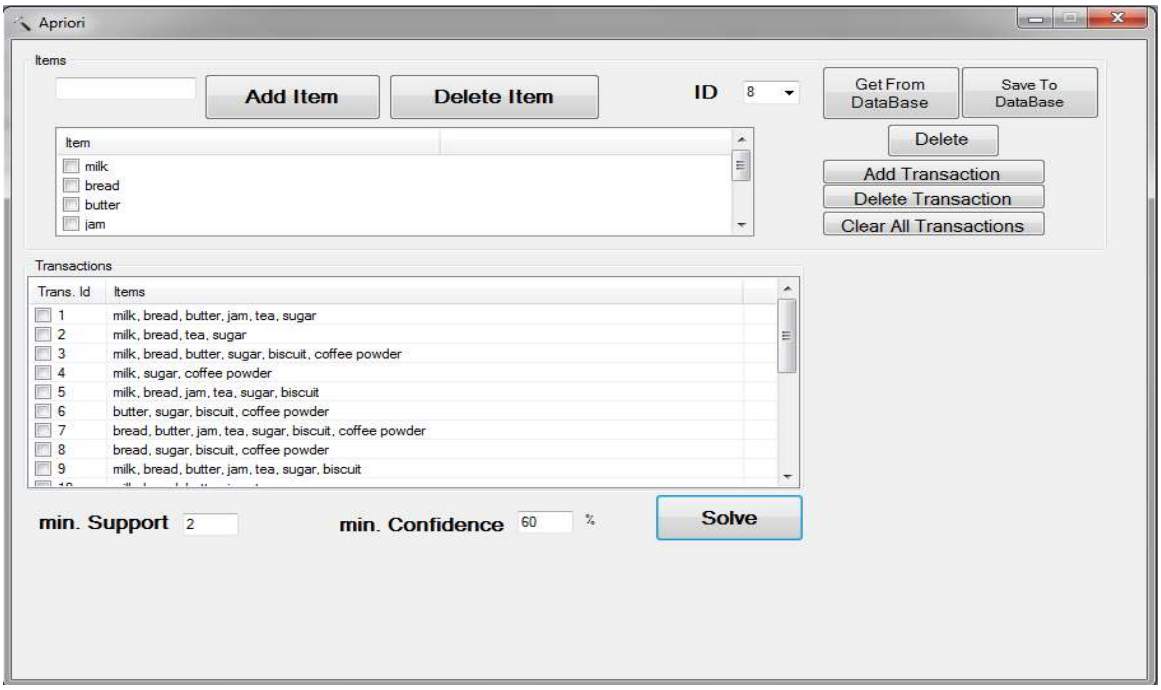

Figure 4: Adding Items and Generating Transactions

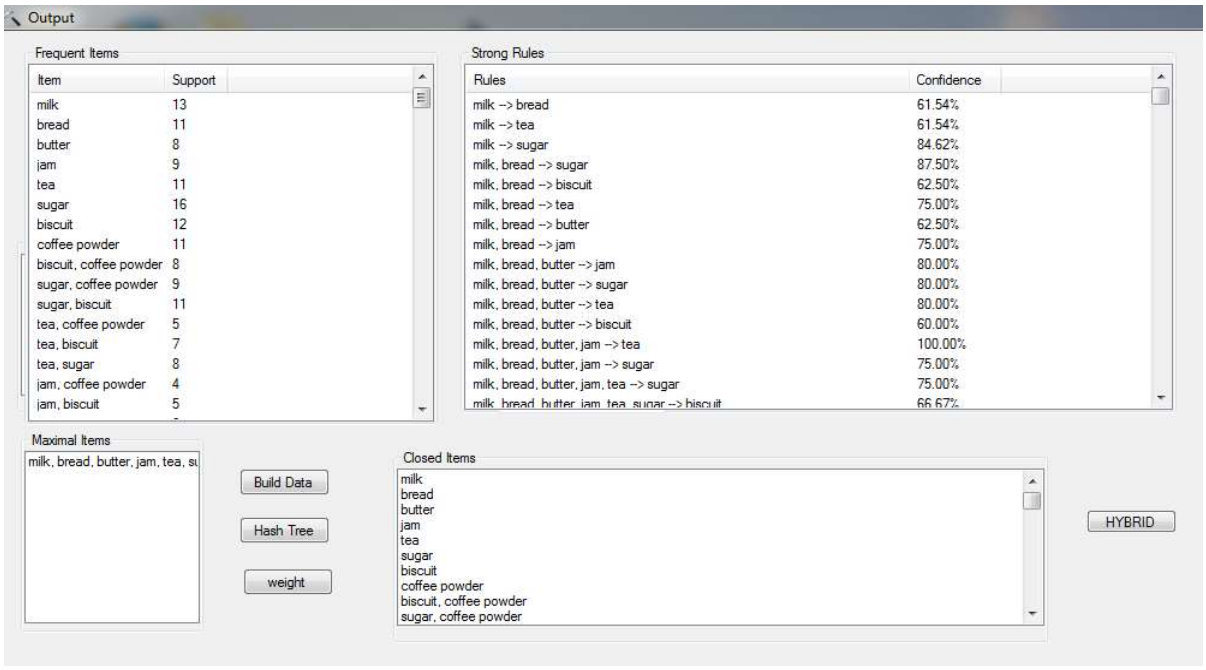

Figure 5: Generating Frequent Itemsets using Apriori Algorithm

Figure 5, Shows the output of apriori algorithm where frequent itemsets are obtained with their support values which are more than the minimum support. Also here calculated strong rules which generate possible combinations of frequent items with respective confidence values by satisfying minimum support and minimum confidence condition. Also in output get closed itemsets are obtained the itemsets that do not have any proper superset of frequent itemsets but they should be frequent and closed. And maximal items are that item which have no supersets and with maximum items in transactions so this is output of applying apriori algorithm on transactional datasets.

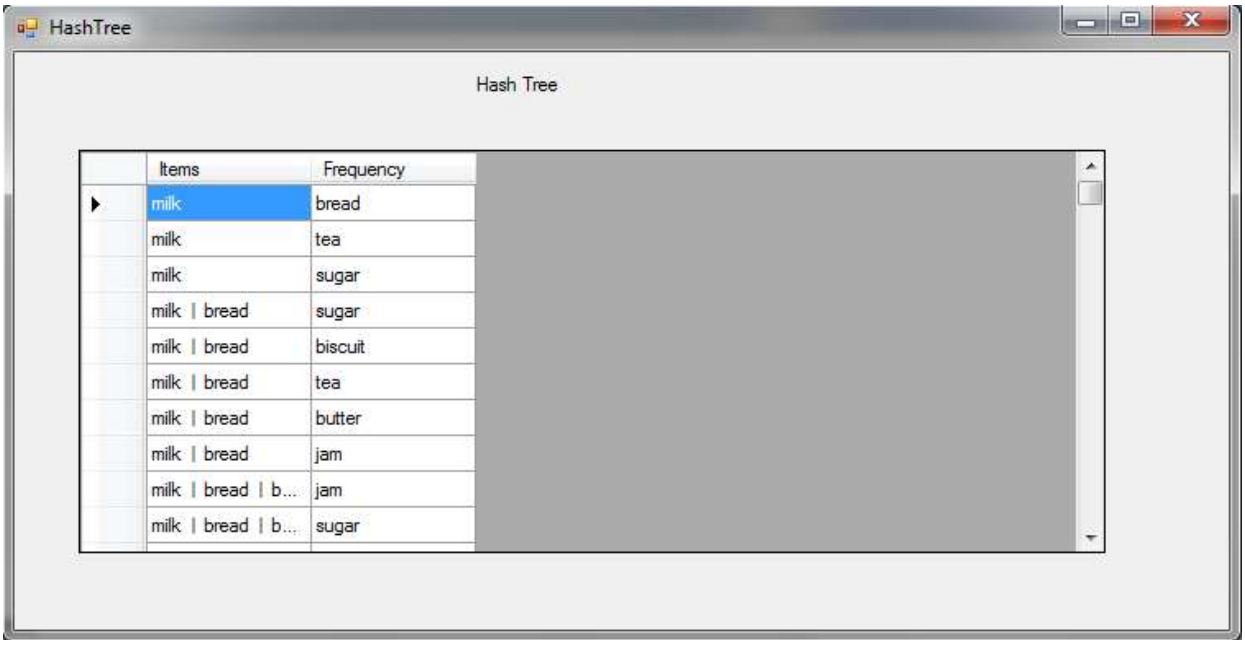

Figure 6: Generating Frequent Itemsets using HashTApriori Algorithm

HashTapriori algorithm mainly applies the hash function to store the items identity. Moreover, hash tree can be saved in tree bucket format by using hash tree HashT directly generates L2 I.e., 2-itemsets combination and generates tree then the execution of HashT is same as apriori here results belonging to only apriori algorithm should be taken. The output of HashTapriori is shown in figure 6, with parent and their child relation shown with the help of pipes. The parent child relation mainly shows the hashing link of itemsets which are frequently brought in specific manner.

Figure 7, shows the output of weighted apriori algorithm with their weights and items. In the weighted value algorithm firstly divide the items into the categories according to the item types and then on those groups assign the weights and then calculate weighted supporting degrees. Here, weighted value apriori algorithms are assigning the weights according to the positions of its items means according to the occurrences of the items coming in each transaction. Its execution is same as the apriori but only difference is that with the items there weight also be taken.

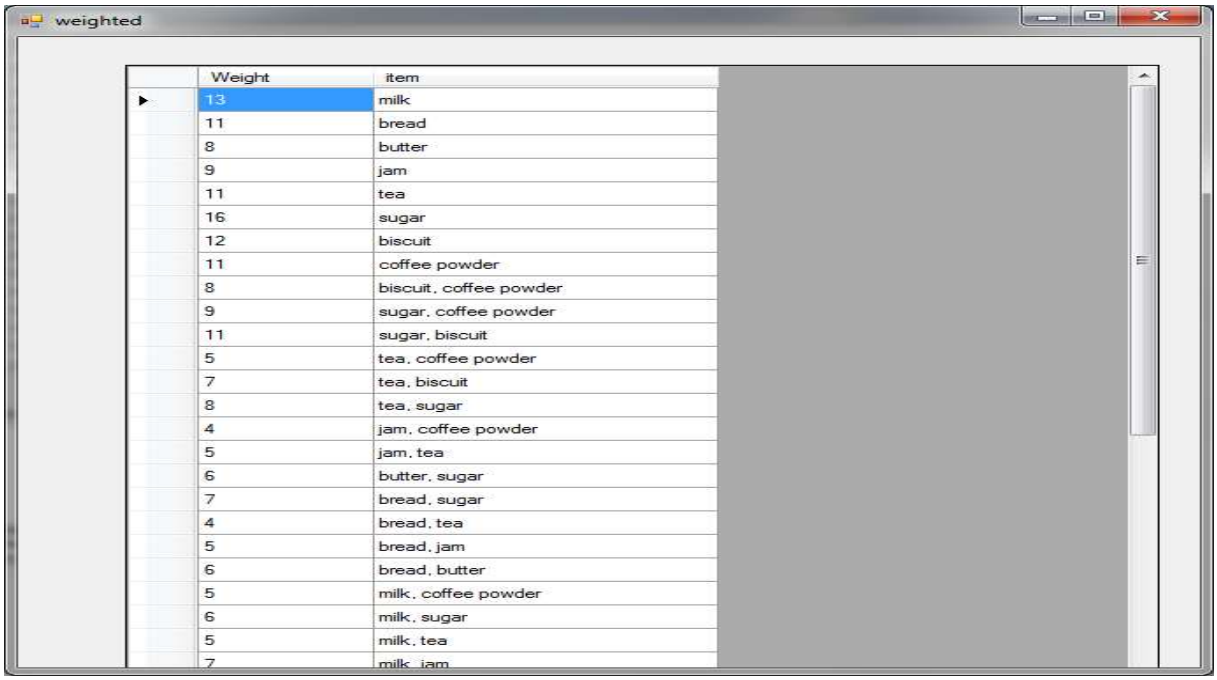

Figure 7: Generating Frequent Itemsets using Weighted Apriori Algorithm

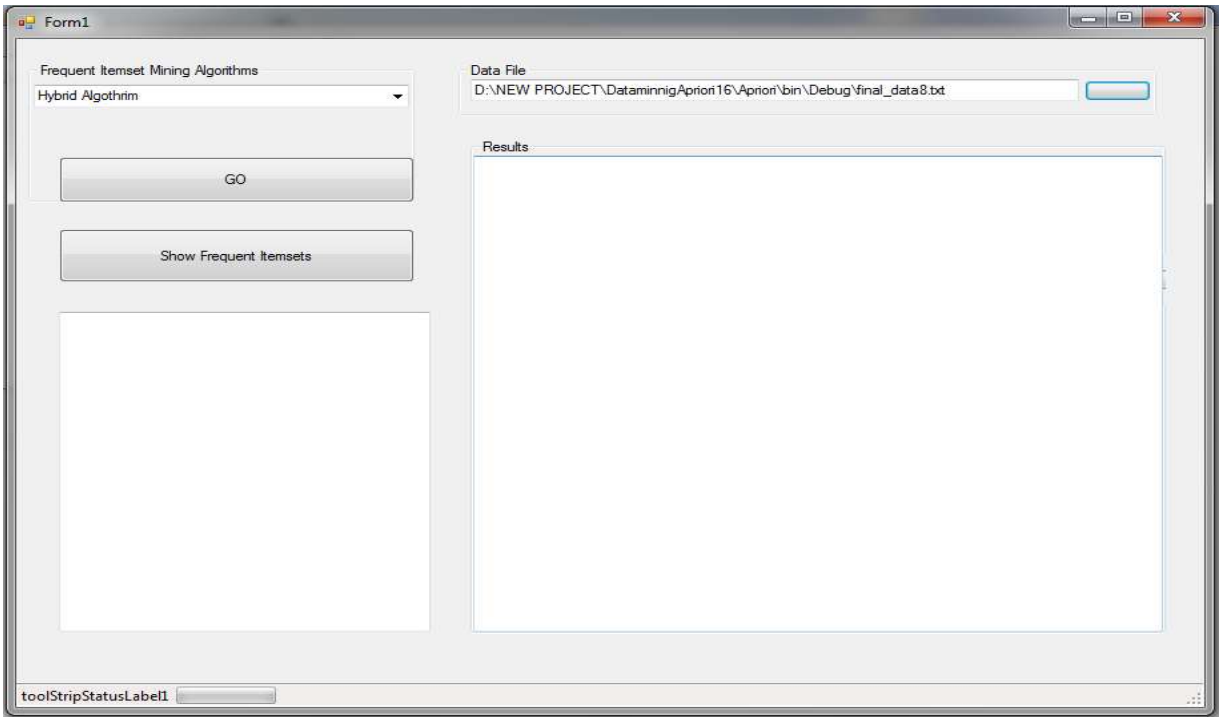

Figure 8: Hybrid Interface

Figure 8, is the hybrid apriori algorithms Interface where the hybridization is applied on the output of HashT and weighted apriori algorithm by applying frequent itemsets mining algorithm as hybrid Algorithm. Here the outputs files are taken in parallel way from this take weighted value from weighted apriori algorithm and hash tree value from HashT algorithm and comparing them in terms of frequent itemsets occurrences.

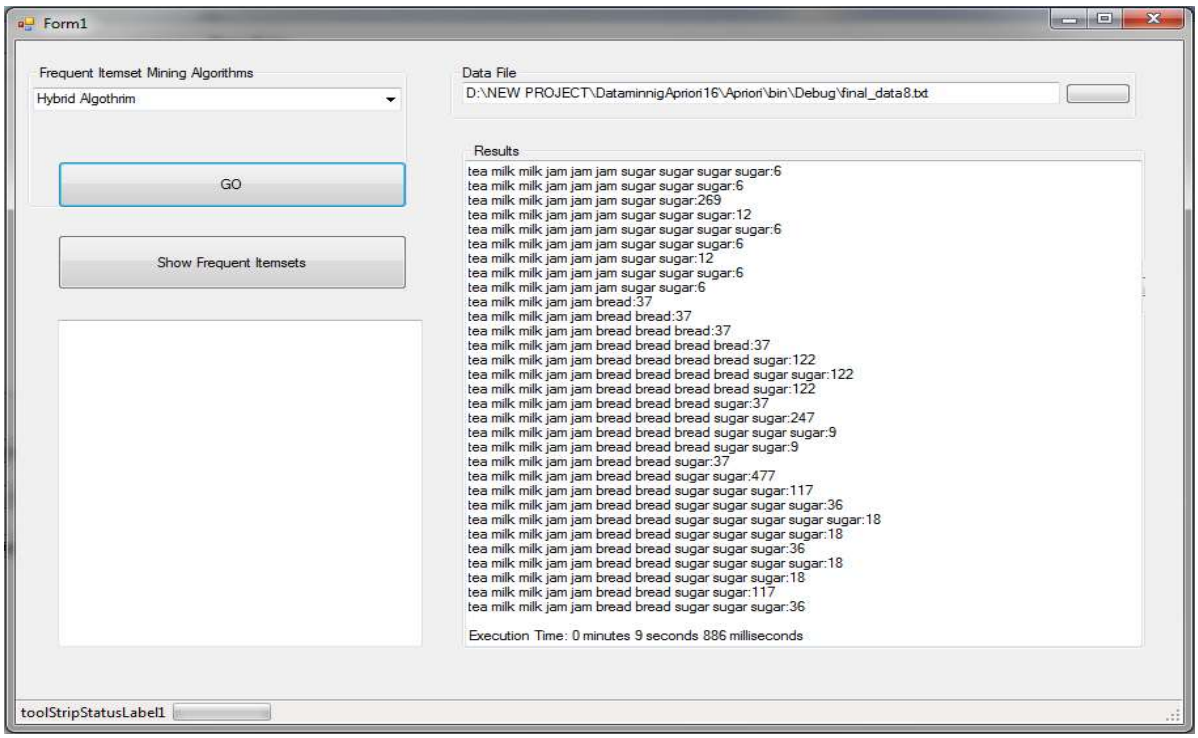

Figure 9: Data Analysis of Hybrid Algorithm

Figure 9, simply shows the analysis of transactions from both the HashT and weighted value apriori algorithm to execute the hybrid algorithm and get frequent itemsets from that algorithm with less computational time. With each analysis of frequent itemsets from both the algorithms in parallel way calculate their required time to complete each comparing

analysis in millisecond. This is a small transactional dataset where its time and analysis structure can be easily taken but for huge datasets it requires more time to analyze according to the size of itemsets and their transactions.

Figure 10, simply shows the output screen of hybrid apriori algorithm where application of hybrid apriori algorithm on the weighted value and HashTapriori algorithm gives frequent itemsets with less time than others according to the analysis output of HashT and weighted value apriori algorithm with its execution time.

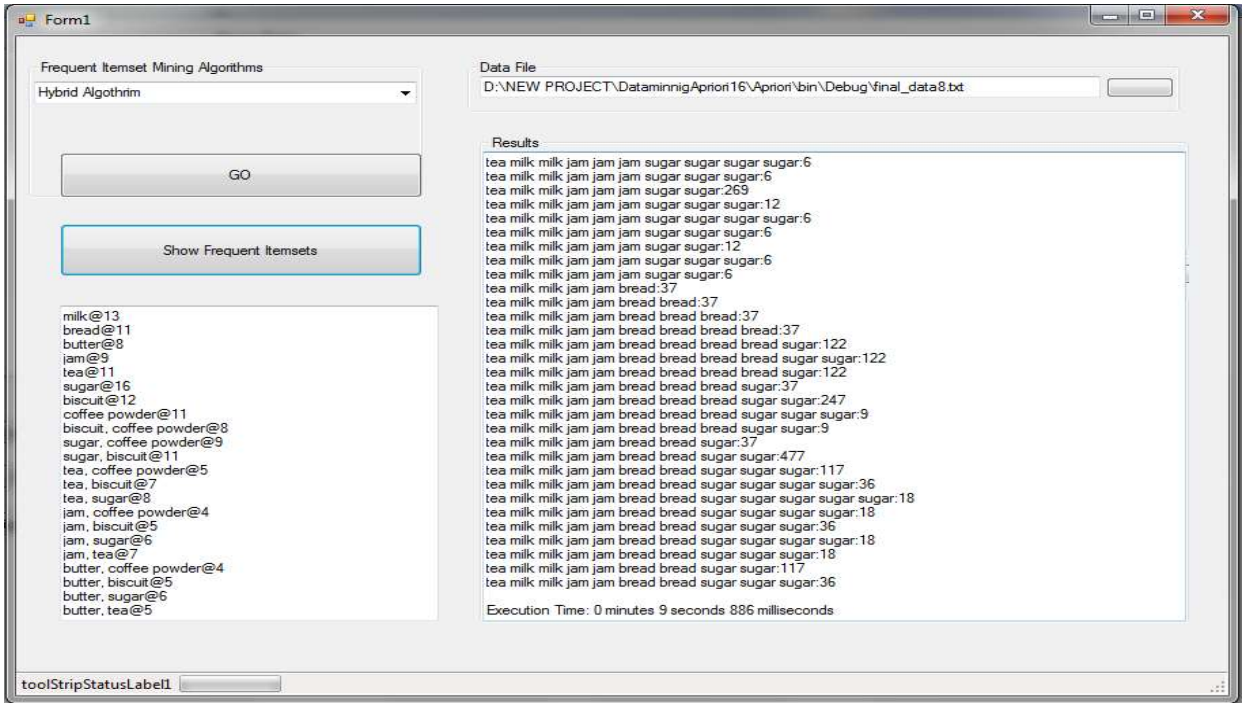

Figure 10: Final Transaction with time analysis

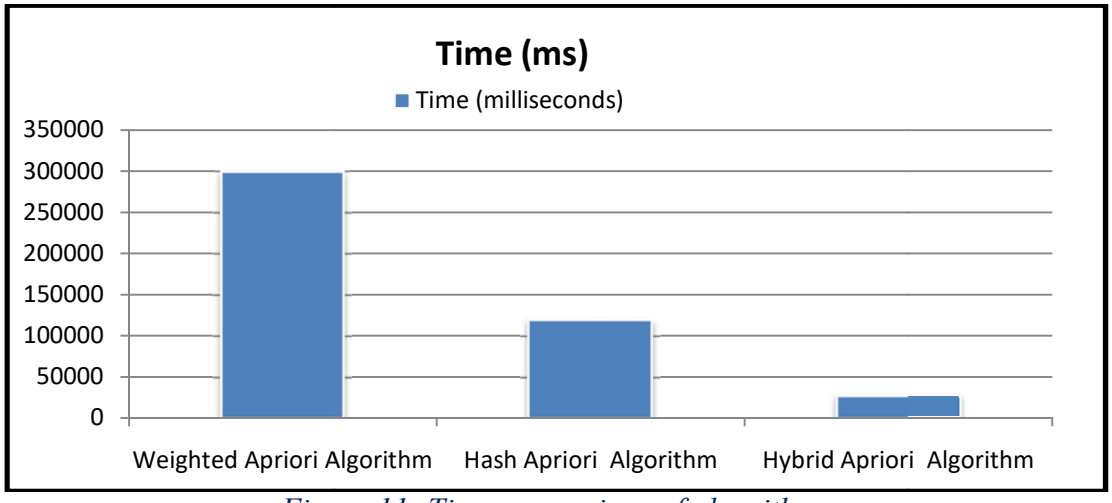

Figure 11: Time comparison of algorithms

A comparative approach among all the algorithms used in our research with respect to some parameters like, the new technique used in algorithms and how they best in nature also the Number of scans done in each algorithm respect to other and the storage structure used to store the items is given below in table 5. The best algorithm is decided according to these parameters. Also the figure 11 shows the time comparison between weighted value apriori, HashTapriori and hybrid apriori algorithm.

Table 5: Comparison of Apriori Algorithms

Attributes	Traditional Apriori Algorithm	HashTApriori Algorithm	Weighted Apriori Algorithm	Hybrid Apriori Algorithm
New Technique Used	Simple Apriori Candidate Generation approach	Hash structure introduced to quick retrieve data from database	Large amount of items divided categorized into groups	Sorted value of hash and sorted value of weighted
Number of scans	More than 1	1	More than 1	1
Storage structure used	Normal Database	Hash Table	Normal Database	Normal Database with Hash Table

5. Conclusion and Future Work

There are number of improvisations are possible in Apriori algorithm. But, the two main issues in apriori algorithm are number of candidate set generation and multiple timesdatabase scanning.There are many ways of improvements in the efficiency of apriori algorithm. From the overall observation, the weighted value Apriori and hash tree Apriori are the best and they give better efficiency in Apriori. But, individually they are not more efficient as they are together. Therefore, it is better to combineboth the algorithmsto getbenefits of them togetherto make more efficient. And, proposing one hybrid approach based on hash tree apriori together with weighted value apriori algorithm to improve computational time and memory usage of required algorithms.

In future, there is a scope for improvisation in existing apriori algorithms and can be applied on retail market, shopping mall, stock market databases to identify frequent itemsets from that with reducing database scan, generating less candidate sets on larger datasets. Also in future apply this hybrid algorithm can be applied on huge amount of data or say big data in unstructured format to show its nature and work on better time consumption of hybrid algorithm.

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Case Report on Adenocarcinoma of Rectum and Anal Canal.

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Abstract: -

Introduction: - Squamous cell carcinomas account for about 75% of anal canal tumours, while adenocarcinomas account for more than 20%. The epithelium of the anal canal, which comprises the mucosal surface, anal glands, and the lining of fistulous tracts, evolves into adenocarcinoma of the anal canal. Adenocarcinomas are malignant tumours with diseased cells grouped in the shape of glands. Adenocarcinomas, which start in the glandular cells of the stomach lining, are the most common type of stomach cancer. Adenocarcinoma is the most frequent kind of pancreatic cancer. Adenocarcinomas are malignant tumours that are organized in the form of glands. Adenocarcinomas start in the glandular cells of the stomach lining and progress to other parts of the body. Adenocarcinoma is also the most frequent form of pancreatic cancer. Cancers and tumorlike diseases of the anus and perianal region arise from the anal canal and anal border, or from tumours that have spread from other organs. The anal canal's structure is complicated, and its many histologic characteristics can contribute to a variety of pathologic diseases. From the anorectal junction to the anal margin, the anal canal runs. Anal canal cancers are divided into two categories by the World Health Organization: (a) anal intraepithelial neoplasia, which is the precursor to squamous cell carcinoma (SCC), and (b) invasive tumours. Epithelial tumours (SCC, adenocarcinoma, mucinous adenocarcinoma, small celiac adenocarcinoma, small celiac adenocarcinoma, small celiac adenocarcinoma, small celiac adenocarcinoma, small celiac adenocarcinoma, small cell.

Clinical findings- A 56 year old male patient admitted in AVBR Hospital with the chief complaint of passing blood in stool since 1month, and pain white defecation since 1month,and bleeding per rectum for 1 month.

Therapeutic Interventions:- All the medication was given and all treatment was taken and the result were fine. Tab. Limcee, Cap. Beolin and Tab. Urimax administered as prescribed.

Adenocarcinoma of rectum and anal canal.

Outcome:- After the medication patient chief complaint vomiting, pain in abdomen, blood in stool is relieved, and pain while defecation was diminished.

Conclusion:-He responded to the medicine, antibiotics, analgesic and physical counselling.

The ampulla of Vater cancer has a higher resectability rate and a better prognosis than pancreatic carcinoma. Because lymph node status affects survival, it's critical to get a diagnosis as soon as possible. Long-term survival is also improved by careful operational dissection and the avoidance of transfusions. Anal adenocarcinoma has a terrible prognosis, and there is little information on how to treat it effectively. According to the studies, the best likelihood of survival is a combination of radical surgical resection and pre- or postoperative chemoradiotherapy.

Keywords: adenocarcinoma, anal canal

Introduction:

Anal canal adenocarcinoma is a rare malignancy with so little research on management and findings. The goal of this study is to see how well people with adenocarcinoma control their condition and how long they live. Adenocarcinoma is a kind of cancer that begins in your body's mucus-producing glandular cells. These glands can be found in a variety of organs, and adenocarcinoma can develop in any of them. The epithelium of the anal canal, which comprises the mucosal surface, anal glands, and the lining of fistulous tracts, evolves into adenocarcinoma of the anal canal. Anal canal

Effects of the FIFA 11+ and Harmoknee warm-up programs on physical performance measures Inindian elite football players (An experimental study)

ISSN NO. 2320–7418 Available online at www.jmpas.com DOI: 10.22270/jmpas.V10I3.1148
Research article

EFFECTS OF THE FIFA 11+ AND HARMOKNEE WARM-UP PROGRAMS ON PHYSICAL PERFORMANCE MEASURES ININDIAN ELITE FOOTBALL PLAYERS (AN EXPERIMENTAL STUDY)

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ABSTRACT

This study was carried to determine the benefits of fifa 11+ and harmoknee warm-up protocol in indian male football players and conclude the superiority between the two established protocols in accordance with their effects on sprinting, vertical jump, kicking accuracy, and agility. 45 healthy male footballers (mean age 21.44±5.3yrs, height1.76±0.2m&weight 73.19±11.5kgs) participated in the study. The participants were equally divided into group a= fifa 11+, group b = harmoknee, and the control group. The experimental groups (gp a &gp b) underwent training for 6 weeks, and trained for 20 minutes per session on all days except sunday (36 sessions), whereas the control group performed their regular football training. The performance tests carried out were the 20m speed test, vertical jump test, illinois agility test, and wall volley test. The results were analyzed by spss version 17. Within-group pre and post comparisons were done using paired t-test, an inter-group comparison was done using one-way anova followed by multiple comparisons bonferroni. The level of significance for all tests was set at 5% (p=0.05). In the present study, the vertical jump was improved significantly only in gp a (6.75% increase, p=0.001) as compared to gp b (p=0.082) & the control group (p=0.291). While agility improved in both gp.a (7.23% increase, p=0.00) & gp.b (5.43% increase, p=0.001), no significant improvements were observed in the kicking accuracy & sprinting ability in all the 3 groups within group comparison. However, on inter-group comparison, significant differences were observed between group a& b (p=0.009) with gp b demonstrating more kicking accuracy as compared to gp a. 6-weeks training of 11+ warm-up program enhance vertical jump and agility but it does not improve player's kicking accuracy and sprinting ability and the harmoknee program improves agility but has no positive effect on sprinting and kicking accuracy in young professional male footballers. 11+ injury prevention programs can be implemented to enhance agility and vertical jump in young male football players.

KEYWORDS: Performance, Vertical jump test, Wall volley test.

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INTRODUCTION

Football is the most popular team sport in the world there are already more than 265 million registered players. According to the International Federation of Association Football (FIFA), 90% of all the registered players were males, with younger football players comprising the greatest proportion (54.7%) of all registered male players. It is a contact sport and challenges physical fitness by requiring a variety of skills at different intensities. Running is the predominant activity, and explosive efforts during sprints, duels, jumps, and kicks are important performance factors. To strengthen the possibility of their success in the sport, football players need a moderate to a high degree of aerobic and anaerobic strength, strong endurance, and a range of technical and tactical skills.[1]

The Warm-up is considered a vital element and is used by athletes on a daily basis to prevent injury and maintain high performance during training and competition. The warm-up, better known as "warming", aims to prepare the competitor, Both physical and mentally, taking their muscles to the point where the work occurs more efficiently. Globally the two most widely used football-specific warm-up programs are the 11+ and Harmoknee programs. The FIFA Medical and Research Centre (FMARC) developed the 11+ warm-up program for football players. The 11+ program is an advanced version of the 11 programs, includes running, strength, plyometric and balance components.[1,2]

The HarmoKnee warm-up program for football players. It includes five parts the essentially consist of a warm-up and muscle activation, along with balance, strength, and core stability exercises. The results showed that the intervention group was associated with a 77% decrease in knee injuries. Furthermore, it is shown that the most effective way to prevent injuries in young football players is to have a proper warm-up program.[1,2]

Spreading of corona virus (COVID-19) across the globe: Nursing protocols for handling positive patient

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REVIEW ARTICLE

SPREADING OF CORONA VIRUS (COVID-19) ACROSS THE GLOBE: NURSING PROTOCOLS FOR HANDLING POSITIVE PATIENT

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ABSTRACT

Corona virus causes influenza, vomiting, sneezing, respiratory disease and coughing while diarrhea and upper respiratory diseases are found in animals. The corona virus was transmitted by airborne droplets to humans or primates. Corona virus reaches the human cell through an exo-peptidase receptor with membrane ACE-2. WHO and ECDC also recommended the avoidance of public spaces and close interaction with contagious individuals and pets. Firstly, on 7 January 2020, Corona virus (2019-nCoV) was isolated from the Chinese Wuhan market.

KEYWORDS: SARS - CoV, corona virus, COVID-19, MERS - CoV, Wuhan

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INTRODUCTION

Discover all the pertinent information about Corona virus 2019 (COVID-19) in this study guide on how it is spread, its symptoms, how it is treated, its preventive measures, health care professional nurse management and therapy. Corona virus Disease 2019 (COVID-19) was identified as the cause of an outbreak first discovered in Wuhan, China, on a local market for seafood/wildlife. The COVID-19 has been declared a World Health Organization (WHO) pandemic in which around 5,000,000 people are currently infected in more than 200 countries around the world.[1]

Origin and History

The first case of corona virus which they described in 1960 as cold. According to the Canadian Survey of 2001 about 500 patients were listed as flu-like systems. Of those cases, 17-18 were identified as a polymerase chain reaction to corona virus strain infection. Corona was considered, until 2002, a common Virus that is not fatal. In 2003, several studies with corona proof were published in many countries. Many cases of severe acute corona-caused respiratory syndrome were recorded in 2003 and their mortally over 1000 patients. This was a black year for a microbiologist. But it was confirmed that until a total of 8096 patients had corona virus infections. Consequently, in 2004, The World Health Organization, and the Centers for Disease Control and Prevention have announced a 'national emergency' Another Hong Kong study report showed 50 patients with the extreme acute respiratory syndrome, 30 of whom were believed to have been infected with corona virus. In 2012, several infected patients and deaths were presented in Saudi Arabian reports.[2] COVID-19 belongs to Wuhan, China, first described and isolated from pneumonia patent.[3]

Microbiotics

Corona virus is a single-stranded, spherical or pleomorphic, RNA shell and covered with glycoprotein in club shape. The corona virus is four sub-species; such viruses include Beta, delta, gamma, and the corona delta. Every and every subtype corona virus has numerous serotypes. Any of them infected humans from other species infected, including pigs, ducks, cats, mice, and dogs.[4,5]

Spreading Mode

People will get an infection from closer touch someone who having virus symptoms including cough and sneezing. The corona virus was typically transmitted through zoonotic droplets in the air. Viruses expressed in ciliated epithelium causing infection and cell damage at the site of the infection. An enzyme 2 transforming corona angiotensin (ACE-2), membrane exo-peptidase in corona virus receptor in human cells, according to a report published in 2019.[6-7] Virus transmission routes were represented in figure 1.

Characteristics

According to a study Infected patients with corona virus, released on 24 January 2020, have some common characteristics This has been found that fever, cough, and fatigue are as rare as diarrhea and dyspnea. Many mentioned being bilateral anomalies as being patient. The corona virus was isolated in china by 2020 from bronchial veolar lavage fluid. It shows up in blood samples as well. The corona virus

Multi-Class Retinopathy classification in Fundus Image using Deep Learning Approaches

Multi-Class Retinopathy classification in Fundus Image using Deep Learning Approaches

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Retinopathy classification from fundus images put a lot of issues in front of ophthalmologists. Convolution and deep neural network models open the doors to handle such challenges and achieve great success in computer vision, but it is reaching its computational limits. This leads to the rethinking of less computationally intensive network architectures for computer vision problems. In this work we have used a RFMiD dataset, which is challenging for machine learning researchers due its multiclass, multi-labelled, and imbalanced nature. In the proposed work three models are developed to classify the retinopathy from fundus images. The first model inherits the properties of the VGG Net and Inception Net. This results in significant reduction in computational complexity compared with VGG Net and Inception net models. The second model is improvised version of the previous one with an increase in depth that yields notable improvement in results, while maintaining the lower number of computations. The third model uses a bidirectional LSTM model as a classifier with 192 hand-crafted features. This model gives 0.985 AUC, with precision of 0.98, and recall of 0.9 respectively.

Keywords: Retinal diseases, retinopathy, computational complexity, RFMiD, Deep learning, Transfer learning, Hybrid model.

1. INTRODUCTION

Anatomical structures and abnormalities on human retina are captured for diagnosis and detection of diverse ophthalmological diseases using retinal image modality. It requires vast experience and expertise for an ophthalmologist and Computer-aided tools to accurately detect the presence of a particular retinal infection. A subject may have one or both of his/her eyes affected and suffering from one or more ophthalmic diseases. Most of the previous and current research is focused on the simultaneous diagnosis of multiple fundus diseases using convolution and deep neural network models. The improved results of many of the deep learning areas depend upon the size or depth of the network that is being used. As a network grows, it requires large amount of computing power, which leads to extensive growth in the computational cost of the network (Thompson, 2020b). But such an improvement faces diminishing returns. According to the study of MIT researchers, they warn that deep learning is facing an important challenge: to "either find a way to increase performance without increasing computing power, or have performance stagnate as computational requirements become a constraint, so deep learning being forced towards less computationally-intensive methods of improvement, or else machine learning being pushed towards techniques that are more computationally-efficient than deep learning" (Thompson, 2020a). Finding the small deep learning architecture is one of the ways to evade the limitation of computational complexity. This work primarily focuses on the use of pretrained networks as a transfer learning to see the computational complexity of existing networks on the newly generated RFMiD dataset (Pachade, 2020) of fundus images. In the second part, the work proposes the design of two different custom networks that inherit the properties of the VGG and Inception net and reduce computational complexity. The section showcases the use of optimum features extracted from the fundus image considering gray and color planes discussed in our previous paper. Here the deep learning six-layer LSTM network is used as a classifier which shows improved results.

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Combustion Synthesis of YAG:Nd: Structural, Luminescent Characterization and Influence of Si Doping

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Abstract—Neodymium-doped yttrium aluminum garnet (YAG:Nd) powder was prepared by solution-combustion synthesis using aluminum nitrate, yttrium nitrate, neodymium nitrate, urea, and glycine as starting materials. The characteristic near-IR emission of Nd^{3+} at 1067 nm was found to maximize at a Nd^{3+} concentration of 1 mol %. The impact of Si^{4+} co-doping on the crystal structure, morphology, and photoluminescence has also been studied. In the presence of the dopant, the emission intensity enhanced by 21% at an optimal Si^{4+} content of YAG:Nd^{3+} phosphor, which can be attributed to improvement in crystallinity, formation of pure phase, and creation of color centers due to mismatch in ionic radii between parent and doped ions.

Keywords: combustion synthesis, YAG:Nd, polycrystalline ceramics, Nd^{3+} luminescence
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1. INTRODUCTION

Yttrium aluminum garnet $Y_3Al_5O_{12}$ (YAG) has a cubic garnet structure with excellent chemical stability, good optical properties and creep resistance [1, 2]. Doping YAG with rare earth ions (REs) makes it an ideal phosphor material for solid-state lasers. Nd^{3+}, Yb^{3+}, and Er^{3+} are the most suitable near-IR luminescing RE^{3+} ions in a YAG matrix. Solid-state lasers employing YAG:Nd are the most commonly used commercially available lasers, emitting at the 1064 nm line from Nd^{3+}, in view of proper optical quality, high quantum efficiency, excellent mechanical toughness, and chemical durability. Single YAG and YAG:Nd crystals are grown by using the standard Czochralski technique [3]. But there is some difficulty in obtaining single crystals containing elevated concentration of activator (Nd). This difficulty is caused by a significant difference between the ionic radii of Nd^{3+} and Y^{3+}. This makes difficult the isomorphic substitution of more than 1 at % Nd^{3+} in a YAG crystal. First transparent YAG:Nd ceramics with the required optical properties were elaborated by Ikesue et al. in 1995 [4]. Low duration of their manufacturing and flexibility in terms of size, geometry, and design made them extremely attractive in comparison with single crystals. Moreover, some recent works [5, 6] have shown that, for laser applications, transparent polycrystalline YAG:Nd ceramics are equivalent or even better than single crystals grown by the Czochralski method.

To date, many efforts have been made to investigate various suitable and effective methods for fabrication of YAG:Nd. Those methodologies still face many issues such as high annealing temperatures, impurity phases like $Y_4Al_2O_9$ (YAM) and $YAlO_3$ (YAP) in the products [7], large particle size, and inefficient control of crystal morphology and composition. All of these are vitally important for high luminescence property. Enhancing the photoluminescence properties of phosphors remains a challenge for current research. To enhance the emission intensity, co-doping with rare earth or metal ions is considered to be a suitable strategy. The co-doping ions work on enhancing the emission intensity of phosphors in two ways. One is the role sensitizers (energy-transfer agents) for rare earth ions and another is the improvement in the host lattice absorption.

In continuation of our previous work (see [8, 9] and references in), we made an attempt to synthesize polycrystalline YAG:Nd phosphor by mixed-fuel solution-combustion synthesis (SCS) at relatively low temperatures without any further heat treatment. The effect of Si co-doping on structural and optical parameters of YAG:Nd was also studied. To our knowledge, the impact of Si^{4+} concentration on the luminescence of YAG:1% Nd^{3+} phosphors at moderate temperatures has not been explored so far.

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Comparative study of synthesis method on dielectric properties of ceramics of binary composition 0.6PMN–0.4PZN

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ABSTRACT

It is demonstrated that the dielectric properties of ceramics in the 0.6PMN–0.4PZN system have been studied as a function of different synthesis method at various temperatures. A detail and systematic study of phase, grain size and dielectric properties has been carried out by using X-ray diffraction, SEM techniques and dielectric measurement. Our analysis revealed that the optimum results were obtained for ceramics synthesized by columbite method as compared to combustion. The maximum dielectric constant was found to be 25,300 with Tc 46 °C at 100 Hz by columbite method whereas 17,449 with Tc 43 °C at 100 Hz by combustion method. The article concludes with the brief discussion of promising method with acceptable relaxor behavior.

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KEYWORDS
Comparative; crystallographic; perovskites; micro structure; dielectric properties

Introduction

With the fast development of the power electronics, dielectric materials with high energy storage density, low loss and good temperature stability are strongly desire for the potential applications in capacitors [1].

Lead based pervoskite ferroelectric relaxors like lead magnesium niobate $Pb(Mg_{1/3}Nb_{2/3})O_3$ (PMN) and lead zinc niobate $Pb(Zn_{1/3}Nb_{2/3})O_3$(PZN) are attractive candidates for applications such as multilayer ceramic capacitors (MLC), actuators and medical ultrasonic transducers due to its high dielectric constant, broad dielectric maxima, high electrostrictive strain response and relative low firing temperature[2–4].

Current study was focused on dielectric characterization of ceramics of binary compositions 0.6PMN–0.4PZN synthesized by columbite (M-I) and combustion method (M-II). Both methods claimed pervoskite phase formation from X-ray diffraction (XRD) studies but dielectric behavior varies considerably from method to method and under such condition microstructure examination of ceramics proves useful. The objective of this work was to study the effect of synthesis process on dielectric properties of PMN–PZN and to get dense ceramic with single phase perovskite at lower sintering temperature exhibiting high value of relative permittivity and low loss with *Tc* near RT most suitable for MLC and electrostrictive applications.

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REVIEW ARTICLE

ONLINE LEARNING DURING LOCKDOWN PERIOD OF COVID-19 PANDEMIC: A STUDENT PERSPECTIVE

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ABSTRACT

The COVID-19 pandemic has impinged on the people irrespective of their nationality, age, income, or gender. It has hit almost all the sectors of the economy and education is no exception. In response to lockdown norms, Higher Education Institutions (HEIs) and universities had to close their premises. However, HEIs were quick to replace traditional classrooms with online learning. In response to this researcher has made an attempt to assess the perspective of MBA students towards Online Learning (OL) compared to the traditional classroom learning (CL) in the Nagpur region of Maharashtra. The sample includes fourth semester & second semester MBA students for the academic year 2019-2020. The data was collected using a structured questionnaire constructed in Google form. A total number of 601 students from five different MBA colleges in the Nagpur region participated in the study. Data were recorded in excel and analyzed. The result indicates that students are comfortable with online learning but still would like to prefer traditional face-to-face learning as it provides experiential learning.

Keywords: Classroom learning, Online learning, Higher Education Institutions (HEIs).

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INTRODUCTION

At the end of November 2019 in Wuhan, China a unique virus had appeared that had killed a few thousand Chinese within the fifty days of spread, and thousands of other citizens were also suffered. The novel virus was nominated as COVID-19 novel coronavirus by the Chinese scientists.(1) In a while, this COVID-19 spread worldwide and affected several country's economies. Further, the outbreak also changed the operating conditions all over the globe within a month.(2) The Covid-19 pandemic has created an array of challenges not only to public health but also in many other aspects of public life, which includes education too. The need to contain the spread of the novel corona virus led many governments across the globe to put in place strict norms limiting physical closeness. These norms have unable the students & faculties of HEIs to meet in person as they would do pre-Covid. The pandemic necessitated HEIs to work in innovative ways, adapting to online teaching-learning styles to a new normal locked-down world. Most of the higher education is operating through E-learning.(3) E-Learning is "a system that uses internet technology to deliver information to students with interactions through computer interfaces." In short, it is learning that is enabled electronically.(4) As we know, MBA faculties are more engaged with information and communication technologies (ICT) than faculties belonging to other streams. It becomes more likely for them to adapt to the online mode of teaching. While faculties were relatively well prepared for the unexpected challenge of lockdown, the same cannot be said for students. On the other hand, we should not overlook that our youths are highly digital natives and use technology as an essential part of their everyday lives where they use technology widely for surfing, socializing, and communication. A special concern here relates to the HEIs students coming from underprivileged backgrounds or rural parts of India where they don't have easy access to a computer or internet and a quiet place at home to study. At this specific point in time, it is significant to find out students' perceptions regarding online teaching and learning. It will be an interesting point to view that whether the students are comfortable with the new teaching methodology, blended learning, and or rather would want to go back to conventional classroom learning.

In this context, an attempt has been made by the researcher to assess the perception of students on the effectiveness of online learning over face-to-face classroom learning. This research is intended to give insight into how MBA student perceives the implementation of online learning over traditional learning.

Objectives

The present research is aimed to achieve the following objectives: To disclose the various tools of online learning adopted by MBA institutions in the Nagpur region during the COVID-19 pandemic.

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A Review on COVID-19 Face Mask Detection using CNN

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

The World Health Organization claims (WHO),Corona Viruses the COVID-19 pandemic is causing a nationwide crisis, wearing a mask on a face in public places is an effective protection measure. The COVID-19 pandemic forced governments all over the world to implement quarantine measures in order to deter virus spread. Reports suggest that the risk of transmission is clearly minimized by wearing face masks when at work. An effective and economic approach to the use of AI in a manufacturing setting to build a secure environment. Using a face mask detection dataset, we will use Open CV to perform real-time face detection from a live stream from our webcam. Using Keras, Python, Tensorflow and Open CV, and, it will build a COVID-19 face mask detector with computer vision. Using computer vision and CNN, I aim to decide whether or not the person in the image or video streaming is wear a mask.

Keywords: Deep learning; COVID-19 dataset; open Cv; tensorflow; CNN.

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Research article

VAMANAKARMA: AN ANCIENT AYURVEDIC CLEANSING THERAPY

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ABSTRACT

'Charaka Samhita' an ancient text of Ayurveda emphasizes the cleansing of the body through Panchakarma. Today's generation is out of touch with nature. Poor dietary habits, fast foods, no proper exercise regimen, stress and strain of daily life to compete and survive- these patterns have led to a lot of hormonal changes, and the agents that regulate the body's mechanism have become poor leading to the spread of toxins throughout the body causing various diseases. As per Ayurveda, these toxins are called "ama". This foul-smelling, sticky, harmful fluid needs to be completely removed from the body. This is done through Panchkarma, which is advised quarterly, half-yearly, or yearly to get rid of the toxins from the body and also to provide protection from different diseases. This process has twofold benefits – cleansing of the body and also rejuvenation, thus giving a youthful appearance to the body. Panchakarma includes five methods through which the body is detoxified –Procedure of Vamana (induced vomiting), Procedure of Virechana (induced purgation), Basti (enema), Nasya(nasal application), Rakthamokshanana (bloodletting). The three Doshas(vital physiological factors according to Ayurveda) in the human body that is - Vata, Pita, and Kapha are balanced, leading to good physical health and mental balance. Vamanaprocedure means induction of emesis. Through this procedure, the toxins are removed from the body especially through the upper body parts. Vamanaisthe best remedy for Kapha-related diseases. Most of the diseases today are due to improper digestion and metabolism (*Agni*). The cause is the changing lifestyle full of stress and anxiety. Irregular dietary habits add further to these issues. Diseases need to be uprooted from the base. Therapies like *Panchkarma* or particular therapy as *VamanaKarma* for particular *Doshas* like *Kapha* can be thought of on a regular basis as a remedy.

KEYWORDS: Ayurveda, Vamana, Kapha, Panchakarma, health, detoxified, rejuvenation.

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INTRODUCTION

Ayurveda is an ancient Indian system of medicine; in fact, it is the world's oldest healing science. Ayurveda means "the science of life". This is made up of two words – 'Ayur' which means "longevity" or "life" and the other is 'Veda' which stands for "science". Ayurveda believes that each individual is unique and made up of three Doshas, that is - Vata, Pitta, and Kapha. When these Doshas become assimilated, it will lead to diseases. The digestive fire or Agni is another important aspect that plays a role in overall health. If it is impaired, it may lead to the accumulation of toxins/ poisons and can further lead to various diseases. Hence restoration or strengthening of the Agniand balance of the three Doshasis very essential for good health. For this periodic cleansing is suggested which works both as curative and preventive because of its rejuvenating action. One of the prominent branches of Ayurveda isPanchakarma meaning "Five procedures" as it consists of five techniques namely Vamana(induced vomiting), Virechana (induced purgation), Basti (enema), Nasya (nasal application), Rakthamokshana (blood purification). According to Ayurvedic texts, Panchakarma procedures are of much more importance than other therapy for preventing further imbalance (Prakopa) of Dosha and for curing of disease.[(1)] Among the five procedures, Vamana is the Pradhana Karma of Panchakarma[(2)] therapy and it has been considered as the best line of treatment for the Kaphaja disorders.[(3)]

According to Acharya Charaka (compiler or editor of the medical treatise Charaka *Samhita*), *Vamana* is defined as a process of elimination of waste products or toxins (*Dosha*) through upper channels[(4)] i.e. mouth. Other Ayurveda scholars such as Chakrapani has used the word *Urdhavamukha* i.e. upper end and Bhavaprakash have used the word *Mukhmarga* which means oral route. *Vamana* is regarded as the best one among all the therapeutic measures for *Kapha*[(5)]. If the *Vamana* procedure is adopted properly, lightness of the body, clarity of precordium (*Hridaya*), throat/(pharynx)

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ANALYSIS OF DEFORESTATION MULTISPECTRAL SATELLITE DATA USING REMOTE SENSING TECHNIQUES

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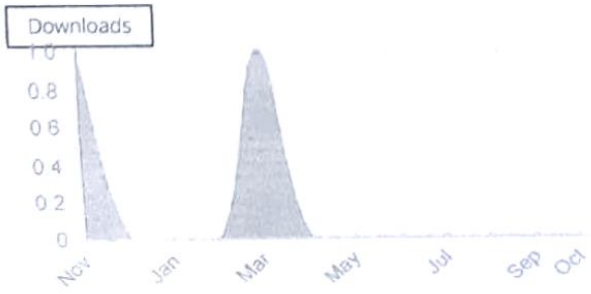

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Abstract

The coverage of global forest cover is most essential for soil health, climate, water cycle and air quality. The condition can be improved by reforestation and afforestation to some extent but cannot be restored to full range. The satellite images used for this analysis of forest change detection are of planet scope having 3 m resolution. The target of this research is to detect the forest cover change using remote sensing and GIS. For the identification of forest covers various techniques like segmentation and classification are used. The best classification is by Normalized Difference Vegetation Index (NDVI) which identifies the health of vegetation along with the changes in the different parameters. After using NDVI some values generated will detect the areas of forest changes with the amount of change. And with the help of this research it is observed that out of total forest area i.e. 76740.32 hectares, the negative forest change is reduced to 29.44% due to degradation of forests maybe due to fires, deforestation, leaf shedding etc.

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Disease Diagnosis System using Machine Learning

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Authors' contributions

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ABSTRACT

The efficient use of data mining in virtual sectors such as e-commerce, and commerce has led to its use in other industries. The medical environment is still rich but weaker in technical analysis field. There is a lot of information that can occur within medical systems. Using powerful analytics tools to identify the hidden relationships with the current data trends. Disease is a term that provides a large number of conditions connected to the heath care. These medical conditions describe unexpected health conditions that directly control all the organs of the body. Medical data mining methods such as corporate management mines, classification, integration is used to analyze various types of common physical problems. Separation is an important problem in data mining. Many popular clips make decision trees to produce category models. Data classification is based on the ID3 decision tree algorithm that leads to accuracy, data are estimated to use entropy verification methods based on cross-sectional and segmentation and results are compared. The database used for machine learning is divided into 3 parts - training, testing, and finally validation. This approach uses a training set to train a model and define its appropriate parameters. A test set is required to test a professional model and its standard performance. It is estimated that 70% of people in India can catch common illnesses such as viruses, flu, coughs, colds etc. every two months. Because most people do not realize that common allergies can be symptoms of something very serious, 25% of people suddenly die from ignoring the first normal symptoms. Therefore, identifying or predicting the disease early using machine learning (ML) is very important to avoid any unwanted injuries.

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Leaf Infection Detection Using Fuzzy Support Vector Machine

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Agriculture plays a very essential role in the food industry and a big economic source of clothing. Identification of infection at a very initial stage can prevent a massive loss of yield and productivity. The infection can be recognized with signs of colors on the leaf, stems. Leaves exhibit symptoms by changing color, showing spots on it. This could also be done by manually inspecting each leaf but it can be time-consuming and prove to be expensive. This paper aims to distinguish the infected part of the leaf. Identification of infection on leaf with modern automatic techniques can be profitable and resource-saving. We processed image which plays the important role used for automatic detection and classification. We have used approximately 19000 images samples of bell paper, potato, tomato to train our model. We proposed a model in which we are using k-mean, SVM, FSVM classifier. We found that FSVM performs better than other classifier. We achieved 80.33

Keywords: Disease, Infection, Fuzzy Logic, Fuzzy SVM, Extraction, Classification.

1. INTRODUCTION

In today's world every sector has seen revolutionary changes with technologies. Following the trend smart farming has also been introduced where the growth of individual plants are controlled and monitored using automatic algorithms. This automation is based on identification of symptoms of infection. This helps the farmers and researchers are informed about the plant's growth quickly and accurately. The key element in recognition from an image is to extract the characteristic features of the infected area. Features extracted from the image are color, shape, texture etc. Distinct leaves of plants bear diverse sicknesses. Identification of disease through automatic algorithms might be very profitable in checking naturally identifying unwanted elements which can later ruin the plant. Therefore automatic detection of plant disease through image processing techniques and machine learning techniques provide more correct way for infection management. Comparatively, visual identification is less accurate and time consuming. So it is required to develop a model to detect disease. The main purpose of doing this paper is to focus on the disease of a leaf. This paper aims to rectify the diseased part of the leaf and to predict the probability of the infection on the plant. With all-new technology, we have come up with a very effective algorithm that would help in the Agriculture Industry. At a very low resource, we can predict the health of the plantation that would be useful in the near future. The existence of the disease in the plant can cost significant loss to the quality as well as the quantity. This has a very strong effect on the farmers. They take up loans prior and can only pay them off if the agriculture yields whereas if there is infection then it would end up in total loss. The algorithm uses Fuzzy-SVM to deal with the problem. This paper gives the solution or result more accurately to deal with the classification and identification of disease. Images of disease prone leaf are shown in figure1.

2. LITERATURE SURVEY

The methods for identifying crop diseases on various leaf samples are proposed. The system combines the features of local binary patterns (LBPs) with one class classification for classifying

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AN EFFICIENT KEY EXCHANGE SCHEME USING SANTILLI'S ISOFIELDS SECOND-KIND FOR SECURE COMMUNICATION

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ABSTRACT. We intend to bring out a unique method for constructing key exchange scheme (KES) using Santilli's isofields second kind for safe transmission. The substantial idea of our offer KES is to utilized isopolynomials with general isonumber coefficient. Suggested KES is an unusual advantage for afore application as Santilli's isofields second kind framework permutable permutation of isocongruence and isoarirthmetic progressions.

1. INTRODUCTION, MOTIVATIONS AND ORGANIZATION

The framework for KES introduced by Diffie–Hellman, permits two users to simultaneously build a mutual private key over an unconfident mechanism [1]. At present, most of KES build on the number theory. The primary concerns on that the public key cryptography is design are discrete logarithm problem (DLP) [2, 3] along with the elliptic curve DLP [4, 5]. The methodically enumerable groups in which DLP structure plays are a fundamental part in cryptosystem [6]. Various implementations of the Diffie-Hellman procedure in matrix rings and diversity of matrices are suggested in [7, 8]. Various cryptographic schemes constructed on DLP and double DLP proposed in [9–12,

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16]. Dihedral group and Suzuki-2 group based cryptosystem which are secure against chosen-plaintext-attack, ciphertext-indistinguishability-attack and adaptive-chosen-ciphertext-attack in random oracle model offered in [13–15]. Lately, Meshram A. [17] presented KES based on isonumbers.

The current work concentrate on a particular procedure for design a KES build on the Santilli's isofields of the second kind to make use of isounit is an element of the original field. This paper is structured as follow. In part 3, we confer the relevant background. In part 4, we present Santilli's isofields of the second kind based KES. Lastly, paper is accomplished in part 5.

2. Mathematical Definitions and Associated Data

In this part, we describes mathematical definitions such as arthmatic operation in morden mathematics, arthmatic operation in Santilli's isomathematics, Santilli's isofields of the second kind, Diffie-Hellman Problem (DHP), Symmetrical Decomposition Problem (SDP) over ring $\widehat{\mathcal{F}}$.

2.1. **Modern Mathematics:** Arithmetic operations with "0" an additive unity and "1" an multiplicative unity define as:

$\alpha + 0 = 0 + \alpha = \alpha$, $\alpha - 0 = \alpha, 0 - \alpha = -\alpha$, $\alpha \times 1 = 1 \times \alpha = \alpha$,

$\alpha \times \beta = \alpha\beta$, $\alpha \div 1 = \alpha$, $1 \div \alpha = \frac{1}{\alpha}$, $\alpha \div \beta = \frac{\alpha}{\beta}$,

with $\alpha^{(0)} = 1$ and $\alpha^{(1)} = \alpha$.

2.2. **Santilli's Iso - mathematics:** The structure for iso - mathematics presented by Jiang [17] as follows:

- Iso-addition $(\widehat{+})$: $\alpha\widehat{+}\beta = \alpha + \widehat{0} + \beta$.
- Iso-subtraction $(\widehat{-})$: $\alpha\widehat{-}\beta = \alpha - \widehat{0} - \beta$.
- Iso-multiplication $(\widehat{\times})$: $\alpha\widehat{\times}\beta = \alpha\widehat{\Upsilon}\beta$.
- Iso-division $(\widehat{\div})$: $\alpha\widehat{\div}\beta = \left(\frac{\alpha}{\beta}\right)\widehat{\hbar}$.

Here, $\widehat{0}$ is called isozero and $\widehat{\Upsilon}$ is called inverse of isounit $\widehat{\hbar} \neq 1$ such that $\widehat{\Upsilon}\widehat{\hbar} = 1$.

2.3. **Santilli's isofields of the second kind $\widehat{\mathcal{F}} = \widehat{\mathcal{F}}(\alpha, +, \times)$.**

For all $\alpha \in \mathcal{F}$ not lifted to $\widehat{\alpha} = \alpha\widehat{\hbar}$ verify all the axioms of a field if and only if the isounit is an element of the original field, i.e. $\widehat{\hbar} = \frac{1}{\widehat{\Upsilon}} \in \mathcal{F}$. Then isoproduct is defined as $\alpha\widehat{\times}\beta = \alpha\widehat{\Upsilon}\beta \in \widehat{\mathcal{F}}$.

We then have the following isoproduct operations of second kind as:

•$\alpha^{\widehat{\hbar}} = \alpha, \alpha^{-\widehat{\hbar}} = \alpha^{-1}\widehat{\hbar}^2,\ \alpha^{\widehat{\hbar}} \mathbin{\widehat{\times}} \alpha^{-\widehat{\hbar}} = \alpha^{\widehat{0}} = \widehat{\hbar} = \widehat{\Upsilon}^{-1} \neq 1.$

•$\alpha^{\widehat{2}} = \alpha^2\widehat{\Upsilon}, \alpha^{-\widehat{2}} = \alpha^{-2}\widehat{\hbar}^3,\ \alpha^{\widehat{2}} \mathbin{\widehat{\times}} \alpha^{-\widehat{2}} = \alpha^{\widehat{0}} = \widehat{\hbar} = \widehat{\Upsilon}^{-1} \neq 1$, and so on.

In general,

•$\alpha^{\widehat{n}} = \alpha^n\widehat{\Upsilon}^{n-1}, \alpha^{-\widehat{n}} = \alpha^{-n}\widehat{\hbar}^{n+1},\ \alpha^{\widehat{n}} \mathbin{\widehat{\times}} \alpha^{-\widehat{n}} = \alpha^{\widehat{0}} = \widehat{\hbar} = \widehat{\Upsilon}^{-1} \neq 1.$

•$\alpha^{\widehat{1/2}} = \alpha^{1/2}(\widehat{\hbar})^{1/2}, \alpha^{-\widehat{1/2}} = \alpha^{-1/2}(\widehat{\hbar})^{3/2},\ \alpha^{\widehat{1/2}} \mathbin{\widehat{\times}} \alpha^{-\widehat{1/2}} = \alpha^{\widehat{0}} = \widehat{\hbar} = \widehat{\Upsilon}^{-1} \neq 1.$

•$\alpha^{\widehat{1/3}} = \alpha^{1/3}(\widehat{\hbar})^{2/3}, \alpha^{-\widehat{1/3}} = \alpha^{-1/3}(\widehat{\hbar})^{4/3},\ \alpha^{\widehat{1/3}} \mathbin{\widehat{\times}} \alpha^{-\widehat{1/3}} = \alpha^{\widehat{0}} = \widehat{\hbar} = \widehat{\Upsilon}^{-1} \neq 1,$ and so on.

In general,

•$\alpha^{\widehat{1/n}} = \alpha^{1/n}(\widehat{\hbar})^{1-\frac{1}{n}}, \alpha^{-\widehat{1/n}} = \alpha^{-1/n}(\widehat{\hbar})^{1+\frac{1}{n}},\ \alpha^{\widehat{1/n}} \mathbin{\widehat{\times}} \alpha^{-\widehat{1/n}} = \alpha^{\widehat{0}} = \widehat{\hbar} = \widehat{\Upsilon}^{-1} \neq 1.$

•$\alpha^{\widehat{\gamma/\beta}} = \alpha^{\gamma/\beta}(\widehat{\hbar})^{1-\frac{\gamma}{\beta}}, \alpha^{-\widehat{\gamma/\beta}} = \alpha^{-\gamma/\beta}(\widehat{\hbar})^{1+\frac{\gamma}{\beta}},\ \alpha^{\widehat{\gamma/\beta}} \mathbin{\widehat{\times}} \alpha^{-\widehat{\gamma/\beta}} = \alpha^{\widehat{0}} = \widehat{\hbar} = \widehat{\Upsilon}^{-1} \neq 1.$

•$\alpha^{\widehat{\beta}} = \alpha^{\beta}(\widehat{\hbar})^{1-\beta} = \alpha^{\beta}(\widehat{\Upsilon})^{1-\beta}, \alpha^{-\widehat{\beta}} = \alpha^{-\beta}(\widehat{\hbar})^{1+\beta},\ \alpha^{\widehat{\beta}} \mathbin{\widehat{\times}} \alpha^{-\widehat{\beta}} = \alpha^{\widehat{0}} = \widehat{\hbar} = \widehat{\Upsilon}^{-1} \neq 1.$

•$\alpha^{\widehat{\hbar}} \mathbin{\widehat{\times}} \alpha^{\widehat{\hbar}} = \alpha\widehat{\Upsilon}\beta,\ \alpha^{\widehat{\hbar}} \mathbin{\widehat{\times}} \alpha^{-\widehat{\hbar}} = \alpha\beta^{-1}\widehat{\hbar}.$

In the first instance, scale isomultiplication notion over $\widehat{\mathcal{F}}$ define as follows:

I. $(\widehat{\lambda})\widehat{\mu} \triangleq (-\widehat{\lambda})(-\widehat{\mu}) = \underbrace{(-\widehat{\mu}) + (-\widehat{\mu}) + (-\widehat{\mu}) + ... + (-\widehat{\mu})}_{-\widehat{\lambda} \text{ times}}, \widehat{\lambda} \in \mathbb{Z} < \widehat{0}.$

II. $(\widehat{\lambda})\widehat{\mu} \triangleq \underbrace{\{\widehat{\mu} + \widehat{\mu} + \widehat{\mu} + ... + \widehat{\mu}\}}_{\widehat{\lambda} \text{ times}}, \widehat{\lambda} \in \mathbb{Z} < \widehat{0}.$

III. $(\widehat{\lambda})\widehat{\mu} = \widehat{0},\ \widehat{\lambda} = \widehat{0}.$

Case-I: For isonumber $\widehat{\amalg}, \overset{\frown}{\surd}, \widehat{\sqcup}, \widehat{\int} \in \mathbb{Z}$, we have $(\widehat{\amalg})\ \widehat{\mu}^{\widehat{\sqcup}} * (\overset{\frown}{\surd})\ \widehat{\mu}^{\widehat{\int}} = (\widehat{\amalg}\ \overset{\frown}{\surd})\ \widehat{\mu}^{\widehat{\sqcup}+\widehat{\int}} = (\overset{\frown}{\surd})\widehat{\mu}^{\widehat{\int}} * (\widehat{\amalg})\ \widehat{\mu}^{\widehat{\sqcup}}, \forall\ \widehat{\mu} \in \widehat{\mathcal{F}}.$

By utilizing definition of scale isomultiplication, the distributivity of isomultiplication with respect to isoaddition, and commutativity of isoaddition, we can conclude the above statement.

Case-II: For distinct $\widehat{\lambda}$ and $\widehat{\mu}$ we have $(\widehat{\amalg})\ \widehat{\mu} * (\overset{\frown}{\surd})\ \widehat{\lambda} \neq (\overset{\frown}{\surd})\ \widehat{\lambda} * (\widehat{\amalg})\ \widehat{\mu}.$

Let us define for isonumber $\widehat{\mu}$ in $\widehat{\mathcal{F}}$, we have $\widehat{\mathfrak{h}}(\widehat{\mu}) = \sum_{|=0}^{\widehat{\int}}(\widehat{\amalg_|})\widehat{\mu}^| = (\widehat{\amalg_0}) + (\widehat{\amalg_1})\widehat{\mu} + ... + (\widehat{\amalg_{\widehat{\int}}})\widehat{\mu}^{\widehat{\int}} \in \widehat{\mathcal{F}}$ for an isopolynomial with positive isointegral coefficient $\widehat{\mathfrak{h}}(\widehat{\updownarrow}) = \widehat{\amalg_0} + \widehat{\amalg_1}\widehat{\updownarrow} + ... + \widehat{\amalg_J}\widehat{\updownarrow}_J \in \mathbb{Z}^+[\widehat{\updownarrow}]$. Furthermore, $\widehat{\mathfrak{h}}(\widehat{\mu})$ is an isopolynomial about variable $\widehat{\mu}, \forall\ \widehat{\mu} \in \widehat{\mathcal{F}}$ then $\widehat{\mathfrak{h}}(\widehat{\mu}) \in \mathbb{Z}^+[\widehat{\mu}]$. Where $\mathbb{Z}^+[\widehat{\mu}]$ is an extension of $\mathbb{Z}^+$ with $\widehat{\mu}$. Consider $\widehat{\mathfrak{h}}(\widehat{\mu}) = \sum_{|=0}^{\widehat{\int}}(\widehat{\amalg_|})\widehat{\mu}^| \in \mathbb{Z}^+[\widehat{\mu}]$, $\widehat{\mathfrak{f}}(\widehat{\mu}) = \sum_{\|=0}^{\widehat{\sqcup}}(\overset{\frown}{\surd})\widehat{\mu}^| \in \mathbb{Z}^+[\widehat{\mu}]$ and $\widehat{\int} \geq \widehat{\sqcup}$,

then $\big(\sum_{|=0}^{\widehat{\int}}(\widehat{\amalg}_{|})\widehat{\mu}^{|}\big)+\big(\sum_{\|=0}^{\widehat{\sqcup}}(\widehat{\bigvee}^{\|})\widehat{\mu}^{\|}\big)=\big(\sum_{|=0}^{\widehat{\sqcup}}(\widehat{\amalg}_{|}+\widehat{\bigvee}^{|})\widehat{\mu}^{|}\big)+\big(\sum_{|=\widehat{\sqcup}+1}^{\widehat{\int}}(\widehat{\amalg}_{|})\widehat{\mu}^{|}\big)$, by utilizing case-I along with isodistributivity and $\widehat{\exists}_{|}=\sum_{\|=0}^{\widehat{|}}\widehat{\amalg}_{|}\widehat{\bigvee}^{|-\|}=\sum_{\|+\lambda=|}\widehat{\amalg}_{|}\widehat{\bigvee}^{\lambda}$, we get $(\sum_{|=0}^{\sqcup+1}\widehat{\exists}_{|}\widehat{\mu}^{|})=(\sum_{|=0}^{\int}(\widehat{\}}_{|})\widehat{\mu}^{|})*(\sum_{\|=0}^{\sqcup}(\widehat{\bigvee}^{\|})\widehat{\mu}^{|})$ Consequently, we accomplish the successive case-III conferring to case-I.

Case-III: We have $\widehat{\mathfrak{b}}(\widehat{\mu})*\widehat{\mathfrak{f}}(\widehat{\mu})=\widehat{\mathfrak{f}}(\widehat{\mu})*\widehat{\mathfrak{b}}(\widehat{\mu}),\forall\,\widehat{\mathfrak{b}}(\widehat{\mu}),\widehat{\mathfrak{f}}(\widehat{\mu})\in\mathbb{Z}^{+}[\widehat{\mu}]$.
As usual, $\widehat{\mathfrak{b}}(\widehat{\mu})*\widehat{\mathfrak{f}}(\widehat{\lambda})\neq\widehat{\mathfrak{f}}(\widehat{\lambda})*\widehat{\mathfrak{b}}(\widehat{\mu})$ for $\widehat{\mu}\neq\widehat{\lambda}$. Assume ring isopolynomial with isonumber coefficient $(\widehat{\mathcal{F}},+,*)$, for each conjecturally select isonumber $\widehat{\dagger}\in\widehat{\mathcal{F}}$, we define a set $\widehat{\mathcal{D}\dagger}\subseteq\widehat{\mathcal{F}}$ by $\widehat{\mathcal{D}\dagger}\triangleq\{\widehat{\mathfrak{b}}(\widehat{\dagger}):\widehat{\mathfrak{b}}(\widehat{\mu})\in\mathbb{Z}^{+}[\widehat{\mu}]\}$

2.4. **SDP over Ring $\widehat{\mathcal{F}}$ with isopolynomial :** Numerate $\widehat{\xi}\in\widehat{\mathcal{D}\dagger}$ such that $\widehat{\updownarrow}=\widehat{\xi}^{\widehat{\sqcup}}\,\widehat{\mu}\,\widehat{\xi}^{\widehat{\int}}$ for $\widehat{\sqcup},\widehat{\int}\in\mathbb{Z},(\widehat{\sqcup},\widehat{\mu},\widehat{\updownarrow})\in\widehat{\mathcal{F}}^{3}$.

2.5. **DHP over Ring $\widehat{\mathcal{F}}$ with isopolynomial :** For given $\widehat{\mu},\widehat{\mu}^{\widehat{\xi}_1}$ and $\widehat{\mu}^{\widehat{\xi}_2}$, numerate $\widehat{\mu}^{\widehat{\xi}_1\widehat{\xi}_2}$ (or $\widehat{\mu}^{\widehat{\xi}_2\widehat{\xi}_1}$), $\widehat{\mu}\in\widehat{\mathcal{F}},\ \widehat{\xi}_1,\widehat{\xi}_2\in\widehat{\mathcal{D}\dagger}$.

3. KES USING SANTILLI'S ISOFIELDS SECOND - KIND

Promptly, We contemplate the ring isopolynomial with the isonumber coefficient as an fundamental structure to set up a KES where two clients, say Hirabai and Aakansha, who come to an agree to share a classified session key over the unsecured unstable channel.

The algorithm is stated as follow:

(i) Hirabai specify pair of two random positive isointegers $\widehat{\sqcup},\widehat{\int}\in\mathbb{Z}^{+}$ and pair of two random elements $\widehat{\amalg},\widehat{\bigvee}\in\widehat{\mathcal{F}}$ to Aakansha.
(ii) Hirabai prefer a conjecturally isopolynomial $\widehat{\mathfrak{b}}(\widehat{\mu})\in\mathbb{Z}^{+}[\widehat{\mu}]$ such that $\widehat{\mathfrak{b}}(\widehat{\amalg})\neq\widehat{0}$ and then proceed $\widehat{\mathfrak{b}}(\widehat{\amalg})$ as her classified key.
(iii) Aakansha prefer a conjecturally isopolynomial $\widehat{\mathfrak{f}}(\widehat{\mu})\in\mathbb{Z}^{+}[\widehat{\mu}]$ such that $\widehat{\mathfrak{f}}(\widehat{\amalg})\neq\widehat{0}$ and then proceed $\widehat{\mathfrak{f}}(\widehat{\sqcup})$ as her classified key.
(iv) Hirabai numerate $\mathcal{H}=\widehat{\mathfrak{b}}(\widehat{\amalg})^{\widehat{\sqcup}}*\widehat{\amalg}*\widehat{\mathfrak{b}}(\widehat{\amalg})^{\widehat{\int}}$ and refers $\mathcal{H}$ to Aakansha.
(v) Aakansha numerate $\mathcal{A}=\widehat{\mathfrak{f}}(\widehat{\amalg})^{\widehat{\sqcup}}*\widehat{\bigvee}*\widehat{\mathfrak{f}}(\widehat{\amalg})^{\widehat{\int}}$ and refers $\mathcal{A}$ to Hirabai.
(vi) Hirabai numerate $\widehat{\mathcal{K}}_{Hirabai}=\widehat{\mathfrak{b}}(\widehat{\amalg})^{\widehat{\sqcup}}*\mathcal{A}*\widehat{\mathfrak{b}}(\widehat{\amalg})^{\widehat{\int}}$ as the shared session key.
(vii) Aakansha numerate $\widehat{\mathcal{K}}_{Aakansha}=\widehat{\mathfrak{f}}(\widehat{\amalg})^{\widehat{\sqcup}}*\mathcal{H}*\widehat{\mathfrak{f}}(\widehat{\amalg})^{\widehat{\int}}$ as the shared session key.

The interpretation of the scheme is demonstrate in the following table.

Table. KES using Santilli's Isofields Second - Kind.

Pass	Hirabai $\rightleftharpoons$ Aakansha
	Pair of isointegers $\hat{t}, \hat{s} \in \hat{\mathbb{Z}}^{+}$ Pair of elements $\hat{q}, \hat{p} \in \hat{\mathcal{F}}$ Conjecturally isopolynomial $\hat{\mathfrak{h}}(\hat{\mu}) \in \hat{\mathbb{Z}}^{+}[\hat{\mu}]$
I	$\hat{t}, \hat{s}, \hat{q}, \hat{p}, \hat{\mathfrak{h}}(\hat{q})^{\hat{t}} \hat{p} \hat{\mathfrak{h}}(\hat{q})^{\hat{s}} \rightarrow$
	Choose at randomly $\hat{\mathfrak{f}}(\hat{\mu}) \in \hat{\mathbb{Z}}^{+}[\hat{\mu}]$
II	$\leftarrow \hat{\mathfrak{f}}(\hat{q})^{\hat{t}} \hat{p} \hat{\mathfrak{f}}(\hat{q})^{\hat{s}}$
	$\hat{\mathcal{K}}_{\text{Hirabai}} = \hat{\mathfrak{h}}(\hat{q})^{\hat{t}} \hat{\mathfrak{f}}(\hat{q})^{\hat{t}} \hat{p} \hat{\mathfrak{f}}(\hat{q})^{\hat{s}} \hat{\mathfrak{h}}(\hat{q})^{\hat{s}}$ $= \hat{\mathfrak{f}}(\hat{q})^{\hat{t}} \hat{\mathfrak{h}}(\hat{q})^{\hat{t}} \hat{p} \hat{\mathfrak{h}}(\hat{q})^{\hat{s}} \hat{\mathfrak{f}}(\hat{q})^{\hat{s}} = \hat{\mathcal{K}}_{\text{Aakansha}}$

3.1. **Example: KES using Santilli's Isofields Second - Kind.**

Select an integer $\mathcal{N} = 17 * 19$, isounit $\widehat{\hbar} = \begin{bmatrix} 1 & 7 & 5 \\ 8 & 6 & 2 \\ 3 & 5 & 9 \end{bmatrix}$ and its inverse of isounit $\widehat{\Upsilon} = \begin{bmatrix} \frac{-1}{7} & \frac{19}{154} & \frac{4}{77} \\ \frac{3}{14} & \frac{3}{154} & \frac{-19}{154} \\ \frac{-1}{14} & \frac{-4}{77} & \frac{25}{154} \end{bmatrix}$. Presume that Hirabai prefer $\widehat{\square} = \widehat{\in}, \widehat{\int} = \widehat{\ni}$, $\widehat{\amalg} = \begin{bmatrix} 5 & 6 & 3 \\ 2 & 5 & 9 \\ 7 & 1 & 8 \end{bmatrix}, \widehat{\surd} = \begin{bmatrix} 1 & 6 & 9 \\ 7 & 9 & 5 \\ 2 & 4 & 3 \end{bmatrix}$ and $\widehat{\mathfrak{h}}(\widehat{\mu}) = \widehat{3}\widehat{\mu}^{3} + \widehat{2}\widehat{\mu}^{2} + \widehat{\mu} + \widehat{2}$. She numerate: $\widehat{\mathfrak{h}}(\widehat{\amalg}) = \widehat{3} \begin{bmatrix} 5 & 6 & 3 \\ 2 & 5 & 9 \\ 7 & 1 & 8 \end{bmatrix}^{\widehat{3}} + \widehat{2} \begin{bmatrix} 1 & 6 & 9 \\ 7 & 9 & 5 \\ 2 & 4 & 3 \end{bmatrix}^{\widehat{2}} + \begin{bmatrix} 5 & 6 & 3 \\ 2 & 5 & 9 \\ 7 & 1 & 8 \end{bmatrix} + \widehat{2} \begin{bmatrix} 5 & 6 & 3 \\ 2 & 5 & 9 \\ 7 & 1 & 8 \end{bmatrix} \widehat{\mathfrak{h}}(\widehat{\amalg}) = \begin{bmatrix} 36578 & 61046 & 63334 \\ 41198 & 71962 & 73626 \\ 41428 & 68656 & 68428 \end{bmatrix} \mod 323, \widehat{\mathfrak{h}}(\widehat{\amalg}) = \begin{bmatrix} 79 & 322 & 26 \\ 177 & 256 & 305 \\ 84 & 180 & 275 \end{bmatrix}$ and $\mathcal{H} = \widehat{\mathfrak{h}}(\widehat{\amalg})^{\widehat{\square}} * \widehat{\surd} * \widehat{\mathfrak{h}}(\widehat{\amalg})^{\widehat{\int}}$,

$$\mathcal{H} = \begin{bmatrix} 79 & 322 & 26 \\ 177 & 256 & 305 \\ 84 & 180 & 275 \end{bmatrix}^{\widehat{2}} * \begin{bmatrix} 1 & 6 & 9 \\ 7 & 9 & 5 \\ 2 & 4 & 3 \end{bmatrix} * \begin{bmatrix} 79 & 322 & 26 \\ 177 & 256 & 305 \\ 84 & 180 & 275 \end{bmatrix}^{\widehat{3}} = \begin{bmatrix} 165 & 38 & 279 \\ 304 & 194 & 67 \\ 159 & 249 & 218 \end{bmatrix}.$$

Then, she indicate $\widehat{\square}, \widehat{f}, \widehat{\amalg}, \widehat{\surd}$ and $\mathcal{H}$ to Aakansha. Now, assume that Aakansha, after getting $\widehat{\square}, \widehat{f}, \widehat{\amalg}, \widehat{\surd}$ and $\mathcal{H}$ from Hirabai, select a another isopolynomial $\widehat{\mathfrak{f}}(\widehat{\mu}) = \widehat{2}\widehat{\mu}^2 + \widehat{\mu} + \widehat{2}$ and numerate

$$\widehat{\mathfrak{f}}(\widehat{\amalg}) = \widehat{2} \begin{bmatrix} 5 & 6 & 3 \\ 2 & 5 & 9 \\ 7 & 1 & 8 \end{bmatrix}^{\widehat{2}} + \begin{bmatrix} 5 & 6 & 3 \\ 2 & 5 & 9 \\ 7 & 1 & 8 \end{bmatrix} + \widehat{2} \begin{bmatrix} 5 & 6 & 3 \\ 2 & 5 & 9 \\ 7 & 1 & 8 \end{bmatrix}, \quad \widehat{\mathfrak{f}}(\widehat{\amalg}) = \begin{bmatrix} 275 & 173 & 27 \\ 286 & 309 & 189 \\ 94 & 175 & 16 \end{bmatrix}.$$

Further,

$$\mathcal{A} = \widehat{\mathfrak{f}}(\widehat{\amalg})^{\widehat{\square}} * \widehat{\surd} * \widehat{\mathfrak{f}}(\widehat{\amalg})^{\widehat{f}} = \begin{bmatrix} 275 & 173 & 27 \\ 286 & 309 & 189 \\ 94 & 175 & 16 \end{bmatrix}^{\widehat{2}} * \begin{bmatrix} 1 & 6 & 9 \\ 7 & 9 & 5 \\ 2 & 4 & 3 \end{bmatrix} * \begin{bmatrix} 275 & 173 & 27 \\ 286 & 309 & 189 \\ 94 & 175 & 16 \end{bmatrix}^{\widehat{3}}$$

$$\mathcal{A} = \begin{bmatrix} 53 & 267 & 173 \\ 264 & 187 & 27 \\ 37 & 251 & 82 \end{bmatrix}.$$

Then, she indicate $\mathcal{A}$ to Hirabai. At the end, Hirabai numerate the session key as

$$\widehat{\mathcal{K}}_{Hirabai} = \widehat{\mathfrak{h}}(\widehat{\amalg})^{\widehat{\square}} * \mathcal{A} * \widehat{\mathfrak{h}}(\widehat{\amalg})^{\widehat{f}}$$

$$\widehat{\mathcal{K}}_{Hirabai} = \begin{bmatrix} 79 & 322 & 26 \\ 177 & 256 & 305 \\ 84 & 180 & 275 \end{bmatrix}^{\widehat{2}} * \begin{bmatrix} 53 & 267 & 173 \\ 264 & 187 & 27 \\ 37 & 251 & 82 \end{bmatrix} * \begin{bmatrix} 79 & 322 & 26 \\ 177 & 256 & 305 \\ 84 & 180 & 275 \end{bmatrix}^{\widehat{3}}$$

$$= \begin{bmatrix} 138 & 218 & 167 \\ 294 & 127 & 282 \\ 317 & 29 & 153 \end{bmatrix},$$

while Aakansha numerate the session key as

$$\widehat{\mathcal{K}}_{Aakansha} = \widehat{\mathfrak{f}}(\widehat{\Pi})^{\widehat{\square}} * \mathcal{H} * \widehat{\mathfrak{f}}(\widehat{\Pi})^{\widehat{f}}$$

$$\widehat{\mathcal{K}}_{Aakansha} = \begin{bmatrix} 275 & 173 & 27 \\ 286 & 309 & 189 \\ 94 & 175 & 16 \end{bmatrix}^{\widehat{2}} * \begin{bmatrix} 165 & 38 & 279 \\ 304 & 194 & 67 \\ 159 & 249 & 218 \end{bmatrix} * \begin{bmatrix} 275 & 173 & 27 \\ 286 & 309 & 189 \\ 94 & 175 & 16 \end{bmatrix}^{\widehat{3}}$$

$$= \begin{bmatrix} 138 & 218 & 167 \\ 294 & 127 & 282 \\ 317 & 29 & 153 \end{bmatrix}.$$

Allegedly, $\widehat{\mathcal{K}}_{Hirabai} = \widehat{\mathcal{K}}_{Aakansha}$ holds.

4. Conclusion

In recent times few promising KES have been design on braid groups, Thompson's groups, etc. In this artical, we have proposed the unique KES which is based on Santilli's isofields of the second - kind is to utilized isopolynomials with general isonumber coefficient. It benefit ahead perusal in view of Santilli's isofields of the second - kind framework like permutable permutation of isonumber.

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Research Article

FRW Viscous Dark Fluid with Non-linear Inhomogeneous Equation of State

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Abstract. In this paper, we considered a bulk viscosity described by non-linear inhomogeneous equation of state of the type $p = \omega(\rho) + f(\rho) + \Lambda(H)$, where $\omega(\rho) = b_0\rho^{\delta-1} - 1$, $f(\rho) = A\rho^{\alpha}$ and $\Lambda(H) = \Lambda_0 H$. We assume the bulk viscosity as a linear combination of two terms of the form $\zeta = \zeta_0 + \zeta_1 H$ i.e. one is constant and the other is proportional to Hubble parameter H. In the first part of the paper we find the solution of the field equations in terms of time-dependent dark energy density ρ, Hubble parameter H, scale factor a and also obtain the transition from non-phantom era to the phantom era by using exponential function method. In the second part of the paper, we again find the solutions of the field equations by using the simple integration method and again obtain ρ, H, and a for the particular case. Finally, we discuss the stability of the model.

Keywords. Dark energy, Viscous fluid, Non-linear equation of state

Mathematics Subject Classification (2020). 83A05; 83C05; 83C15; 83C56

1. Introduction

The discovery of accelerating universe has led to the appearance of a new theoretical model [8]. The cosmic acceleration can be explained via the introduction of dark energy [7] strange properties like negative pressure and negative entropy. It is well known that present universe

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is subject to acceleration, which can be explained in terms of an ideal fluid (dark energy) with usual matter, and which has uncommon equation of state.

Khadekar *et al.* [5], consider the effect of dark energy model with inhomogeneous equation of state of the form $p = (\gamma - 1)\rho + \Lambda(t)$ and proposed dynamical generalized scale factor for the universe in which they assume the bulk viscosity ζ and time dependent parameter Λ as a linear combination of two terms: one is proportional to constant and other is proportional to scalar expansion θ. In continuation of this work recently Khadekar and Deepti [3] obtained the solutions of the field equations by using the above inhomogeneous equation of state with equation of state parameter ω is constant and is a function of ρ. Similarly, Khadekar and Rupali [4] also describe the cosmological evolution by considering the above ζ and Λ and obtained the analytical solutions of the field equations using effective equation of state.

Brevik *et al*. [1] investigated the specific model for a dark fluid with a non-linear inhomogeneous equation of state of the type $p = \omega(\rho) + f(\rho) + \Lambda(t)$ and find the solutions of the field equation in terms of Hubble parameter $H(t)$, Scale factor $a(t)$ and also investigated the transition from non-phantom to the phantom era. In particular they studied the transition towards super acceleration, i.e., the case in which the third derivative of the scale factor $a(t)$ is positive.

In this paper, we use the exponential function method to solve the non-linear inhomogeneous equation of state and obtained the time dependent dark energy density ρ, Hubble parameter $H(t)$ and scale factor $a(t)$ and investigate the effect of viscosity to the evolution of the universe.

This paper is organized as follows. Section 2 deals with the model and field equations. In Section 3, we consider a non-linear inhomogeneous equation of state of the universe and obtained the solutions of the field equations by using exponential function method. We also discussed the time dependent dark energy density ρ, Hubble parameter $H(t)$ and the scale factor $a(t)$ for particular case $\delta = \frac{1}{2}$. In Section 4 we have the discuss sound speed and stability of the model. In last section, we present our conclusion.

2. Model and Field Equation

We consider the FRW metric of the form [5]

$$ds^2 = -dt^2 + a^2(t)(dr^2 + r^2 d\theta^2 + r^2 sin^2\theta d\phi^2), \tag{2.1}$$

where a is the scalar factor.

The Einstein field equations takes the usual form

$$R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R = 8\pi G T_{\mu\nu}. \tag{2.2}$$

In the FRW cosmology with bulk viscosity the stress energy momentum tensor can be written as

$$T_{\mu\nu} = (p + \rho)U_\mu U_\nu + p g_{\mu\nu} - \zeta\theta H_{\mu\nu}, \tag{2.3}$$

where ζ is the bulk viscosity, θ the expansion factor defined by $\theta = 3\dot{a}/a$ and the projection tensor $H_{\mu\nu}$ is defined by $H_{\mu\nu} = g_{\mu\nu} + U_\mu U_\nu$ with $U_{\mu\nu}$ being the four velocity and fluid on the comoving coordinates p and ρ are pressure and density.

For the FRW model eq. (2.1) Einstein field equations are given by

$$\frac{3}{X^2}H^2 = \rho, \tag{2.4}$$

$$\dot{H} + H^2 = -\frac{X}{6}(\rho + 3\bar{p}), \tag{2.5}$$

where $X = 8\pi G$, $\bar{p}$ is an equivalent pressure defined by $\bar{p} = p - \zeta\theta$ and dot $(\dot{})$ stands for differentiation with respect to time.

3. Non-linear Inhomogeneous Equation of State and Its Solutions

In this section, we assume the non-linear inhomogeneous equation of state depending on time as given by Brevik *et al*. [1]

$$p = \omega(\rho)\rho + f(\rho) + \Lambda(t), \tag{3.1}$$

where $\omega(\rho) = b_0\rho^{\delta-1} - 1$ given by Myrzakul *et al*. [6] $f(\rho) = A\rho^{\alpha}$ and $\Lambda = \Lambda_0 H$.

Energy of conservation for a complete dynamics system is given by

$$\dot{\rho} + (\rho + \bar{p})\theta = 0, \tag{3.2}$$

where $\bar{p} = p - \zeta\theta$ is the effective pressure, $\zeta = \zeta_0 + \zeta_1 H$ and $\theta = 3H$.

By using eq. (3.1) and considering $\alpha = \frac{1}{2}$, then conservation eq. (3.2) becomes

$$\dot{\rho} = \sqrt{3}\zeta_1 X^3 \rho^{\frac{3}{2}} - (\sqrt{3}AX + \Lambda_0 X^2 - 3\zeta_0 X^2)\rho - \sqrt{3}b_0 X\rho^{\delta+\frac{1}{2}}. \tag{3.3}$$

We are unable to find out the solutions of above differential equation due to its non-linear behavior. Hence to solve this equation we consider the change of variable $\rho = Y^2$ with $\delta = -m$ where $m > 0$, gives

$$\dot{Y} + b_1 Y^2 + b_2 Y^{-2m} + b_3 Y = 0, \tag{3.4}$$

where $b_1 = \frac{-\sqrt{3}\zeta_1 X^3}{2}$, $b_2 = \frac{\sqrt{3}b_0 X}{2}$ and $b_3 = \frac{\sqrt{3}AX - 3X^2\zeta_0 + \Lambda_0 X^2}{2}$.

By using exponential function method given by Ganji and Kachapi [2], eq. (3.4) yields

$$Y = \frac{c_1 e^{-kt} + c_2 + c_3 e^{kt}}{e^{-kt} + C + c_4 e^{kt}}, \tag{3.5}$$

where c_1, c_2, c_3, c_4 and b are constants given by Ganji and Kachapi [2].

We get the energy density parameter of the form

$$\rho = Y^2 = \left[\frac{c_1 e^{-kt} + c_2 + c_3 e^{kt}}{e^{-kt} + C + c_4 e^{kt}}\right]^2. \tag{3.6}$$

In this case, when $C = 0$ and $k = 0$ then any dependence on time vanishes and the energy density ρ reduces to a constant and will be conserved during the time. The behavior of this energy density ρ as shown in Figure 1.

In the following, we find out the solutions non-linear eq. (3.3) for particular case $\delta = \frac{1}{2}$. In this case, the differential eq. (3.3) becomes

$$\dot{\rho} = \sqrt{3}X\rho^{\frac{3}{2}}\left[\zeta_1 X^2 - \left(A + \frac{\Lambda_0 X}{\sqrt{3}} - \sqrt{3}\zeta_0 X + b_0\right)\rho^{\frac{-1}{2}}\right]. \tag{3.7}$$

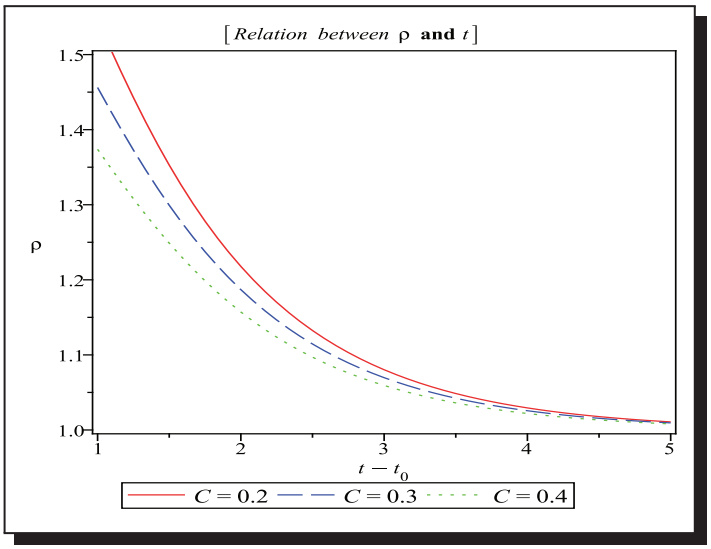

Figure 1. Time-dependent dark energy density with $C = 0.2$ and $c_1 = c_2 = c_3 = c_4 = 1$

After integrating eq. (3.7) we get the density parameter $\rho(t)$ as

$$\rho = \left[\frac{D_0}{\zeta_1 X^2 - \exp\left[D_0 \frac{\sqrt{3}Xt+D}{2}\right]}\right]^2, \tag{3.8}$$

where $D_0 = B - \sqrt{3}X\zeta_0 - A + \frac{\Lambda_0 X}{\sqrt{3}}$.

By using the field eq. (2.4) we get the Hubble parameter $H(t)$ as

$$H = \frac{X}{\sqrt{3}}\left[\frac{D_0}{\zeta_1 X^2 - \exp\left[D_0 \frac{\sqrt{3}Xt+D}{2}\right]}\right]. \tag{3.9}$$

The time derivative of $H(t)$ becomes

$$\dot{H} = \frac{X^2 D_0^3 \exp\left[D_0 \frac{\sqrt{3}Xt+D}{2}\right]}{2\left(\zeta_1 X^2 - \exp\left[D_0 \frac{\sqrt{3}Xt+D}{2}\right]\right)^2}. \tag{3.10}$$

If $\dot{H} > 0$, then the universe is accelerating and if $\dot{H} < 0$, then the universe is decelerating. In our case, we get $\dot{H} > 0$ i.e. universe is accelerating. It is well known that in the phantom phase if $\dot{\rho} > 0$, then the energy density grows and the universe is expanding and in non-phantom phase $\dot{\rho} < 0$ i.e. energy density decreases. In our case, if $t \to \infty$ then $H(t) \to 0$ and $\rho(t) \to 0$ so that phantom energy decreases. In this case, the cosmology singularity does not appear.

The scale factor $a(t)$ can take the following form

$$a(t) = \left[X^2\zeta_1 \exp\left[-\frac{D_0}{2}(\sqrt{3}Xt + D)\right] - 1\right]^{\frac{-2}{3X^2\zeta_1}}. \tag{3.11}$$

The derivative of scale factor is given by

$$\dot{a}(t) = \frac{D_0}{\sqrt{3}} X \exp\left[-\frac{D_0}{2}(\sqrt{3}Xt + D)\right]\left[X^2\zeta_1 \exp\left[-\frac{D_0}{2}(\sqrt{3}Xt + D)\right] - 1\right]^{-\left(\frac{2}{3X^2\zeta_1}+1\right)}. \tag{3.12}$$

The second derivative of scale factor is

$$\ddot{a}(t) = \dot{a}(t)\frac{D_0\sqrt{3}X}{2}\left[\frac{\frac{2}{3}\exp\left[-\frac{D_0}{2}(\sqrt{3}Xt+D)\right]+1}{X^2\zeta_1\exp\left[-\frac{D_0}{2}(\sqrt{3}Xt+D)\right]-1}\right]. \tag{3.13}$$

Here $\ddot{a}(t)=0$ for $t_1=\frac{2}{\sqrt{3}XD_0}\log\left(\frac{2}{3D}\right)$.

For this, it is observed that the for $t<t_1$, first and second derivative of scale factor $a(t)$ are both positive i.e. the universe expands with acceleration. While for $t>t_1$, first and second derivative of scale factor $a(t)$ are both negative i.e. universe expands with deceleration. The behaviour of energy density ρ, Hubble parameter $H(t)$ and the scale factor $a(t)$ are shown graphically in Figure 2, Figure 3 and Figure 4, respectively.

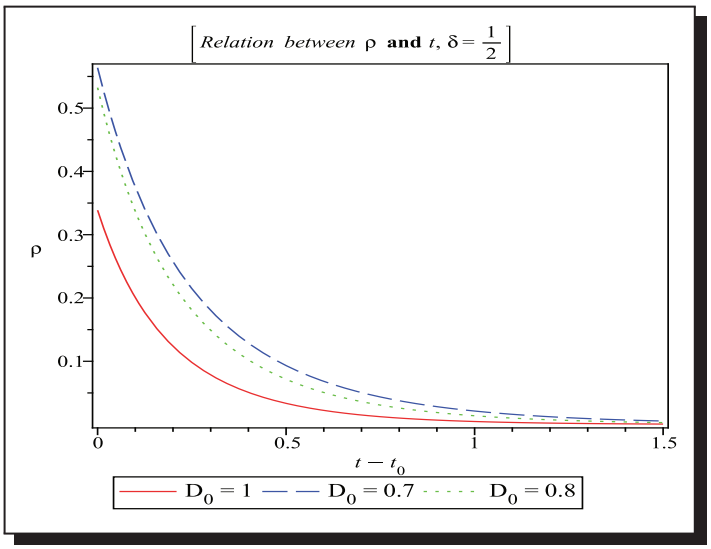

Figure 2. Time-dependent dark energy density with $D_0=\zeta_1=D=X=1$

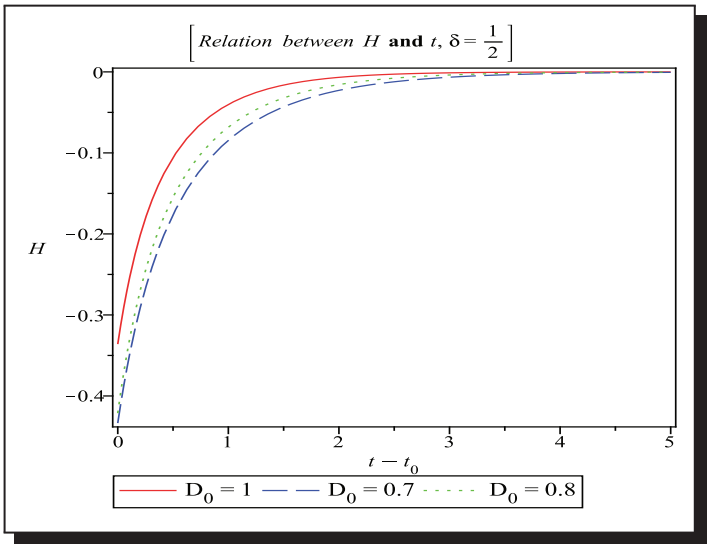

Figure 3. Hubble expansion parameter with $D_0=\zeta_1=D=X=1$

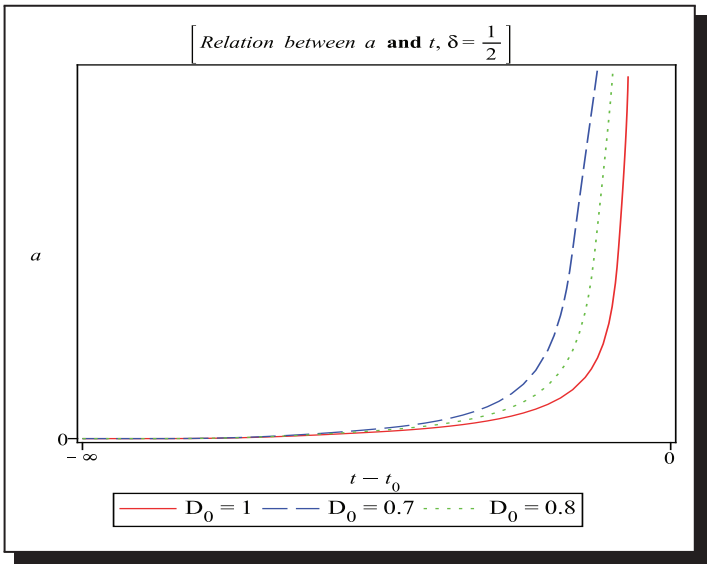

Figure 4. Scale factor with $D_0 = \zeta_1 = D = X = 1$

4. Sound Speed

There are several ways to discuss the stability of the model. In an acceptable model, the sound speed $c_s^2 = \frac{\partial \bar{p}}{\partial \rho}$ should be bounded by a constant, like the upper bound of light speed or approaches to a constant to a late time of the universe. In our case, the value of $\bar{p}$ is

$$\bar{p} = b_0\rho^{\delta} - (1-\zeta_1 X^2)\rho + \left(\frac{A+\Lambda_0-3\zeta_0}{\sqrt{3}}\right)X_0\rho^{\frac{1}{2}}. \tag{4.1}$$

Hence, the sound speed is given by

$$c_s^2 = \delta b_0\rho^{\delta-1} - (1-\zeta_1 X^2) + \frac{1}{2}\left(\frac{A+\Lambda_0-3\zeta_0}{\sqrt{3}}\right)X_0\rho^{\frac{-1}{2}}. \tag{4.2}$$

Using eq. (3.6) we get the sound speed as

$$c_s^2 = \delta b_0\left[\frac{c_1e^{-kt}+c_2+c_3e^{kt}}{e^{-kt}+C+c_4e^{kt}}\right]^{2\delta-2} - (1-\zeta_1X^2) + \frac{1}{2}\left(\frac{A+\Lambda_0-3\zeta_0}{\sqrt{3}}\right)X_0\left[\frac{c_1e^{-kt}+c_2+c_3e^{kt}}{e^{-kt}+C+c_4e^{kt}}\right]^{-1}. \tag{4.3}$$

For $\delta = \frac{1}{2}$, using eq. (3.8) and eq. (4.1), we get the sound speed as

$$c_s^2 = \frac{1}{2}\left[b_0 + \left(\frac{A+\Lambda_0-3\zeta_0}{\sqrt{3}}\right)X_0\right]\left[\frac{D_0}{\zeta_1X^2 - \exp\left[D_0\frac{\sqrt{3}Xt+D}{2}\right]}\right]^{-1} - (1-\zeta_1X^2). \tag{4.4}$$

Figure 5 and Figure 6 shows the behaviour of sound speed throughout the universe. From Figure 5 it is observed that the sound speed begins with positive value and approaches to a constant value. Thus, we get the stability throughout the universe. Figure 6 is the plot of square of sound speed versus cosmic time and shows that there is instability in future time.

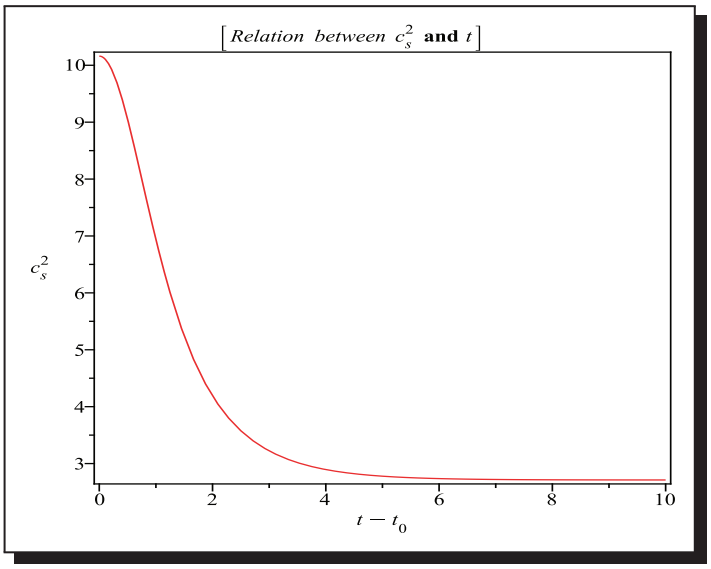

Figure 5. c_s^2 versus time t with $\delta = 3$, $b_0 = c_1 = c_2 = c_3 = c_4 = A = \zeta_1 = \Lambda_0 = \zeta_0 = X_0 = 1$ and $C = 0.2$

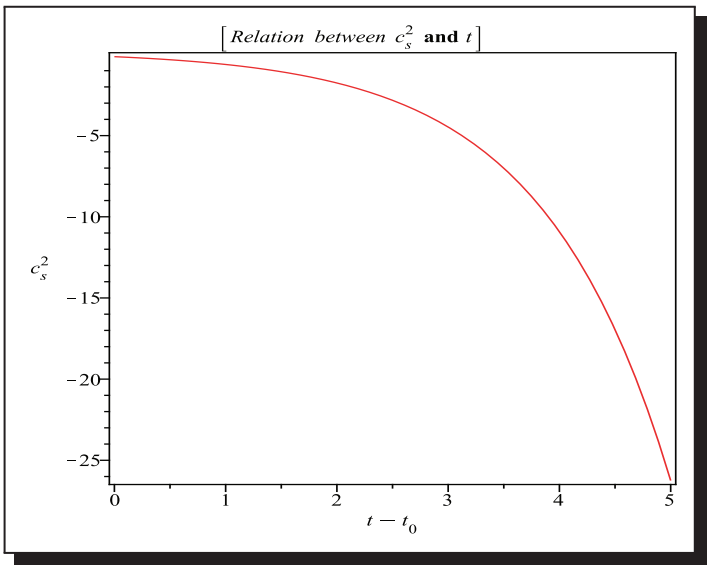

Figure 6. c_s^2 versus time t with $b_0 = A = \Lambda_0 = \zeta_0 = X_0 = D_0 = \zeta_0 = D = 1$

5. Conclusion

We have studied the cosmological model of the universe in which there is a non-linear inhomogeneous equation of state with equation of state parameter ω is of the form $\omega = b_0\rho^{\delta-1} - 1$. We find the complete description of evolutionary transition according to the value of scale factor $a(t)$ and its first, second derivative which characterized different types accelerating (for $\ddot{a} > 0$) and decelerating (for $\ddot{a} < 0$) expansion of the universe. The introduction of viscosity to the system yields to a non-linear differential equation which gives the time-dependent dark energy density. We solved this equation by using the exponential function method, and studied the behavior of dark energy density ρ, Hubble parameter $H(t)$ and the scale factor $a(t)$.

From eq. (3.6), it is observed that when $C = 0$ and $k = 0$ then any dependence on time vanishes and the energy density ρ reduces to a constant and it will be conserved during the time. On the other hand if $k > 0$ and $C = 1$, eq. (3.6) becomes

$$\rho = \left[\frac{c_1 e^{-t} + c_2 + c_3 e^{t}}{e^{-t} + 1 + c_4 e^{t}}\right]^2. \tag{5.1}$$

From this equation it is observed that when $t \to \infty$ then $\rho \to \infty$. Numerically, we draw energy density ρ in terms of time t as shown in Figure 1. In this case, the dark energy density is a decreasing function of time which agrees with expansion of universe. For different values of C we can show that the increase in parameter C, decreases the value of dark energy density.

For the case $\delta = \frac{1}{2}$, we get the energy density in the form of eq. (3.8). We have seen from Figure 2, that energy density ρ is decreasing function of time which agrees with expansion of the universe. We also noted that it begins with a positive value and recovers asymptotically to a constant value. The Hubble parameter of the model from eq. (3.9) starts at relatively small value and rapidly decreases to a constant value, followed by smooth evolution between -0.1 and 0 as plotted in Figure 3. From eq. (3.11), we draw the behavior of scale factor $a(t)$ verses time t. It is observed that there are two phases during the evolution: an exponentially inflationary scenario at the beginning of the universe followed by decelerating phase as shown in Figure 4. Similarly, from eq. (3.12) and eq. (3.13), it is seen that for $t < t_1$, first and second derivative of scale factor $a(t)$ both are positive i.e. the universe expands with acceleration, while for $t > t_1$, $\dot{a}(t) < 0$ and $\ddot{a}(t) < 0$ i.e. universe expands with deceleration.

From eq. (4.3) and eq. (4.4) we draw the behaviour of sound speed throughout the universe as shown in Figure 5 and Figure 6, respectively. From Figure 5 it is observed that the sound speed begins with positive value and approaches to a constant value. Thus, we get the stability throughout the universe. From Figure 6, we observed that there is instability.

Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

All the authors contributed significantly in writing this article. The authors read and approved the final manuscript.

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Research Article

Bianchi Type I Cosmological Model with Viscous Fluid in the Framework of VSL Theory

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Abstract. The Bianchi type I cosmological model in the framework of *Variable Speed of Light* (VSL) theory is investigated, by taking into account the effect due to viscosity, considering $\overline{p} = p - 3\zeta H$ where $\zeta = \zeta_0 \rho H^{-1}$. The Einstein field equations are solved for variable G, c and Λ in which G, c, Λ and shear parameter σ^2, all are coupled. It is shown that the viscosity term exhibits the influence on the form of solutions, in the framework of varying speed of light theory.

Keywords. VSL theory, Viscous fluid, Dark energy

Mathematics Subject Classification (2020). 83A05; 83C05; 83C15; 83C56

1. Introduction

The *Varying Speed of Light* (VSL) cosmology has been received considerable attention as alternatives to cosmological inflation to provide different basics for resolving the problems of the standard models. Albrecht and Magueijo [1] have investigated possible consequences of a time variation in the velocity of light in vacuum. In particular, it offers new ways of solving the problems of the standard big bang cosmology, distinct from their resolutions in context of

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the inflationary paradigm (Guth [6]) or the pre big bang scenario of low energy string theory (Veneziano [10]). However, a new approach, which has been widely investigated (Kalligas *et al*. [7]), is appealing. In the relativistic cosmological models, generally the energy momentum tensor of matter generated by perfect fluid is considered. For approaching to more realistic model, the consideration of effect of viscosity mechanism is important. In the present paper, we have extended our previous work, Khadekar and Ghogre [8], by introducing a viscosity term as $\bar{p} = p - 3\xi H$.

2. Model and Field Equations

We consider the Bianchi type I space-time with metric

$$ds^2 = -c^2(t)dt^2 + X^2(t)dx^2 + Y^2(t)dy^2 + Z^2(t)dz^2 \tag{2.1}$$

in the comoving co-ordinates $u^i = \delta^i_0$. An average expansion scale factor is defined by $R(t) = (XYZ)^{\frac{1}{3}}$ and the Hubble parameter is $H = \frac{\dot{R}}{R}$. Here G, c and Λ are considered as functions of cosmic time t. We use the field equations in the form

$$R_{ij} - \frac{1}{2}Rg_{ij} = \frac{8\pi G(t)}{c^4(t)}T_{ij} + \Lambda(t)g_{ij}, \tag{2.2}$$

where R_{ij} is the Ricci tensor and R is Ricci scalar. For the physical interpretation of the model, the energy momentum tensor is defined as $T_{ij} = (\rho + \bar{p})u_i u_j + \bar{p}g_{ij}$, where ρ is the energy density, p is the pressure of the cosmic fluid and $\bar{p} = p - 3\xi H$. Here ξ is a viscosity term. We consider viscosity coefficient (Sheykhi and Setare [9]) as $\xi = \xi_0 \rho H^{-1}$, where ξ_0 is constant. As per the procedure given by Belinchón [3], for the metric (2.1), the Einstein field equations can be written as:

$$\frac{\dot{X}\dot{Y}}{XY} + \frac{\dot{Y}\dot{Z}}{YZ} + \frac{\dot{Z}\dot{X}}{ZX} = \frac{8\pi G\rho}{c^2} + \Lambda c^2, \tag{2.3}$$

$$\frac{\ddot{X}}{X} + \frac{\ddot{Y}}{Y} + \frac{\dot{X}\dot{Y}}{XY} - \frac{\dot{c}}{c}\left(\frac{\dot{X}}{X} + \frac{\dot{Y}}{Y}\right) = \frac{-8\pi G\bar{p}}{c^2} + \Lambda c^2, \tag{2.4}$$

$$\frac{\ddot{Y}}{Y} + \frac{\ddot{Z}}{Z} + \frac{\dot{Y}\dot{Z}}{YZ} - \frac{\dot{c}}{c}\left(\frac{\dot{Y}}{Y} + \frac{\dot{Z}}{Z}\right) = \frac{-8\pi G\bar{p}}{c^2} + \Lambda c^2, \tag{2.5}$$

$$\frac{\ddot{Z}}{Z} + \frac{\ddot{X}}{X} + \frac{\dot{Z}\dot{X}}{ZX} - \frac{\dot{c}}{c}\left(\frac{\dot{Z}}{Z} + \frac{\dot{X}}{X}\right) = \frac{-8\pi G\bar{p}}{c^2} + \Lambda c^2. \tag{2.6}$$

The shear tensor σ_{ij} is defined as

$$\sigma_{ij} = \frac{1}{2}\left(u_{i;j} + u_{j;i} + q_i u_j + q_j u_i\right) - \frac{1}{3}\vartheta h_{ij}, \tag{2.7}$$

where $\vartheta = u^k{}_{;k}$, $h_{ij} = g_{ij} + u_i u_j$ and $q_i = u_{i;j}u^j$.
The magnitude $\sigma^2 = \frac{1}{2}\sigma^{ij}\sigma_{ij}$ is obtained as

$$\sigma^2 = \frac{1}{6c^2}\left[\left(\frac{\dot{X}}{X} - \frac{\dot{Y}}{Y}\right)^2 + \left(\frac{\dot{Y}}{Y} - \frac{\dot{Z}}{Z}\right)^2 + \left(\frac{\dot{Z}}{Z} - \frac{\dot{X}}{X}\right)^2\right]. \tag{2.8}$$

Using equations (2.4)-(2.6) we get,

$$\left(\frac{\dot{Z}}{Z}-\frac{\dot{X}}{X}\right)^2+\left(\frac{\dot{X}}{X}-\frac{\dot{Y}}{Y}\right)^2+\left(\frac{\dot{Y}}{Y}-\frac{\dot{Z}}{Z}\right)^2=\frac{3\alpha_1^2c^2}{(XYZ)^2}, \tag{2.9}$$

where α_1 is constant. By using eq. (2.8) and (2.9), we get $\sigma^2=\frac{\alpha_1^2}{2(XYZ)^2}$. Hence $\sigma^2\propto R^{-6}$ or $\sigma=\alpha_2R^{-3}$, where α_2 is proportionality constant. Thus, we get

$$\frac{\dot{\sigma}}{\sigma}=-\left(\frac{\dot{X}}{X}+\frac{\dot{Y}}{Y}+\frac{\dot{Z}}{Z}\right)=-3H. \tag{2.10}$$

Squaring, we get

$$H^2=\frac{1}{9}\left[\frac{\dot{X}^2}{X}+\frac{\dot{Y}^2}{Y}+\frac{\dot{Z}^2}{Z}+\frac{2\dot{X}\dot{Y}}{XY}+\frac{2\dot{Y}\dot{Z}}{YZ}+\frac{2\dot{Z}\dot{X}}{ZX}\right]. \tag{2.11}$$

From eqs. (2.3), (2.8) and (2.11), we can write the analogue of Friedman equation as

$$3H^2=c^2(\sigma^2+\Lambda)+\frac{8\pi G\rho}{c^2}. \tag{2.12}$$

Differentiating eq. (2.3) and using eq. (2.4)-(2.6) in it, we get the conservation equations as:

$$\frac{8\pi G}{c^2}\left[\dot{\rho}+3(p+(1-3\xi_0)\rho)H\right]=\frac{-8\pi\rho}{c^2}\left[\dot{G}-\frac{4\dot{c}}{c}G\right]-c^2\dot{\Lambda}. \tag{2.13}$$

We assume that the conservation of energy momentum tensor of matter holds. i.e. $T^j_{i;j}=0$, which implies

$$\dot{\rho}+3(p+(1-3\xi_0)\rho)H=0. \tag{2.14}$$

Hence we get the relation between G and Λ as

$$\frac{8\pi\rho}{c^2}\left[\dot{G}-4G\frac{\dot{c}}{c}\right]+c^2\dot{\Lambda}=0. \tag{2.15}$$

Assuming $p=\omega\rho$, eq. (2.14) leads to the relation as $\rho=\alpha_3R^{-3(1+\omega-3\xi_0)}$, where α_3 is constant of integration. Using this value of ρ in eq. (2.15), we get

$$\dot{G}-\frac{4\dot{c}}{c}G=-\frac{c^4\dot{\Lambda}R^{3(1+\omega-3\xi_0)}}{8\pi\alpha_3}. \tag{2.16}$$

Now using H^2 from eq. (2.11) in eq. (2.14), it becomes

$$\frac{\dot{\rho}^2}{\rho^3}=3(1+\omega-3\xi_0)^2\left[\frac{8\pi G}{c^2}+\frac{c^2\sigma^2}{\rho}+\frac{c^2\Lambda}{\rho}\right]. \tag{2.17}$$

Differentiating eq. (2.17), and then putting the value of $\dot{\Lambda}$ from eq. (2.15), the value of $\dot{\sigma}$ from eq.(2.10) and $\dot{\rho}$ from eq. (2.14), in the R.H.S. of the resultant equation, we get

$$\frac{2\ddot{\rho}}{\rho}-\frac{3\dot{\rho}^2}{\rho^2}=3c^2(1+\omega-3\xi_0)^2\left[\sigma^2\left(\frac{1-\omega+3\xi_0}{1+\omega-3\xi_0}\right)-\Lambda\right]+\frac{2(1+\omega-3\xi_0)}{H}\frac{\dot{c}}{c}\left[\frac{8\pi G\rho}{c^2}+c^2(\sigma^2+\Lambda)\right]. \tag{2.18}$$

The early highly anisotropic universe is reduced to a smooth present universe during the physical processes. These physical processes are also responsible for bringing down the large value of Λ to its small present value. Hence there must be some relation between the two parameters $\sigma^2$and Λ. Hence we choose Λ such that the R.H.S. of above equation becomes zero,

i.e.,

$$3c^2(1+\omega-3\xi_0)^2\left[\sigma^2\left(\frac{1-\omega+3\xi_0}{1+\omega-3\xi_0}\right)-\Lambda\right]-\frac{2(1+\omega-3\xi_0)}{H}\frac{\dot{c}}{c}\left[\frac{8\pi G\rho}{c^2}+c^2(\sigma^2+\Lambda)\right]=0. \tag{2.19}$$

Here we consider $\frac{G}{c^2}$ as a constant α_0, (Belinchón [4]), $c=c_0R^n$ (Barrow [2]) and value of ρ as $\rho=\alpha_3R^{-3(1+\omega-3\xi_0)}$ in eq. (2.10), where c_0 is constant, we get

$$\alpha_4\sigma^2-\alpha_5\Lambda=AR^{-\alpha_5}, \tag{2.20}$$

where $\alpha_4=3-3\omega+9\xi_0-2n$, $\alpha_5=3+3\omega-9\xi_0+2n$, $A=\frac{16n\pi\alpha_0\alpha_3}{c_0^2}$. Using the value of R from $\sigma^2\propto R^{-6}$ or $\sigma=\alpha_2R^{-3}$, we solve eq. (2.20) to get the value of Λ as:

$$\Lambda=B_1\sigma^2A_1\sigma^{\frac{-\alpha_5}{3}} \tag{2.21}$$

where $B_1=\frac{\alpha_4}{\alpha_5}$, $A_1=\frac{A}{\alpha_5(\alpha_1)^{\frac{\alpha_5}{3}}}$. Using this value of Λ in eq. (2.18), we get $\frac{2\ddot{\rho}}{\dot{\rho}}=\frac{3\dot{\rho}}{\rho}$, after solving which we get,

$$\rho=Dt^{-2}, \tag{2.22}$$

where $D=\frac{4}{d_2^2}$ and d_2 is constant of integration. Using ρ from $\rho=\alpha_3R^{\frac{-3(1+\omega)}{1+3\xi_0}}$ and eq. (2.22), we get the scale factor R as

$$R=at^{\frac{2}{3(1+\omega-3\xi_0)}}, \tag{2.23}$$

where $a=\frac{\alpha_3(d_2)^2}{4}$. By using the value of R from the above in eq. (2.10), we get

$$\sigma=B_3t^{\frac{-2}{(1+\omega-3\xi_0)}}, \tag{2.24}$$

where $B_3=\frac{d_0}{a^3}$.

Using this value in eq. (2.21), we get the value of Λ as:

$$\Lambda=B_4t^{\frac{-4}{(1+\omega-3\xi_0)}}-B_5t^{\frac{-2(3+3\omega-9\xi_0+2n)}{3(1+\omega-3\xi_0)}}, \tag{2.25}$$

where $B_4=B_1B_3^2$ and $B_5=A_1B_3^{\frac{\alpha_5}{3}}$. Substituting this value of Λ in eq. (2.16), and then solving the resultant linear differential equation in G, we get

$$G=G_0t^{\frac{-8n}{3(1+\omega-3\xi_0)}}\left[B_6t^{\frac{-2(1-\omega+3\xi_0)+4n}{(1+\omega-3\xi_0)}}+B_7t^{\frac{2(3+3\omega-9\xi_0)+8n}{3(1+\omega-3\xi_0)}}\right], \tag{2.26}$$

where $B_6=\frac{B_4C_0^4(1+\omega-3\xi_0)a^{3+3\omega-9\xi_0+4n}}{4\pi\alpha_3(1+\omega-3\xi_0)(1-\omega+3\xi_0)}$, $B_7=\frac{B_5\alpha_5C_0^4(1+\omega-3\xi_0)a^{3+3\omega-9\xi_0+4n}}{8\pi\alpha_3(3+3\omega-9\xi_0-\alpha_5)}$, G_0 is constant of integration. Also using $q=-\frac{R\ddot{R}}{\dot{R}^2}$ we get the deceleration parameter as

$$q=\frac{1+3\omega-9\xi_0}{2}. \tag{2.27}$$

3. Conclusion

We have extended the previous work of Vishwakarma [11] in the framework of VSL theory proposed by Albrecht and Magueijo [1], by taking into account the viscosity mechanism. The effect of variable c on the dynamics and the evolution of Bianchi type I universe is essentially determined by G, c and Λ. Observational existence of the variation of the speed of light seems to be suggested by the variation of the fine structure contact in the spectra of quasars

(Drinkwater *et al*. [5], and Webb *et al*. [12]). Here we have obtained the solutions for Bianchi type I cosmological model, for the viscous fluid by considering $\bar{p} = p - 3\xi H$, where ξ is the viscosity coefficient defined as $\xi = \xi_0 \rho H^{-1}$. We have obtained solutions of the field equations under the assumption that $\frac{G}{c^2} = \alpha_0 = constant$ and varying speed of light c is proportional to the expansion rate of the universe i.e. $c_0 R^n$, where c_0, n are constants. The resultant equations (2.23)-(2.26) clearly exhibit the essential influence of the viscous term on the values of σ, Λ and G. For $\xi_0 = 0$, the values of cosmological constants approach to the results discussed earlier in Khadekar and Ghogre [8]. From this study of the Bianchi I model, it is observed that such models are compatible with the results of recent observations.

Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

All the authors contributed significantly in writing this article. The authors read and approved the final manuscript.

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Evaluation of the Effect of Cranioplasty Using Different Prosthetic Materials on Functional Improvement in Patients with Post-traumatic Brain Injury: A Protocol

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Study Protocol

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ABSTRACT

Background: Cranioplasty is considered an essential step for restoring defects in the skull, generally due to the esthetic appearance, safety of the brain, or handling the adverse effect of the Trephined Syndrome (TS) or sinking skin flap syndrome. Moreover, many studies saw the unexpected enhancement of cognitive and motor function after cranioplasty. These favorable progressive effects can be helpful in further therapy preparations in association with cranioplasty effects. Nevertheless, the proof is mainly restricted to case studies that do not target comparison between different materials in post-traumatic brain injury (P-TBI) people even though it is helpful

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but not enough.
Objectives: To comparatively evaluate the effect of cranioplasty using autologous bone graft, polymethylmethacrylate (PMMA), titanium, and bone cement on cognitive and functional improvement in patients with P-TBI.
Methodology: 40 subjects will be allocated into four groups. Group A (10 using Autologous bone graft) Group B (10 using PMMA), Group C (10 using Titanium), and Group D (10 using Bone cement). Glasgow Coma Scale (GCS) and Mini-Mental State Examination (MMSE) will be used for cognitive improvement. For functional improvement, Muscle power and Barthel index will be used. The data will be compared before and after cranioplasty.
Expected Results: Cognitive and functional improvement will be present after cranioplasty. But the effect of cranioplasty using autologous bone graft, polymethylmethacrylate (PMMA), titanium, and bone cement has to be evaluated & compared to assess the patient's cognitive and functional improvement and provide desired intervention as required.
Conclusion: This study will comparatively evaluate the effect of cranioplasty using different prosthetic materials and determine which material is better for patients' cognitive and functional improvement.

Keywords: Cranioplasty; functional improvement; cognitive improvement; PMMA; cranial reconstruction.

1. INTRODUCTION

Decompressive craniectomy (DC) is a preliminary surgical technique that reduces the intracranial pressure for traumatic brain injury patients. DC followed by cranioplasty is regularly conducted everywhere to re-establish the protective barrier and esthetic appearance. It is not only related to enhanced cognitive outcomes but also neurological function [1,2].

The best material used in cranial renovation should be infection-resistant, easier to obtain, biocompatible, inexpensive, and malleable to fit defects. Various materials are used to rebuild cranial defects with different advantages and disadvantages. Autologous bone has always been considered a gold standard in cranioplasty since it mainly accomplishes all the necessities of the perfect restoration material [3]. A distinctive and frequent complication observed after autologous bone cranioplasty is the resorption of bone flap, which could lead to reconsideration of surgery followed by replacing with alloplastic material. And many times, the autologous bone flap is not available for cranioplasty. Hence, the need for searching for an ideal material for cranioplasty was the purpose of this study [3].

Numerous resources are considered that can be used as a substitute to avoid the resorption of the flap of bone and morbidity of the donor region. Polymethyl methacrylate (PMMA) is one of the oldest materials utilized in cranioplasty due to its lightness, strength, heat resistance, and malleability [3].

Titanium mesh is an alloplastic frequently utilized in cranioplasty due to its decent mechanical strength, negligible infection rate, and economic reasons. Also, newer titanium mesh is available, which is prefabricated with the help of 3-D CBCT, which provides a significant esthetic look [4]. However, titanium mesh also has some shortcomings, like patients showing metal allergies, and therefore substitute materials must be found out [5]. Cranioplasty is considered an essential step for restoring defects in the skull, generally due to the esthetic appearance, the safety of the brain, or handling the adverse effect of the trephined syndrome (TS) or sinking skin flap syndrome. Moreover, many studies saw the unexpected enhancement of cognitive and motor function after cranioplasty [6]. These favorable progressive effects can be helpful in further therapy preparations associated with cranioplasty effects. Nevertheless, the proof is mainly restricted to case studies that do not target comparison between materials in people with post-traumatic brain injury(P-TBI) [6]. So, the present study is conducted to evaluate and compare the effect of cranioplasty using different prosthetic materials on cognitive and functional improvement in patients with post-traumatic brain injury.

1.1 Aim

To comparatively evaluate the effect of cranioplasty using different prosthetic materials on cognitive and functional improvement in patients with post-traumatic brain injury.

1.2 Objectives

- To comparatively evaluate the effect of cranioplasty using autologous bone graft on cognitive and functional improvement in patients with post-traumatic brain injury
- To comparatively evaluate the effect of cranioplasty using polymethylmethacrylate (PMMA) on cognitive and functional improvement in patients with post-traumatic brain injury
- To comparatively evaluate the effect of cranioplasty using titanium on cognitive and functional improvement in patients with post-traumatic brain injury
- To comparatively evaluate the effect of cranioplasty using bone cement on cognitive and functional improvement in patients with post-traumatic brain injury

2. METHODOLOGY

2.1 Study Design

It is a type of retrospective cross-sectional study conducted in six months.

2.2 Sample Size Calculation

With the significance level at 5%, i.e., 95%, and a confidence interval of 1.96, a sample size of 35.70 was obtained. Four samples will be placed considering a 5% loss to follow up. Thus, a total sample size of 40 cranioplasty patients will be considered for the proposed study.

2.3 Patient Selection

2.3.1 Inclusion criteria

- Trauma patients who have undergone cranioplasty
- Age group 18-60 yrs.

2.3.2 Exclusion criteria

- Patients who were physically or cognitively unstable.
- Patients who have systematic conditions

Sample size: 40 (10 PER GROUP)

Participants: Four groups are made:

Group A: Cognitive and functional improvement in patients using autologous bone graft.

Group B: Cognitive and functional improvement in patients using polymethylmethacrylate (PMMA).

Group C: Cognitive and functional improvement in patients using titanium.

Group D: Cognitive and functional improvement in patients using bone cement.

Data collection tool: Digitalized patient database.

2.4 Assessment

A retrospective cross-sectional study will be performed in the Department of Prosthodontics of Sharad Pawar Dental College (SPDC) along with the Neurosurgery Department of Jawaharlal Nehru Medical College (JNMC) affiliated Acharya Vinobha Bhave Rural Hospital (AVBRH). Atleast40 people who have suffered from P-TBI and have undergone cranioplasty using Autologous bone graft, PMMA, Titanium, or Bone cement from January 2015 to November 2020 will be included in this study.

The subjects will be allocated into four groups. Group A will comprise 10 subjects using Autologous bone graft, Group B will comprise 10 subjects using PMMA, Group C will comprise ten subjects using Titanium, and Group D will comprise ten subjects using Bone cement.

All the information will be gathered from the digitalized patient database from the Dept. of Neurosurgery of Acharya Vinoba Bhave Rural Hospital (Sawangi, Meghe) and old files and documents from the Medical Record Department (MRD).

To compare the effect of cranioplasty on ‘cognitive improvement’ using different prosthetic materials, we will use the cognitive function tests including ‘Glasgow Coma Scale (GCS)’ and ‘Mini-Mental State Examination (MMSE).’ Similarly, to check the ‘functional improvement,’ we will use the functional tests including ‘Muscle power’ and ‘Barthel index.’ The attending physician will calculate the score for all the scales and indexes.

Furthermore, we will compare the data before and after cranioplasty to analyze the effect of cranioplasty using different prosthetic materials on cognitive and functional improvement in patients.

2.5 Statistical Analysis

Statistical analysis will be performed using inferential & descriptive statistics where $p<0.05$ is considered the level of significance. Software executed in the analysis will be SPSS 21.0 & Graph Pad Prism 7.0 version. Intergroup comparison will be made using One-way Analysis of variance (ANOVA) with Post-Hoc Tukey test & intragroup comparison will be made using paired t-test.

2.6 Expected Outcomes

The effect of cranioplasty using autologous bone graft, polymethylmethacrylate (PMMA), titanium, and bone cement would be evaluated & compared to assess the patient's cognitive and functional improvement propose a desired intervention for such patients. A cognitive and functional improvement would be present after cranioplasty since it can recover the cognitive discrepancies possibly by reversing the physiological mechanisms including intracranial pressure (ICP), alterations of the cerebral-spinal fluid (CSF) circulation, glucose metabolism, cerebral blood flow (CBF), and, ultimately the Volume Transmission (VT) signal communication [7].

3. DISCUSSION

A retrospective study was conducted by J. M. Joffe et al. [8] of 66 titanium cranioplasties to determine the consequence of management in subjects given titanium prostheses. They concluded that titanium is a brilliant material when concerned with cranioplasty, mainly due to its specialized preparation technique [8]. Mahy Eldin Ibrahim et al. (2015) compared to repair of skull defects with titanium mesh and methyl methacrylate. They found that cranioplasty is relatively safe and gives a satisfactory cosmetic reconstruction alternative and leads to improvement in neurological function. They also stated that although PMMA is more economical and easy to mold than titanium, it has a greater risk of causing infection to the patient [9].

Swetet Al Ulkar et al. (2020) published multiple case-reports regarding restoration of the defect and gaining psychological confidence in the individuals [10]. One unique technique was used in this case-report which demonstrated the use of bone cement in conjunction with PMMA [10]. In this technique, the bone cement was mixed in proper proportions, due to which there was a change in its consistency from luting to dough stage. This was molded and applied on top of the PMMA prosthesis intra-operatively on the junction between the prosthesis and bone. During the setting of the bone cement there is an exothermic reaction due to which heat dissipates. Hence, in order to reduce this effect, the layer of bone cement must be lesser than 5mm. The main advantage of this alloplastic material is that it gets reabsorbed as well as substituted by human bone [10]. This study stated that restoration of the neurological deficits with prosthesis acts as a protective shell as well as enhances the neurological status of the individual [10]. The objective of cranioplasty is to aesthetically rehabilitate the defect as well as provide relief to the psychological problems. This enhances the individual's acceptance in society and various activities [10].

Cristina Di Stefano et al (2012) performed a study with multiple case-reports to assess the consequence of cranioplasty on motor and cognitive functions in patients with severe brain-injury. They found a descent of motor function as well as neuropsychological discrepancies before cranioplasty which was followed by a succeeding unanticipated development in the functional activity after cranioplasty. They concluded that the restoration of the skull defect can generate a relevant enhancement in neurological function in motor as well as cognitive provinces [11]. Stephen Honeybul et al (2013) described a study for evaluating alterations in neurological functioning after cranioplasty. They accomplished that minor yet substantial amount of individuals appeared to recover considerably after cranioplasty due to enhancement of their motor functioning [12].

Nela Jelcic et al (2013) conducted a study depicting case-reports of 5 individuals having a large P-TBI, which had undergone cranioplasty from 1-3 yrs after initial trauma. Neurological and brain MRI studies were conducted before and 12 weeks after cranioplasty. They determined that cranioplasty has the ability to recover the neurological function even when conducted after an extended span of period from craniectomy, probably due to reversing of the physiological mechanisms and thereby reestablishing the VT signal communication [7]. Jyong-Huei Su et al (2017) accomplished that during in-patient therapy, enhancement of quality of life and neurological activity is perceived due to intervention with cranioplasty. This is useful in formulating rehabilitation approach in extreme

traumatic brain-injury individuals, that will mostly help in improvement in cognitive and functional domains subsequent to cranioplasty [6].

A study was performed by Byung Wook Kim et al (2017) in which they concluded that early cranioplasty following craniectomy in TBI individuals can be useful in restoring cognitive deficits, particularly language ability, movement as well as orientation of these individuals [13]. Adilson Jose Manuel de Oliveira et al (2019) in their experiment assessed the connection amongst cranioplasty and enhancement of vision which was not known earlier. There were no former studies of enhancement of vision following cranioplasty, excluding the cases with optic nerve decompression. The study demonstrated that the enhancement of the individual was due to the stabilization of the intracranial pressure. This study depicted the significance of cranioplasty in association with the functional improvement of the patient. So, further research should be carried out to investigate into this field [14]. A number of studies on related aspects of trauma and brain injury were reported [15-17]. Related studies by Sheikh et al. [18], Kakani et. al. [19] and Abbafati et al. [20] were reviewed.

So various studies have been conducted which shows a significant improvement in the neurological function of the patient. But there is limited data available regarding the comparison between various materials that might improve the neurological outcome.

4. SCOPE

The current study will help in identifying the success of cranioplasty in neurological functioning by using specific material. This might help the clinician to choose a particular material for better cognitive and functional neurological outcome. In cumulation, this will play a key role for the prosthodontist in deciding the type of material and also to the neurophysician for determining the treatment plan of the patient. Since there are many mortalities due to traumatic brain injury in Central India, this study would provide a great insight in the field of maxillofacial prosthodontics.

5. LIMITATION

Apart from being a unique study, the proposed sample size is small in comparison to the huge prevalence of the deformity. Thus, studies with greater sample size will be required in future to give a statistically significant outcome. Also, the study is not a case-controlled trial since there are very limited studies available about these. So, further research must be carried out in continuation of this study.

6. CONCLUSION

Conclusion will be drawn based on the study.

ETHICAL APPROVAL AND CONSENT

The study approval has been acquired from the IEC (Institutional Ethical committee) Ref no–DMIMS (DU)/IEC/2020-21/53 dated 30/01/2021. The subjects involved will be informed of the study, and written consent will be obtained from the subjects before starting the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Fractional chaotic maps based short signature scheme under human-centered IoT environments

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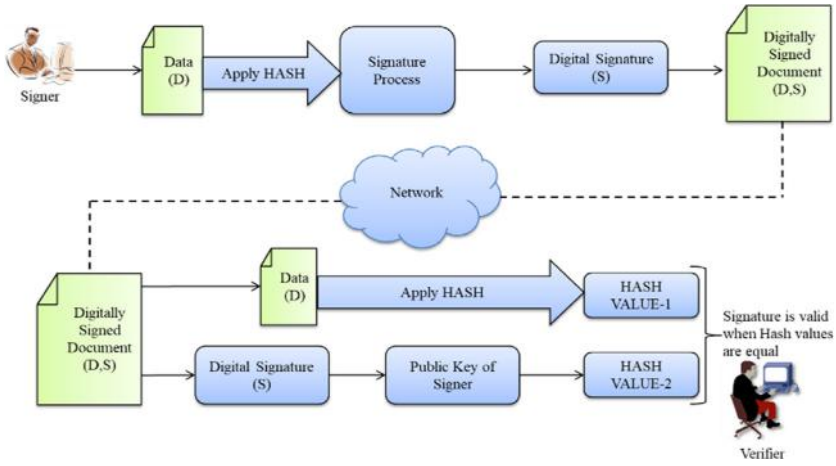
GRAPHICAL ABSTRACT



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ABSTRACT

Introduction: The Internet of Things (IoT) comprises of various smart devices for the sharing of sensed data through online services. People will be directly contacted to check their health parameters and the reports will be collected centrally through smart devices. The requirement is protection of messages during the exchange of data between sender and receiver in order to tackle human malicious attacks. Various signature-based schemes are discussed in the literature to provide secure communication.

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Smart devices however require lightweight tasks by ensuring critical safety strengths. An important problem in the signature based method is that it incurs more computational expenses for signing and verification process in large numbers.

Objectives: In this study, we introduced an efficient Short Signature Scheme (SSS) that uses Fractional Chaotic Map (FCM) for secure communication in IoT based smart devices, the security of which is closely related to a random oracle based on FCM assumption.

Methods: In this study, we have designed new short signature scheme using FCM. The presented scheme consist of four sub-algorithm as follows: setup, key generation, signing and verification. We have used less rigorous operations based on the FCM to carry out signing and verification procedures, similar to human signing on valid documents and then verifying them as per witness.

Results: The proposed SSS offers a better security assurance than currently established signature schemes. The key advantage of the SSS over the DSA schemes is that at the verification stage and signing period it takes less computation; it retains the degree of protection. The presented SSS takes less bandwidth for storage, communication, and computing resources; particularly applicable to wireless devices and smart cards.

Conclusion: We concluded that the uses of fractional chaotic maps is more effective for secure communication in human-centered IoT to present a provably secure short signature technique.

Introduction

In this era of the Internet of Things (IoTs), in which various device types are connected to the Internet. Such devices can be household appliances, agricultural equipments, manufacturing, energy meter, industrial machinery, healthcare monitoring machinery, mining sensors, surveillance system, environmental equipment, smart grids and smart city, etc. which includes Machine-to–Machine model. With the advent of IoT enable devices, monitoring or control of various types of systems on the tips of the fingers has become very easy. IoT devices are smart enough to share and exchange data for cloud storage over a public internet. IoT is an effective method for applying to domain varieties and proves the vital function by providing substantial advantages.

Some acknowledged literature are [1–8], the application of IoT witness in various domains ranging from manufacturing automation to healthcare. Moreover, every attempt is made to improve hardware interfaces, software, improved communication, and less focus is on user interaction and experience, and protection and privacy policies. This means, less significance is given to human related Internet of Things. Subsequently, we investigate human-centered IoT enabled device to offer more preference to human viewpoint in technology. Human-centered IoT is an upcoming filed of research connects to various aspects of life includes smart cards, e-commerce, business, healthcare, and sensitive private data. That means, the human-related Internet of Things is given less significance. Subsequently, we have investigated devices enabled by human-centered IoT to offer more preference in technology to the human viewpoint. Human-centered IoT is an upcoming field of research connected to various aspects of life that includes smart cards, e-commerce, business, healthcare, and sensitive private data. Nonetheless, the design of human-centered IoT [9] offers many opportunities and challenges. Thus, it not only is focuses on IoT system performance, integration, communication and interoperability, but more emphasis is placed on user application features, user need, and human-centered IoT motivation (see Fig. 1).

Smart factories have emerged as a result of the Industry 4.0 revolution and are capable of intelligently managing data produced from the overall production system [10]. Tracking or labeling of items or objects in this scenario is often achieved by RFID tags, QR codes, and barcodes named as labels or tags. The challenges are the incorporated of too many practices in an IoT-centric human world. So we have to address all these challenges to build productive 4.0 industry with human centric applications using smart labels. We are witnessing that human participation in human-centered IoT-based applications in which the design approach adopted focuses less on devices and more on the human-centered [11,12]. In human-centered IoT, information is exchanged over the public communication channel through various devices. Thus, fraudulent practices occur to steal or change the information. Because of this, the major challenge is preserving confidentiality and privacy during transmission time. Hence, for information exchange, we need more effective and reliable security mechanism. IoT systems are resource-constrained and heavy computing resources lose out. Radwan et al. [13] presented the concept of the synchronization with active control technique of different fractional order chaotic systems. Based on the switching parameters, four different cases of synchronization are also introduced. Ibrahim et al. [14] discussed some symmetric conformable fractional derivatives of complex variables for fractional chaotic maps generalizations. The standard DSA such as RSA [15], ElGamal [16], ECDSA [17], and bilinear pairing [18] are therefore not necessary to apply. We need a quick and lightweight short-size signature security scheme for IoT. It does, however, take time to check the bilinear maps used by the short-signature schemes based on pairing. Moreover, such short signature schemes are not as computationally efficient as the signature schemes of the DSA-type. Hence the storage capacity of pairing-based signatures comes at the expense of losing computational performance. Vaidyanathan et al. [19] introduced a novel 3D jerk chaotic system with one-quadratic nonlinearity and two-cubic nonlinearities designed to produce complex chaotic signals, and addressed voice encryption applications. Vaidyanathan et al. [20] proposed a new model of hyperchaotic temperature fluctuations and described its modeling, and also discussed the characteristics of the new model of hyperchaotic temperature fluctuations, such as its phase portraits, rest points, symmetry, invariance, characteristic exponents of Lyapunov, bifurcation analysis etc. Explain it for image encryption application just briefly. Mobayen et al. [21] introduced 3-D chaotic system with a closed equilibrium point curve, which has the form of a boomerang and modeled the theoretical system's electronic circuit implementation to test its feasibility. Also addressed the sound encryption applications.

A short signature scheme using a chaotic map is more efficient and costs less in terms of computation. Consequently, we have adopted chaotic maps for human-centered IoT's proposal for a short signature security scheme. Chaotic maps are used in [22] to introduce the authentication scheme for ID-based digital signature. Schemes security promise based on the assumptions of chaotic

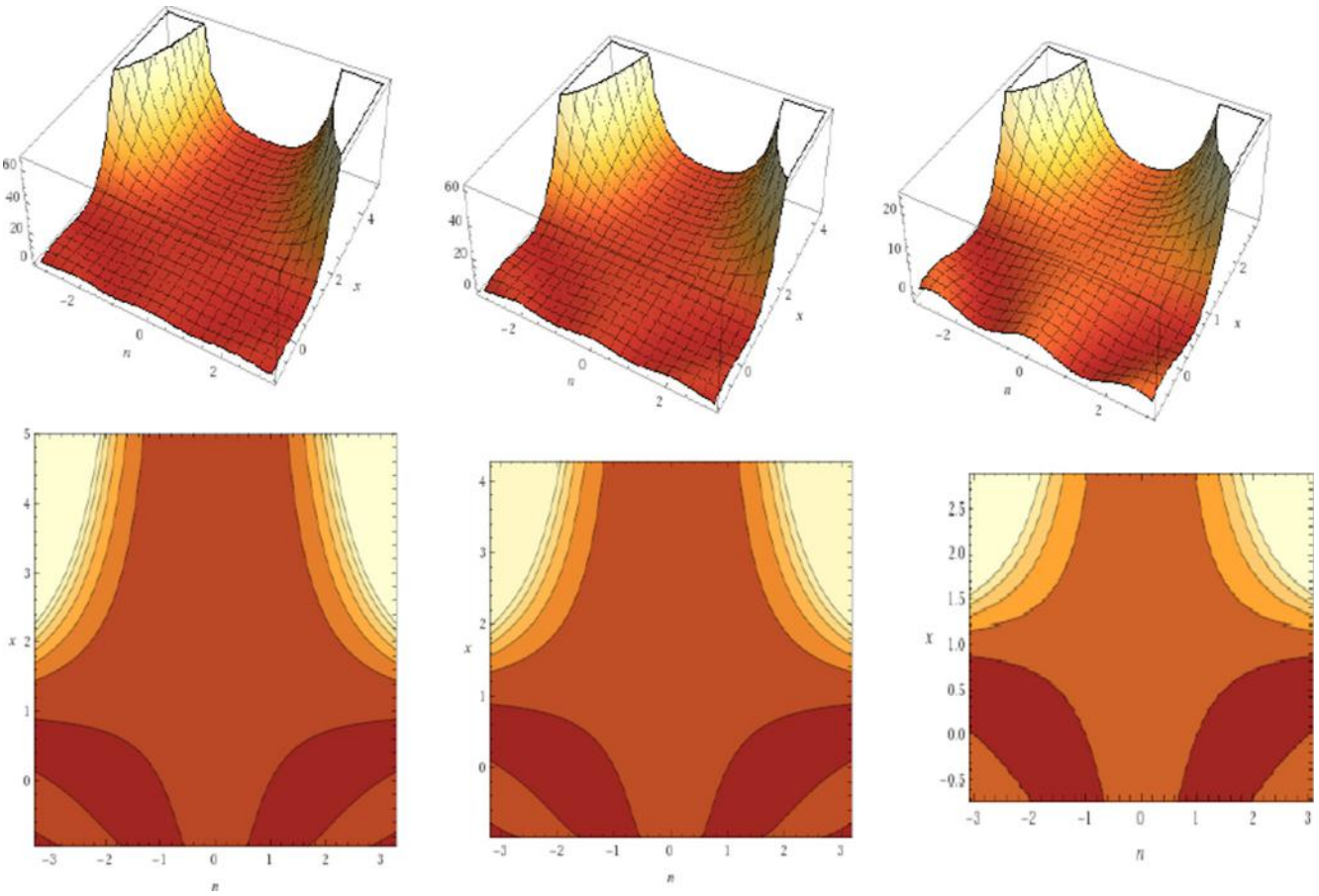

Fig. 1. 3D-fractal Chebyshev polynomials for $\alpha = 0$, 0.5 and 0.75 respectively.

maps hardness (Diffie-Hellman) and difficulties (DL). In 2016, Gao et al. [23] presented an authentication scheme based on chaotic maps for wireless body area network in which health data was recorded and monitored. The cost of multiplication and exponential computation was achieved with reduced communication cost. User confidentiality was the key element in sharing of information during authentication. An anonymity which preserves authentication scheme is shown in [24]. AVISPA was used for analyzing and verifying security. Compared to other approaches the enhanced performance was recorded. Meshram et al. [25–27] proposed more efficient authentication schemes using extended chaotic maps. The results obtained in these schemes are testimony to the suitability of chaotic maps as the good choice for proposing a new security scheme.

Motivation

While some researchers have proposed security mechanisms, they are not lightweight enough to meet the IoT based system's needs. In this paper, we have proposed an efficient secure and lightweight short signature scheme using fractional chaotic maps which provides security under adaptive chosen-message attack (CMA) in random oracle model.

Recently, Mughal et al. [43] presented a digital signature scheme using complex numbers for providing secure communication among smart devices in human-centered IoT based systems but, have not discussed its security in any standard security model as discussed in the previous literature. A variety of signature-based schemes are discussed in literature to provide secure communication, but smart devices need more lightweight operations by ensuring the required security strengths. Due to the large real numbers required for signature and verification processes, the main problem during signature-based approaches is the computational overhead. This paper presents a lightweight short signature scheme using fractional chaotic maps for providing secure communication between smart devices in human centered IoT. We have used less extensive operations to achieve processes of signing and verification, as human beings do signatures on legal documents and then verify as per witness. The presented scheme is secure under adaptive chosen-message attack (CMA) in random oracle model.

Contribution

This paper presents an efficient provably secure short signature scheme using fractional chaotic map for smart devices in human centric IoT. During verification and signing operations, it uses the less detailed operations based on fractional chaotic maps to generate security credentials. The main advantage of this strategy over the DSA signature scheme is a one-fourth reduction in the verification process as well as signature frequency. The methodology is illustrated with simple step-by-step, outstanding principles to prove proof of notion. In DSA-based systems, this eliminates overhead computation and communication, and coordination along with improved flexibility compared to existing detailed operations based on real number. However, we show the reliability of the proposed SSS is closely linked, if not strongly, to the difficulty of solving fractional chaotic maps. Under adaptive chosen attacks in ROM, an efficient security proof exists for unforgeability, i.e. the presented scheme provides superior security guarantees than the

existing other signature schemes. The scheme presented does not use pairings resulting in effortless implementation and higher performance, nor is it relying on the relatively untested and recent assumptions of hardness associated with pairing-based cryptography. Results show that our methodology presented is less time consuming than equivalents for the verification and signature process. It requires less time to check the variations in the length of the message, less communication costs needed for signature messages, fewer bytes exposed by undermining devices and less ability to compromise midway devices.

Road map of article: Section 'Related materials' describes the definition and terminology associated with the presented scheme. The proposed new scheme based on fractal calculus to generalize the Chebyshev polynomial are listed in Section 'PROPOSED SHORT SIGNATURE SCHME (SSS)'. Section 'Security analysis and discussion' explains the security target of signature schemes, security models and provably security in ROM, and we are also presenting a reductionist proof of security against forgery that occurs under the adaptive chosen message attacks (EUF-CMA) in ROM. Section 'Performance comparison' describes the study by which other similar recent schemes are contrasted with the scheme proposed. Finally, Section 'Conclusion' stretches the conclusions.

Related materials

In this segment, we have highlighted Chebyshev polynomial and fractional chaotic maps subsequently we would use in the proposed technique. We will then define some necessary notations used in the article (see Table 1).

Chebyshev chaotic transforms

We reviewed Chebyshev sequential polynomials (CSP) (see [28]) and assessed their operatory. CSP $\mathcal{T}_r(\tau)$ is a polynomial of n-degree in the variantτ. Let $\tau \in [-1,1]$ be the version, and let n be an integer. In general, CSP stated as follows:

$$\mathcal{T}_n(\tau) = cos(n \times cos^{-1}(\tau)),$$

$$\mathcal{T}_0(\tau) = 1$$

$$\mathcal{T}_1(\tau) = \tau$$

$$\mathcal{T}_n(\tau) = 2\tau\mathcal{T}_{n-1}(\tau) - \mathcal{T}_{n-2}(\tau); n \geq 2$$

In this case, the functional $cos^{-1}(\tau)$ and $\cos(\tau)$ represented as $cos^{-1} : [-1,1] \to [0,\pi]and\cos : \mathrm{R} \to [-1,1]$.

There are two main properties of CSP [25–26,29–32]: chaotic properties and semi-group properties.

(1) The chaotic possessions: The CSP transform demarcated as $\mathcal{T}_r : [-1,1] \to [-1,1]$ with degree$n > 1$, is a chaotic transform connected to the functional (invariant density) $f^*(\tau) = \frac{1}{(\pi\sqrt{1-\tau^2})}$.

Table 1
. List of notations.

	Private Key
$\mathfrak{p}$	Public Key
$\mathcal{T}^{\alpha}$	Fractal Chebyshev chaotic maps
r	Random number per message
h_1, h_2	One Way Hash Functions
M	Message
D	1st parameter of signature
s	2nd parameter of signature
$\mathfrak{c}$	Digital Signature
$\amalg$	Large prime number of bit length
$\surd$	Large prime factors of $\amalg - 1$

(2) The possessions of what is calling semi-group satisfies the following equalities:

$\mathcal{T}_{\omega}(\mathcal{T}_{\ell}(\tau)) = \cos(\omega\cos^{-1}(\cos(\ell\cos^{-1}(\tau)))) = \cos(\omega\ell\cos^{-1}(\tau)) = \mathcal{T}_{\ell\omega}(\tau) = \mathcal{T}_{\ell}(\mathcal{T}_{\omega}(\tau))$, where ω and ℓ are positive integers and $\tau \in [-1,1]$.

Chebyshev polynomials have two tests that in polynomial time considered handling:

(1) The discrete log's (DL) assignment is to find the integer ω with the end goal $\mathcal{T}_{\omega}(\tau) = y$ given two components $\tau$and y.
(2) Because of three componentsτ, $\mathcal{T}_{\omega}(\tau)$, and $\mathcal{T}_{\ell}(\tau)$, the Diffie-Hellman problem (DHP) assignment is to measure the $\mathcal{T}_{\omega\ell}(\tau)$ element.

Fractional Chebyshev polynomials (FCP)

Fractional discrete systems have a most important benefit over their conservative complements due to the infinite memorial feature, which agrees for more flexibility in demonstrating and indicates a higher degree of chaotic performance. We have confidence in the fractional calculus approaches and fractional discrete formulation that will give us a recovering explanation of discrete fractional maps. From our research, we discovered that the fictionalized standard map could also be employed in the information security field. In this section, we aim to formulate the *Fractional Chebyshev Polynomials.*

Assume the fractional (arbitrary) number $\alpha\epsilon[0,1]$. An operator δ^{α} is fractal derivative if and only if [30]

$$\delta^{\alpha}\vartheta(x) = \lim_{x\to x_0} \frac{\Delta^{\alpha}(\vartheta(x) - \vartheta(x_0))}{(x - x_0)^{\alpha}} = \Gamma(\alpha+1)(\vartheta(x) - \vartheta(x_0)).$$

The fractal integral corresponds to δ^{α} is defined by

$$I^{\alpha}\vartheta(x) = \frac{1}{\Gamma(\alpha+1)} \int_a^b \vartheta(x)(dx)^{\alpha}.$$

Note that

$$I^{\alpha}\vartheta(x) = \frac{(b-a)^{\alpha}}{\Gamma(\alpha+1)}\vartheta(x), \quad a \leq x \leq b. \tag{1}$$

By employing the concept of Fractal Calculus to simplify the polynomial$\mathcal{T}_n(\tau)$, we can attain the subsequent structure:

$$I^{\alpha}\mathcal{T}_n(\tau) := \mathcal{T}_n^{\alpha}(\tau) = \frac{(2)^{\alpha}}{\Gamma(\alpha+1)}\mathcal{T}_n(\tau), \tag{2}$$

Eq. (2) is named the Fractal Chebyshev polynomials (FCP). Formula that is more frequent can be seen in the following result:

Proposition 2.1. *The FCP fulfills the frequent associations*

$$\mathcal{T}_n^{\alpha}(\tau) = \frac{(2)^{\alpha}}{\Gamma(\alpha+1)}(2\tau\mathcal{T}_{n-1}(\tau) - \mathcal{T}_{n-2}(\tau)). \tag{3}$$

Proof. Connection (2) with the frequent formula implies that

$$\mathcal{T}_n(\tau) = 2\tau\mathcal{T}_{n-1}(\tau) - \mathcal{T}_{n-2}(\tau); n \geq 2$$

we have

$$\mathcal{T}_n^{\alpha}(\tau) = \frac{(2)^{\alpha}}{\Gamma(\alpha+1)}\mathcal{T}_n(\tau)$$

$$= \frac{(2)^{\alpha}}{\Gamma(\alpha+1)}(2\tau\mathcal{T}_{n-1}(\tau) - \mathcal{T}_{n-2}(\tau)).$$

Note that when $\alpha \to 0$, we have the main ordinary result, which can be seen in [33].

Proposition 2.2. *The semi-group possessions clamps for FCP positioned on interval (-∞,∞).*

Proof. Let $h = \frac{(2)^{\alpha}}{\Gamma(\alpha+1)}$. By Proposition 2.1, we obtain

$$\mathcal{T}^{\alpha}_{n+2}(\tau) = \frac{(2)^{\alpha}}{\Gamma(\alpha+1)}(2\tau\mathcal{T}_{n+1}(\tau) - \mathcal{T}_{n}(\tau)).$$

The above preparation proposes an adjustment equation (disconnected equation) which has a typical principle

$$\omega^2 - 2h\omega + \mu_1 = 0$$

Satisfying the relations

$$\omega_1 + \omega_2 = 2h,\ \ \omega_1\omega_2 = \mu_1,\ \ \omega_{1,2} = h \pm \sqrt{h-\mu_1}.$$

A computation yields that

$$\mathcal{T}^{\alpha}_{n}(\tau) = ({\omega_1}^n + {\omega_2}^n)/2$$

$$= \frac{(h+\sqrt{h^2-\mu_1})^n + (h-\sqrt{h^2-\mu_1})^n}{2}$$

$$= \sum_{m=0}^{[n/2]} \binom{n}{m} h^{n-2m}(h^2-\mu_1)^m$$

A computation yields that

$$\mathcal{T}^{\alpha}_{k}(\mathcal{T}^{\alpha}_{n}(\tau)) = ({\tau_1}^k + {\tau_2}^k)/2$$

$$\tau_1 + \tau_2 = 2\mathcal{T}^{\alpha}_{n}(\tau),\ \ \omega_1\omega_2 = \mu_1.$$

Hence, we have the important relation

$$\mathcal{T}^{\alpha}_{k}(\mathcal{T}^{\alpha}_{n}(\tau)) = \mathcal{T}^{\alpha}_{n}(\mathcal{T}^{\alpha}_{k}(\tau)) = \mathcal{T}^{\alpha}_{kn}(\tau).$$

The closed form expression for Chebyshev polynomials of any order is

$$T_i(x) = \sum_{j=0}^{[i/2]} (-1)^j \binom{i}{2j} x^{i-2j}(1-x^2)^j \qquad (4)$$

where $[i/2]$ is the integer part of $(i/2)$. Then the FCP becomes

$$\mathcal{T}_i{}^{\alpha}(x) = \frac{(2)^{\alpha}}{\Gamma(\alpha+1)}(2x\mathcal{T}_{i-1}(x) - \mathcal{T}_{i-2}(x))$$

$$= \frac{(2)^{\alpha}}{\Gamma(\alpha+1)}\left(2x\sum_{j=0}^{[i/2]}(-1)^j\binom{i-1}{2j}x^{i-2j-1}(1-x^2)^j - \sum_{j=0}^{[i/2]}(-1)^j\binom{i-2}{2j}x^{i-2j-2}(1-x^2)^j\right)$$

Proposed short signature schme (SSS)

In this section, we presented a secure FCM based SSS under the environment of IoT. The presented scheme as follows (see Fig. 2):

- *Setup*: Let $\mathscr{g}$ and $\mathscr{p}$ be huge prime numbers with $\mathscr{p}|(\mathscr{g}-1)$. Similarly let $G_{\acute{E}_i,\mathscr{g}} = \{\acute{E}_i{}^0, \acute{E}_i{}^1, \ldots \acute{E}_i{}^{\mathscr{p}-1}\}$ be a subgroup with prime order $\mathscr{g}$ of the multiplicative group $\mathcal{Z}^*_{\mathscr{g}}$, where $\acute{E}_i$ is a generator with prime order $\mathscr{p}$. Let h_1 and h_2 be one way hash functions where

$$h_1 : \{0,1\}^* \times \mathcal{Z}^*_{q} \to \{0,1\}^{m_{\mathscr{p}}/2} \text{ and } h_2 : \{0,1\}^* \to \mathcal{Z}^*_{q}$$

We will omit the "$(mod_{\mathscr{g}})$" and "$(mod_{\mathscr{p}})$" markers for notational convenience. We denote 's bit length by $|\mathscr{p}| = m_{\mathscr{p}}$ and q, by $|q| = m_q$. The notation $\ell \xleftarrow{R} \mathcal{S}$ implies that an is selected randomly from a set $\mathcal{S}$ at random. We are now explaining the SSS in full detail.

- Key generation algorithm
  1. Picks an arbitrary $\xleftarrow{R} \mathcal{Z}^*_{\mathscr{p}}$ as the private key.
  2. The corresponding public key is $\mathfrak{p} \leftarrow \mathcal{T}^{\alpha}_{e}(g)$.
- *Signing algorithm*: The inputs are the private key , the public key $\mathfrak{p}$ and a message $M\epsilon\{0,1\}^*$.
  1. First choose an arbitrary $r \xleftarrow{R} \mathcal{Z}^*_{\mathscr{p}}$.
  2. Computes $\mathfrak{B} \leftarrow h_2(M), \kappa \leftarrow \mathfrak{B}.\mathcal{T}^{\alpha}_{r}(g), D \leftarrow h_1(M,\kappa)$ and $s \leftarrow r - De$..

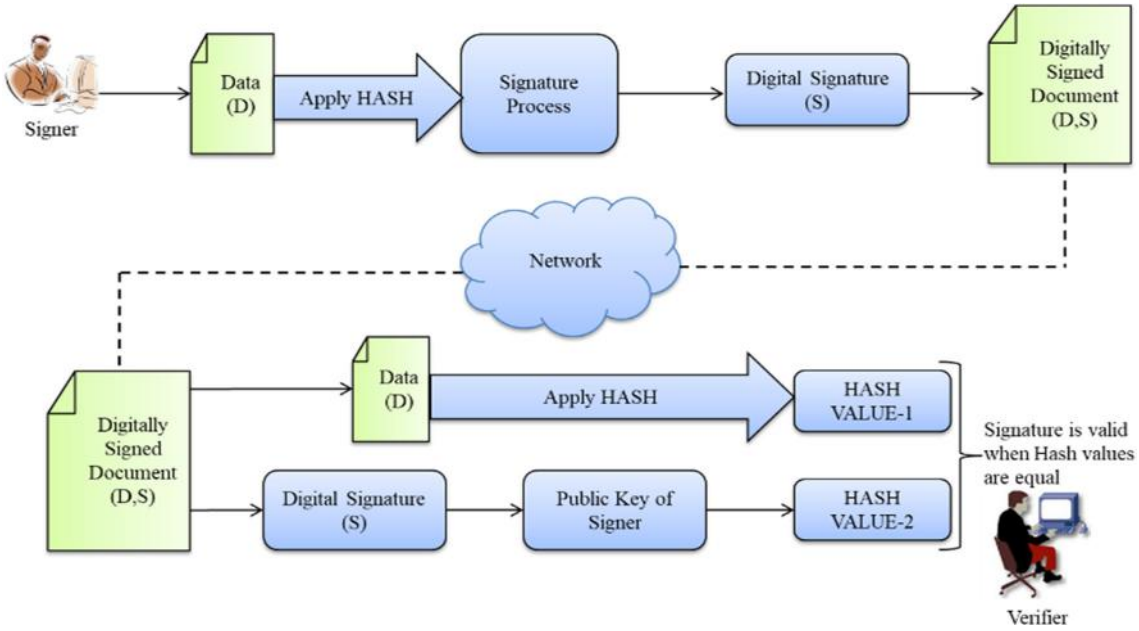

Fig. 2. Digital Signature and Verification Process.

3. The signature of the message m is $\mathfrak{c} \leftarrow (D, \mathfrak{s})$.

- *Verification algorithm*: The inputs are the message M, the public key $\mathfrak{p}$ and the signature $\mathfrak{c} \leftarrow (D, \mathfrak{s})$.
  1. Computes $\mathfrak{B} \leftarrow \mathfrak{h}_2(\mathrm{M}), \kappa' \leftarrow \mathfrak{B}\mathcal{T}_D^{\alpha}(\mathfrak{p})\mathcal{T}_{\mathfrak{s}}^{\alpha}(\mathfrak{g})$ and $D' \leftarrow \mathfrak{h}_1(\mathrm{M}, \kappa')$
  2. If $\mathcal{D} = \mathcal{D}'$, verification outputs valid, otherwise it outputs in valid.

Consistency of the proposed scheme: Because $\mathfrak{s} = r - D\mathfrak{z}$ and $\kappa = \mathfrak{B}.\mathcal{T}_r^{\alpha}(\mathfrak{g})$, $r = \mathfrak{s} + D\mathfrak{z}$ imply $\mathcal{T}_D^{\alpha}(\mathfrak{p})\mathcal{T}_{\mathfrak{s}}^{\alpha}(\mathfrak{g}) = \mathcal{T}_r^{\alpha}(\mathfrak{g})$ and $\kappa' = \mathfrak{B}\mathcal{T}_D^{\alpha}(\mathfrak{p})\mathcal{T}_{\mathfrak{s}}^{\alpha}(\mathfrak{g}) = \mathfrak{B}.\mathcal{T}_r^{\alpha}(\mathfrak{g}) = \kappa$ so $D' = \mathfrak{h}_1(\mathrm{M}, \kappa') = \mathfrak{h}_1(\mathrm{M}, \kappa) = D$. Hence, the signature $\mathfrak{c} \leftarrow (D, \mathfrak{s})$ produced by the signing algorithm is always valid.

Security analysis and discussion

At the very outset, the prototype of the security inspection for presented short signature schemes is observed. Secondly, the concept of the random oracle and the "provable security" are investigated. Finally a near-reductionist method is brought forth to prove that SSS is safe to prevent existential forgery in the setup of chosen attacks in ROM assuming FCM are difficult under human-centered Internet of Things environments.

Security frameworks and provably security analysis

The primary safety principles of the short signature schemes, the first of its kind technique to use, were described by Goldwasser et al. [35]. Universal forgery, existential forgery (EUF), and absolute break are the three types of attacks chosen by the enemy. However, to destabilize the signature's security the strategies used by enemy may be different. Attacker has the basic knowledge of the signer's public key in the First instance. Secondly attacker has access to a set of accurate pairs such as message and signature. On the basis of earlier obtained feedback of the questions, the adaptive chosen-message attack (CMA) authorizes the attacker to use the signer's sign for some of his/her chosen message. In order to avoid many other formerly signatures to correspond to single given message the algorithm for signature generation has to be definite in nature. The attacker is allowed to ask for each message at most one signature due to compromised defensive system in Single-occurrence adaptive chosen-message attack (SO-CMA). The implications of [36] and [37] are essential to be pursued for a "ROM" to confer authenticated verified security for the cryptosystems. Hash functions specifically arbitrary items, the hash function is exploited as an oracle to generate a random number for the fresh inquiry. An attacker utilizes a reductionist method of a logical assumption-contradicting method. Probabilities are judged on both guesses and random oracles. A well-constructed hash function generally doesn't bring out random responses practically. As a result, the value of the proofs performed in ROM is contentious. Reformed "artificial" equivalent which are "probably secure" in ROM are described in [38]. However, if the short signature scheme (SSS) needs to be protected a random-model security proof is required to be followed.

Definition 4.1. (SSS's Existential CMA Security): We deduce that a short signature scheme when running for t steps is shattered by $\mathrm{A}(\mathrm{t}, \mathrm{q}_{\mathfrak{h}_1}, \mathrm{q}_{\mathrm{sig}}, \varepsilon)$, probabilistic algorithm and gives way to the creation of adaptive inquiries of $\mathrm{q}_{\mathfrak{h}_1}$ to the hash function oracles. The place where probability is based on coins of *A*, Gen algorithm, Sig algorithm, and hash function oracles, *A* for some message M with ε probability creates fake signature, demanding signatures $((\mathrm{q}_{\mathrm{sig}}))$ for adaptively selected messages, $((\mathrm{M}, \mathfrak{c}))$.

When $(\mathrm{t}, \mathrm{q}_{\mathfrak{h}_1}, \mathrm{q}_{\mathrm{sig}}, \varepsilon)$ is hard to be ruined by any counterfeiter, the short signature scheme is $((\mathrm{t}, \mathrm{q}_{\mathfrak{h}_1}, \mathrm{q}_{\mathrm{sig}}, \varepsilon))$-secure.

Definition 4.2. (FCM Assumption):, If $\mathfrak{S}$ runs in a maximum of *t* steps and computes the fractional chaotic maps $FCM_{\dot{\mathrm{E}}\mathrm{i},\mathscr{g}}\left(\mathcal{T}_{\ell}^{\alpha}(\dot{\mathrm{E}}\mathrm{i})\right) = \ell$ given input $(\dot{\mathrm{E}}\mathrm{i}, \mathscr{g}, \mathscr{k})$ and $\mathcal{T}_{\ell}^{\alpha}(\dot{\mathrm{E}}\mathrm{i})$ with ε probability where probability is based on uniformly selected coins of $\mathfrak{S}$ and ℓ from $\mathcal{Z}_{\mathscr{g}}^{*}$, $\mathfrak{S}$, probabilistic algorithm is said to $((t, \varepsilon))$-split FCM in a group$G_{\dot{\mathrm{E}}\mathrm{i},\mathscr{g}}$

Here it can be said that group $G_{\dot{\mathrm{E}}\mathrm{i},\mathscr{g}}$ is a $((t, \varepsilon))$-FCM group unless algorithm in group $G_{\dot{\mathrm{E}}\mathrm{i},\mathscr{g}}$ can split FCM.

Security proof of the introduced SSS utilizing FCM'

The recommended SSS is based on [39,40] which is a prevalent signature scheme. When an input message M is provided, it generates $(\mathfrak{c}_1, \mathrm{D}, \mathfrak{c}_2)$ in which $\mathfrak{c}_1$ arbitrarily chose its value in a set consist of larger values, $\mathcal{D}$ is hash value $(\mathfrak{h}_1(\mathrm{M}, \mathfrak{c}_1), \mathfrak{h}_2(\mathrm{M}))$ and $\mathfrak{c}_2$ depends only on $\mathfrak{c}_1$, M, and $\mathcal{D}$.

We can derive subsequent standard outcome with the help of direct use of techniques in [40].

Theorem 4.1. *(Forking lemma): Let $\mathscr{U}$ be a Turing machine with probabilistic polynomial time, the input of which contains public information only. By R and $\mathscr{O}$, we denote count of relevant queries $\mathscr{U}$ may request from the random oracle, and count of relevant queries A may request from the signer, respectively. Suppose in time limit T, $\mathscr{U}$ produces a valid $((\mathrm{M}, \mathfrak{c}_1, D, \mathfrak{c}_2))$ signature with a probability of $\varepsilon \geq \frac{10(\mathcal{O}+1)(\mathcal{O}+\mathcal{R})}{2^k}$. If the triple $(\mathfrak{c}_1, \mathrm{D}, \mathfrak{c}_2)$ can be simulated with an indistinguishable probability of distribution without knowing the secret key, then there is another system which has control over the machine which can be obtained from $\mathscr{U}$ by replacing the interaction with the signer with a simulation and which produces two valid signatures $(\mathscr{U})$ and $((\mathrm{M}, \mathfrak{c}_1, D', \mathfrak{c}'_2))$ such that $((\mathfrak{h}_1(\mathrm{M}, \mathfrak{c}_1), \mathfrak{h}_2(\mathrm{M})) \neq (\mathfrak{h}_1'(\mathrm{M}, \mathfrak{c}_1), \mathfrak{h}_2(\mathrm{M})))$ in the predicted time $T' \leq 120686T/\varepsilon$.*

With the help of procedure implemented we acquire two equations in our given technical entry:

$$\mathfrak{h}_2(\mathrm{M})\mathcal{T}_{\mathfrak{s}}^{\alpha}(\mathfrak{g})\mathcal{T}_{\mathfrak{h}_1(\mathrm{M},\kappa)}^{\alpha}(\mathfrak{p}) = \kappa \text{ and } \mathfrak{h}_2(\mathrm{M})\mathcal{T}_{\mathfrak{s}'}^{\alpha}(\mathfrak{g})\mathcal{T}_{\mathfrak{h}_1'(\mathrm{M},\kappa)}^{\alpha}(\mathfrak{p}) = \kappa$$

We can get the definite private value with the help of this method

$$\mathfrak{z} = (\mathfrak{s} - \mathfrak{s}')/\mathfrak{h}_1'(\mathrm{M}, \kappa) - \mathfrak{h}_1(\mathrm{M}, \kappa)).$$

SSS's security and FCM's hardness relation get compromised because of ineffectiveness of reductionist technique of Forking lemma. As expected, the secret value $\mathfrak{z} = (-\mathfrak{s} - \mathfrak{t})/\mathfrak{h}_1(\mathrm{M}, \kappa)$ would be obtained when attacker acts in response to the inquiry $\mathfrak{h}_2(\mathrm{M})$ by$\kappa\mathcal{T}_{\mathrm{t}}\left(\dot{\mathrm{E}}\mathrm{i}\right)$, as a substitution for a random number t in $\mathcal{Z}_{\mathscr{g}}^{*}$ (Note: simulator responds to the $\mathfrak{h}_2$-query $\mathfrak{h}_2$ (M) by random number t in $\mathcal{Z}_{\mathscr{g}}^{*}$ as per proof of Theorem 4.1). Hence, oracle replay attack is not required.

As a result, a more dominant reductionist method in depth is supposed to be instigated. A close association among the SSS security and the FCM problem's hardness can better be shown with the help of following theorem.

Theorem 4.2. *Let $G_{\acute{E}_i,\mathscr{I}}$ be a $((t',\varepsilon'))$-FCM group, then the SSS in the ROM is $((t, q_{h_1}, q_{h_2}, q_{sig}, \varepsilon))$ secure against EUF-CMA, where*

$$t' \approx 3\left(\mathcal{C}_e\left(q_s+\frac{q_{h_2}}{2}\right)+\frac{t}{2}\right) \text{ and}$$

$$\varepsilon' \approx \left(\frac{\varepsilon}{2}-\left(\frac{1}{2^{(m_{\mathscr{P}}/2+1)}}+\frac{q_s(q_s+q_{h_1})}{2^{(m_q+1)}}\right)\right)+\left(\frac{1}{8q_{h_1}}+\frac{1}{16}\right)\left(\varepsilon-\left(\frac{1}{2^{m_{\mathscr{P}}/2}}+\frac{q_s(q_s+q_{h_1})}{2^{m_q}}\right)\right)^3$$

Here $\mathcal{C}_e$ refers to the expense of computing a long exponentiation in $G_{\acute{E},\mathscr{I}}$group.

Proof. For proving security of SSS, ROM is used. We assume that a EUF-CMA counterfeiter $\mathscr{U}$ that $((t, q_{h_1}, q_{h_2}, q_{sig}, \varepsilon))$ separates the SSS is found. The random oracles h_1, h_2, S can be enquired with a polynomial number of queries by which is a probabilistic polynomial time program arranged with extended open sequence of arbitrary bits.

An algorithm $\mathfrak{S}$, which receives $((q, \mathscr{p}, g, \mathbb{p}))$ as input is needed to be generated for us being a "simulator". For calculating the FCM i.e. $\mathcal{T}_{\mathbb{p}}^{\alpha}(g)$ as a computer programme, $\mathfrak{S}$ tries to utilize $\mathscr{U}$.

Algorithm $\mathfrak{S}$ simulates one or two SSS runs to counterfeiter A. Hash inquiries h_1 and h_2 are reacted by A, S signature inquiries by Algorithm $\mathfrak{S}$, and tries to twist A's potential forgeries (M, σ) into an FCM i.e. $\mathcal{T}_{\mathbb{p}}^{\alpha}(g)$ solution. By providing $((q, \mathscr{p}, g, \mathbb{p}))$ Algorithm $\mathfrak{S}$ commences the first imitation and an extensive series of arbitrary bits for A. Then, A's inquiries are responded by as follows:

Responding h_1-oracle inquiries:, To get the compliant answer, $\mathfrak{S}$ search for the h_1-list (query-response list in which entries contain of tuples $((M_i, \kappa_i)\mathcal{D}_i)$ if A subjects a random oracle inquiry (M_i, κ_i) in which $1 \le i \le q_{h_1}$. $\mathfrak{S}$ replies with $\mathcal{D}_i$ when tuple $((M_i, \kappa_i), \mathcal{D}_i)$ is in the h_1-list. Then $\mathfrak{S}$ homogeneously at random generates $\mathcal{D}_i$from $\mathcal{Z}_{\mathscr{p}}^*$, responds with it, and improves tuple $((M_i, \kappa_i), \mathcal{D}_i)$ to the h_1-list.

Responding h_2-oracle inquiries: In the attempt of achieving the compliant answer, $\mathfrak{S}$ search for the h_2-list (list of inquiry–response) where entries contain of tuples $((M_i), \mathfrak{B}_i, t_i)$ when $\mathscr{U}$ subjects a random oracle inquiry (M_i) where $1 \le i \le q_{h_2}$. If the h_2-list contains a tuple$((M_i), \mathfrak{B}_i, t_i)$then $\mathfrak{S}$ reacts with $\mathfrak{B}_i$.

$\mathfrak{S}$ will search for the h_1-list in the condition of (M_i) is a new inquiry. If the h_1-list contains some tuples$((M_i, \kappa_i)\mathcal{D}_i)$, $\mathfrak{S}$ elects to choose oneκ_i, creates t_i from $\mathcal{Z}_{\mathscr{p}}^*$ homogeneously at random, evaluates $\mathfrak{B}_i = \kappa_i \mathcal{T}_{t_i}^{\alpha}\left(\acute{E}_i\right)$ and reacts with $\mathfrak{B}_i$. $\mathfrak{S}$ adds h_2-list with the tuple$((M_i), \mathfrak{B}_i, t_i)$. $\mathfrak{S}$ homogeneously creates t_i from $\mathcal{Z}_{\mathscr{p}}^*$at random, evaluates $\mathfrak{B}_i = \mathcal{T}_{t_i}^{\alpha}\left(\acute{E}_i\right)$ and reacts with $\mathfrak{B}_i$. $\mathfrak{S}$ adds the h_2-list with the tuple $((M_i), \mathfrak{B}_i, 0)$ in the absence of tuple $((M_i, \kappa_i)\mathcal{D}_i)$ in the h_1-list.

Responding S-oracle inquiries: For the purpose of obtaining the accurate reply, $\mathfrak{S}$ search for the S-list (list of query–response) in which entries contain $((M_i, D_i, s_i))$ proviso $\mathscr{U}$ subjects an inquiry for signature (M_i) in which $1 \le i \le q_s$. When a tuple $((M_i, D_i, s_i))$ occurs in S-list then $\mathfrak{S}$ retorts with $((D_i, s_i))$.

$\mathfrak{S}$ search for the h_2-list for the first time in the event of $(M_i)$is a new query for signature. $\mathfrak{S}$ chooses $\mathfrak{B}_i$ if the h_2-list contains a tuple $((M_i), \mathfrak{B}_i, t_i)$ or else $\mathfrak{S}$ homogeneously generates t_i at random from $\mathcal{Z}_{\mathscr{p}}^*$, calculates $\mathfrak{B}_i = \mathcal{T}_{t_i}^{\alpha}\left(\acute{E}_i\right)$, and adds the tuple $((M_i), \mathfrak{B}_i, 0)$to the h_2-list.

Then $\mathfrak{S}$ homogeneously opts for s_i from $\mathcal{Z}_{\mathscr{p}}^*$ at random and evaluates $\kappa_i = \mathfrak{B}_i \mathcal{T}_{D_i'}^{\alpha}(\mathbb{p}) \mathcal{T}_{s_i}^{\alpha}(g)$. $\mathfrak{S}$ replies with $((M_i, D_i', s_i))$, improves the tuple $((M_i, D_i', s_i))$, to S-list, and improves the tuple (M_i, D_i', κ_i) to h_1-list. If tuple $((M_i, \kappa_i)\mathcal{D}_i)$ is in the h_1-list with $\mathcal{D}_i \neq \mathcal{D}_i'$, the simulation will be aborted and restarted (this unfortunate occurrence is at most probability $\frac{(q_{h_1}+q_{h_2})}{2^{m_{\mathscr{p}}/2}}$.

We can say that in order to bring entirely distinct outputs contrary to the real attacks oracle based simulations are helpful.

We can presume that a novel authorized message and signature tuple ε with probability $\mathscr{U}$ are ensued by counterfeiter $\mathfrak{S}$. When h_2 (M) or h_1 (M, κ) is not inquired by $\mathfrak{S}$, the probability is $Pr\{h_1(M, h_2(M)\mathcal{T}_s^{\alpha}(g)\mathcal{T}_D^{\alpha}(\mathbb{p})) = D\} < \frac{\alpha}{2^{m_{\mathscr{p}}/2}} \le \frac{1}{2^{m_{\mathscr{p}}/2}}$, given that both h_2 (M) or h_1 (M, κ) are elected arbitrarily. Thus, the counterfeiter $\mathfrak{S}$ carries on with the probability $\left(\varepsilon-\left(\frac{q_s(q_s+q_{h_1})}{2^{m_q}}+\frac{1}{2^{m_{\mathscr{p}}/2}}\right)\right)$ a new signature $((M, D, s))$ such that $h_1(M, h_2(M)\mathcal{T}_s^{\alpha}(g)\mathcal{T}_D^{\alpha}(\mathbb{p})) = D$ and $h_2(M) \in h_2 - \text{list}, h_1(M, \kappa) \in h_1 - \text{list}$.

The h_2-list consists of two kinds of entries. If $h_2(M) = \kappa\mathcal{T}_t^{\alpha}(g)$, then $h_2(M)\mathcal{T}_s^{\alpha}(g)\mathcal{T}_D^{\alpha}(\mathbb{p}) = \kappa$ implies $\mathcal{T}_1^{\alpha}(\mathcal{T}_s^{\alpha}(g))\mathcal{T}_D^{\alpha}(\mathbb{p}) = 1$, and $z = (-t - s)/D$. Considering that the number of h_1-query (M, κ) with $h_2(M) = \kappa\mathcal{T}_t^{\alpha}(g)$ is $\varepsilon_{\wp_{h_1}}$. Therefore in the first replication the probability of solving the FCM is $\varepsilon_{\cdot}$.

We assume $\mathfrak{S}$ acquires the signature and message pair $((M_j, D_j, s_j))$ in the first simulation, with $D_j = h_1(M_j, \kappa_j)$ and $h_2(M_j) \neq \kappa_j \mathcal{T}_{t_j}^{\alpha}(g)$.

The second simulation with the probability $(1 - \varepsilon_{\cdot})$ will be initiated by Algorithm $\mathfrak{S}$ as long as the same $((q, \mathscr{p}, g, \mathbb{p}))$ is supplied. The counterfeiter $\mathscr{U}$ is provided with the same random bits series, analogous random responses to hash function and signature queries as those in the first simulation before $\mathscr{U}$ requests for $h_1(M_j, \kappa_j)$ by $\mathfrak{S}$.

Thus various series of random bits, signatures, and diverse values for random functions tend to be given by $\mathfrak{S}$. The point to be noted here is that $\mathfrak{S}$ acts in response with the same value which is at the time of first simulation when the h_2-query (M_j) is asked after this argument. Here, "Forking lemma" in [40] is applied. We expect that yields signature $((M_j, D_j, s_j))$ this time around such that $h_2(M_i) \neq \kappa_i \mathcal{T}_{t_i}^{\alpha}(g)$ and $h_2(M_i)\mathcal{T}_{s_i}^{\alpha}(g)\mathcal{T}_{D_i}^{\alpha}(\mathbb{p})$ or the signature (M_j, D'_j, s'_j) with $\mathcal{D}'_j \neq \mathcal{D}_j$.

Here, the "Splitting lemma" [34] is employed to calculate the probability in order to work $\mathscr{U}$ as anticipated. Let U be the set of probable random bits series and random function estimates that carry forger $\mathscr{U}$ up to the argument where $\mathscr{U}$ requests for $h_1(M_j, \kappa_j)$; let V be the set of probable random bits series and random function estimates after that. By inference, the probability at which $\mathscr{U}$, supplying the series of random bits and random estimates $(z||\mathbb{p})$, produces a forgery is $(q, \mathscr{p}, g, \mathbb{p})$ for any ubiquity $z \in U, \mathbb{p} \in V$. Using "Splitting lemma", a "agreeable" subset occurs $\Omega \in U$ such that

(i) $Pr\{z \in \Omega\} \ge \varepsilon/2$.
(ii) The probability that A, delivered the arbitrary bits and arbitrary values sequences $((\mathscr{b}||\mathbb{p}))$ in which $\mathscr{b} \in \Omega$; $\mathbb{p} \in V$, produces a copy is at least $\varepsilon/2$.

Expect the sequences of random bit and random function values given up to the argument in first simulation are ℓ. Consequently, the probability that A, delivered$(\ell||v)$, produces a forgery in second simulation in the condition of any $\mathbb{p} \in V$ is $(\varepsilon/2)^2$.

Forged signature probability (M_i, D_i, s_i) with $h_2(M_i) = \kappa_i \mathcal{T}_{t_i}^{\alpha}(g)$ and $h_2(M_i)\mathcal{T}_{s_i}^{\alpha}(g)\mathcal{T}_{D_i}^{\alpha}(v) = \kappa_i$. Forged signature probability (M_j, D'_j, s'_j) with$\mathcal{D}'_j \neq \mathcal{D}_j$is $(1 - \varepsilon)/((1 - \varepsilon)q_{h_1} = 1/q_{h_1}$.

The probability of $\mathfrak{S}$ resolving the FCM in the second simulation is thus

$$\left(\varepsilon-\left(\frac{1}{2^{(m_{\mathcal{P}}/2)}}+\frac{q_s(q_s+q_{h_1})}{2^{(m_q)}}\right)\right)\left(\frac{\varepsilon}{2}-\left(\frac{1}{2^{(m_{\mathcal{P}}/2+1)}}+\frac{q_s(q_s+q_{h_1})}{2^{(m_q+1)}}\right)\right)^2\left(\varepsilon_t+\frac{1}{q_{h_1}}\right)$$

$$\approx\left(\varepsilon-\left(\frac{1}{2^{m_{\mathcal{P}}/2}}+\frac{q_s(q_s+q_{h_1})}{2^{m_q}}\right)\right)^3\left(\frac{\varepsilon_t}{4}+\frac{1}{4q_{h_1}}\right)$$

The probabilities can be concluded such that Algorithm $\mathfrak{S}$ at least solves the FCM with probability (nearly)

$$\varepsilon_t\left(\varepsilon-\left(\frac{1}{2^{(m_{\mathcal{P}}/2)}}+\frac{q_s(q_s+q_{h_1})}{2^{(m_q)}}\right)\right)+(1-\varepsilon_t)\left(\varepsilon-\left(\frac{1}{2^{m_{\mathcal{P}}/2}}+\frac{q_s(q_s+q_{h_1})}{2^{m_q}}\right)\right)^3\left(\frac{\varepsilon_t}{4}+\frac{1}{4q_{h_1}}\right)$$

In one simulation the computation stage is $(t+(2q_s+q_{h_2})\mathcal{C}_e)$. Then final stage in the calculation is

$$\varepsilon_t((2q_s+q_{h_2})\mathcal{C}_e+t)+(1-\varepsilon_t)2\left((2q_s+q_{h_2})\mathcal{C}_e+t\right)=(2-\delta)\left((2q_s+q_{h_2})\mathcal{C}_e+t\right).$$

The single h_1-query and one $D'\leftarrow h_1(M,\kappa')$-query are allowed for eachM request in the approximation of the probability ε_t: akin to the slightly feeble SO-CMA security structure, that is to say, the counterfeiter $\mathcal{U}$ demands (M,κ) for both h_1-query and one h_2-query. At the same time Algorithm $\mathfrak{S}$ reacts with $h_1(M,\kappa)=D$, and $h_2(M)=\kappa\mathcal{T}_t(g)$. In this case, $\varepsilon_t=1$. Here a robust reductionist evidence of safety is obtained.

Each h_1-query (M,κ) is consequently the h_2-query(M)acting against this affirmative approximation. It leads to find a movable reductionist security evidence as it is observed when $\varepsilon_t=0$ similar to the Schnorr signature scheme. We are eclectically letting $\varepsilon_t=1/2$ because the set of series of arbitrary bits and arbitrary function values that $\mathfrak{S}$ supplies to counterfeiter $\mathcal{U}$ is arbitrary. Therefore

$$t'\approx 3\left(\mathcal{C}_e\left(q_s+\tfrac{q_{h_2}}{2}\right)+\tfrac{t}{2}\right)\text{ and}$$

$$\varepsilon'\approx\left(\frac{\varepsilon}{2}-\left(\frac{1}{2^{(m_{\mathcal{P}}/2+1)}}+\frac{q_s(q_s+q_{h_1})}{2^{(m_q+1)}}\right)\right)+\left(\frac{1}{8q_{h_1}}+\frac{1}{16}\right)\left(\varepsilon-\left(\frac{1}{2^{m_{\mathcal{P}}/2}}+\frac{q_s(q_s+q_{h_1})}{2^{m_q}}\right)\right)^3$$

Essentially, this reductionist technique effectively works on the utilization of h_1-query command and h_2-query for the duplicate message insisted by counterfeiter A. Hence, we are led to believe that lying among tight and loose, this reductionist evidence is complete (Goh and Tarecki [36]).

The security of the hash functions: For acquiring a short signature we allow $\mathcal{P}$ to be 160 bits. Recovering M and M′ messages is unproblematic such that $h_1(M,\kappa)=h_1(M',\kappa)$ by birthday attacks consequently the hash value of h_1 is 80 bits. The signature returned by the signer is based on a random number κ' instead of κ whenever the attacker insists on a signature on M. Despite the uncertainty of viability in finding other M′ message with $h_1(M,\kappa)=h_1(M',\kappa')$, it is for certain that finding M′ with $h_2(M')=h_2(M)$ is impracticable, as the hash value of h_2 is at least 1024 bits. In the meantime no process will recover s,D from the multivariate congruence $h_1(M,h_2(M)\mathcal{J}_s^{\alpha}(g)\mathcal{J}_D^{\alpha}(\mathfrak{p})$ or find κ,s from $h_2(M)\mathcal{J}_s^{\alpha}(g)\mathcal{J}_{h_1(M,\kappa)}^{\alpha}(\mathfrak{p})=\kappa$. Since the ROM adopts that hash functions are perfect, the probability is

$$\Pr_{\kappa\in Z_q}\left\{h_1(M,\kappa)=D\middle|\forall M\in\{0,1\}^*,\forall D\in 2^{m_{\mathcal{P}}/2}\right\}=\frac{1}{2^{m_{\mathcal{P}}/2}}.$$

Performance comparison

In this section, we discussed the performance comparison between the proposed technique and the recent presented technique such as Cui et al.[41], Shen et al. [18], Espositoet al. [42], Mughal et al. [43], Meshram and Obaidat [44] and Zhang et al. [45]. The performance of the proposed work has been discussed based on the storage cost, communication cost, and the computational cost. The performance has been compared based on the cost for signing stage, and the verification stage. Table 2 give information about the notations used for comparative estimations.

It has been noted that the signing stage and the verification stage require more computational costs compared to the stage of installation and extraction. Therefore, the comparative study has been done based on the computational cost for signing stage and the verification stage. The state-of-the-art studies discussed in Cui et al. [41], Shen et al. [18], Espositoet al. [42], and Mughal et al. [43], Meshram and Obaidat [44] and Zhang et al. [45] have been compared with the proposed work on performance metrics. The relations between $\mathcal{T}_{exp}$, $\mathcal{T}_{chaotic}$, $\mathcal{T}_{mul}$, $\mathcal{T}_{ecsm}$, $\mathcal{T}_{sym}$, and $\mathcal{T}_{pair}$ with respect to $\mathcal{T}_{hash}=0.32\,ms$ has been established in [25–27,46,47]. The proposed work has used the above mentioned notations and their relations are shown in Table 3.

Using Table 2, the computational complexity order among the metrics is shown as;

$$\mathcal{T}_{hash}\approx\mathcal{T}_{chaotic}<\mathcal{T}_{mul}<\mathcal{T}_{inv}<\mathcal{T}_{exp}<\mathcal{T}_{pair}$$

Fig. 3 shows the comparative analysis between the existing schemes and the proposed scheme based on the computational cost for signing stage. The proposed scheme is seen effective as compared to the existing schemes. The proposed scheme requires 2.56 ms for signing stage, shows the effectiveness over the existing schemes.

Fig. 4 shows the comparison on the computational cost for verification stage. It shows that the proposed technique is also efficient in verification stage.

Table 4 present the quantitative analysis of the proposed technique and show the comparison based on the total cost including signing stage and the verification stage. It from Table 4 that the total cost has been reduced to 4. 97 ms. Thus, the proposed technique is found to be efficient as compared to the other techniques in the literature.

Table 2
Notations used for comparative estimations.

Sr. No.	Notation	Meaning
1	$\mathcal{T}_{exp}$	Execution time for a modular exponentiation in group
2	$\mathcal{T}_{chaotic}$	Execution time for chaotic map operation
3	$\mathcal{T}_{mul}$	Execution time for a modular multiplication
4	$\mathcal{T}_{hash}$	Execution time for one way hash function
5	$\mathcal{T}_{pair}$	Execution time for one bilinear pairing operation
6	$\mathcal{T}_{inv}$	Execution time for one modular inverse operation

Table 3
Relationship among notations.

Sr. No.	Relationships among notations
1	$\mathcal{T}_{chaotic}\approx\mathcal{T}_{hash}$
2	$\mathcal{T}_{mul}\approx 2.5\,\mathcal{T}_{hash}$
3	$\mathcal{T}_{inv}\approx 7.5\mathcal{T}_{hash}$
4	$\mathcal{T}_{exp}\approx 600\,\mathcal{T}_{hash}$
5	$\mathcal{T}_{pair}\approx 1550\,\mathcal{T}_{hash}$

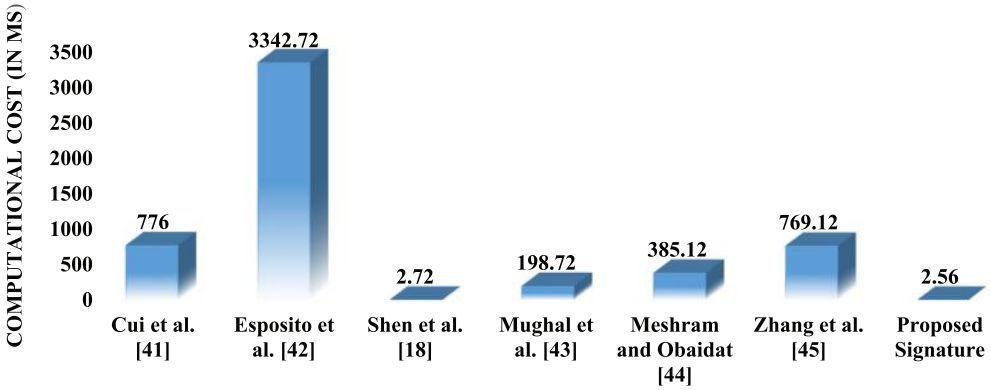

Fig. 3. . Comparison based on computational cost for signing stage.

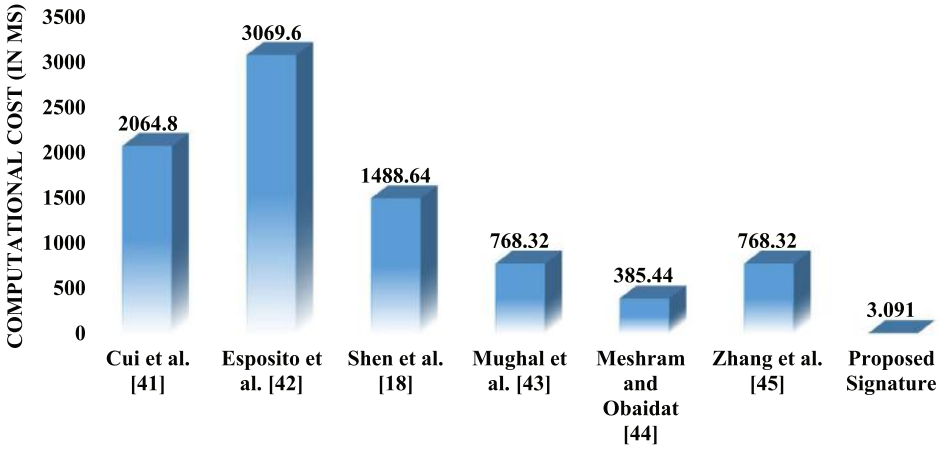

Fig. 4. . Comparison based on computational cost for verification stage.

Table 4
Quantitative analysis based on total computational cost including signing stage and verification stage.

Schemes/Stages	Signing stage	Verification stage	Total (ms)
Shen et al. [18]	$\mathcal{T}_{hash} + 3\mathcal{T}_{mul}$	$2\mathcal{T}_{hash} + 3\mathcal{T}_{pair}$	1489.76
Cui et al. [41]	$4\mathcal{T}_{exp} + 10\mathcal{T}_{mul}$	$3\mathcal{T}_{pair} + 3\mathcal{T}_{exp}+\mathcal{T}_{mul}$	2840.8
Esposito et al. [42]	$\mathcal{T}_{hash} + 7\mathcal{T}_{exp} + 2\mathcal{T}_{pair} + 3\mathcal{T}_{mul} + 2\mathcal{T}_{inv}$	$3\mathcal{T}_{exp} + 5\mathcal{T}_{pair} + 5\mathcal{T}_{mul} + 4\mathcal{T}_{inv}$	5413.12
Mughal et al. [43]	$1\mathcal{T}_{hash} + \mathcal{T}_{exp} + \mathcal{T}_{mul} + \mathcal{T}_{inv}$	$\mathcal{T}_{hash} + 4\mathcal{T}_{exp}$	963.84
Meshram and Obaidat [44]	$\mathcal{T}_{hash} + \mathcal{T}_{mul} + 2\mathcal{T}_{exp}$	$2\mathcal{T}_{hash} + \mathcal{T}_{mul} + 2\mathcal{T}_{exp}$	770.56
Zhang et al. [45]	$4\mathcal{T}_{exp}+\mathcal{T}_{hash}+\mathcal{T}_{mul}$	$4\mathcal{T}_{exp}+\mathcal{T}_{hash}$	1537.44
Proposed Signature	$2\mathcal{T}_{hash} + +\mathcal{T}_{chaotic} + \mathcal{T}_{mul}$	$2\mathcal{T}_{hash} + 2\mathcal{T}_{chaotic} + 2\mathcal{T}_{mul}$	4.97

Conclusion

In human-centered IoT, the protection of sensitive data is essential to provide a protection from forgery attacks. Digital signature is the safest option in asymmetric cryptography for ensuring the ownership and validity of the contact parties. This paper uses fractional chaotic maps for secure communication in human-centered IoT to present an effective provably secure short signature technique. This is existentially unforgeable under EUF-CMA at ROM. Results demonstrate the superiority of our strategy, in comparison with competitors, to take fewer overhead based on computing and communication costs alongside resilience studies. The proposed SSS achieves less processing time and less overhead communication in verification and signature operations, in addition to improved resistance to capture attacks. It is therefore very difficult to crack FCM-based SSS compared to DSA which is based on discrete logarithm. In future work, we will develop a new efficient fuzzy signature scheme using fractional chaotic maps for Block-

chain using Biometrics under human-centered IoT environments. The limitation of fractional chaotic maps based scheme is only sample selection.

Compliance with Ethics Requirements

This article does not contain any studies with human or animal data subjects.

Declaration of Competing Interest

The authors have declared no conflict of interest.

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Title: Enhancement of fault ride-through capability of grid-connected wind farm

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Abstract: The distributed power generation (DPG) at low and medium voltage demands that the renewable generation system is always grid connected during fault condition to ensure the stability of wind power system. The DPG consist of wind turbines (WT) along with fixed speed induction generator (FSIG) does not provide accurate reactive power control and hence, there is need for dedicated compensation. Due to fault condition, the negative sequence component is affected and there is direct impact on DPG with reduction in life expectancy. This paper proposes the application of distributed static compensator (DSTATCOM) for fault ride through (FRT) and reactive power compensation. It has been observed that the compensation of negative sequence component improves the performance of FSIG-based WT. Also, the compensation of positive sequence component avoids the collapsing of voltage and improved the stability of WT. The simulation is done in MATLAB and various tests are considered under fault condition in which results are presented. The FRT enhancement of grid connected WT by using DSTATCOM is 30% and hence, 30% additional wind power is penetrated to the grid.

Keywords: distributed power generation; DPG; wind turbines; fixed speed induction generators; FSIGs; fault ride through capability; distributed static compensator; DSTATCOM.

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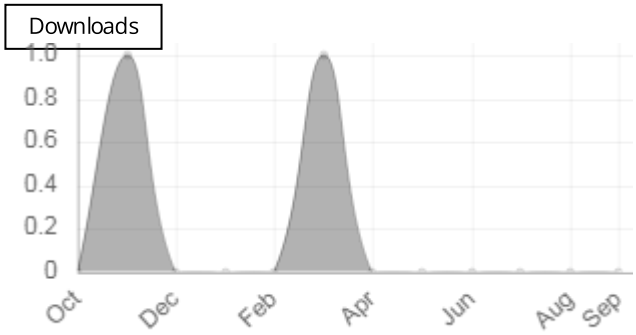

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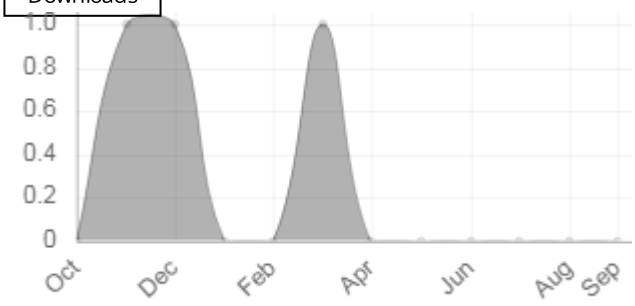

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Development of self-compacting concrete blended with sugarcane bagasse ash

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ABSTRACT

Self-compacting concrete (SCC) can be flows in crowded reinforcement without segregation and it flows under its own weight without vibration. Sugarcane Bagasse ash (SCBA) (agricultural waste) is present in massive amounts in India. The use of SCBA in SCC is described in this paper as a feasible solution to environmental concerns. The usage of bagasse ash is important for sustainable development since it decreases carbon emissions and structural costs. The goal of this study is to discover and compare the fresh and strength properties of SCC made using SCBA as replacement of cement in 0, 10, 15 and 20%. The fresh characteristics of SCC are marginally lowered when the proportion of SCBA increases due to partial cement replacement, but they remain within the EFNARC range. It has been discovered that using it in SCC improves its strength properties.

Selection and peer-review under responsibility of the scientific committee of the International Conference on Latest Developments in Materials & Manufacturing.

1. Introduction

Sugar cane is one of the most widely farmed crops in the world, with a total production of over 1500 million tonnes in over 110 nations [1]. Every year, India produces around 10 million tonnes of SCBA and 300 million tonnes of sugarcane [2]. The sugar processing industry produces SCBA as a by-product. Many researchers proposed that bagasse ash is pozzolanic in nature and it improves the properties of concrete [3]. SCBA's pozzolanic reactivity is fundamental to the reported results [4]. SCBA contains amorphous silica, which produces pozzolanic action [5]. As a result, scientists have looked at the utilization of SCBA as a pozzolanic supplementary cementitious materials in order to limit CO_2 emissions into the environment [6,7]. Adding up to 15% SCBA reduced porosity and sorptivity while increasing strength and durability properties [8].

SCC is a rising concrete with new properties like filling, passing through congested reinforcement, and resistance to segregation. A higher binder concentration (400–600 kg/m^3), a low water- powder ratio, a smaller coarse aggregate quantity, and a superplasticizer admixture are all required for SCC mixtures [9]. Add a viscosity modifying admixture (VMA) to the SCC mixture to accomplish the viscosity property [10]. In SCC, the addition of alternate cement-based materials saves material costs while improving self-compaction. SCC research has recently focused on the incorporation of extra cementitious materials with the goal of alleviating solid waste disposal issues. When agricultural by-products like SCBA are employed in concrete manufacturing, significant energy and cost reductions is attainable [10]. For achieving self-consolidation is to substantially surge the volume of fine materials such as SCBA without raising the pricing [11]. Because SCBA has a larger percentage of amorphous silica, it is an outstanding pozzolanic material and may be utilised as an advantages cementitious material [12]. The strength properties of specimens formed from a combination of 30% SCBA and 30% BFS in place of OPC was equivalent to that of the control.

In SCC, significantly enhanced sulphate resistance, particularly in mixtures with the greatest SCBA ratio [9]. Ingredients for a particular SCC including bagasse ash are 35.63 percent less expensive than those for a control concrete [11]. GGBFS, SCBA, and fly ash have enhanced the strength, and durability because of silica rich content [13]. With the accumulation of SCBA to SCC, the resistance to sulphate assault is reduced [14]. SCC slump flow improves with more bagasse ash, and filling and passing ability improves [15]. Low permeability, decreased ion penetration, and strong resistance to heat assault were seen in concrete replaced with SCBA, resulting

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Use of industrial waste burnt residue to develop sustainable brick

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ABSTRACT

An increase in environmental concern has occurred from the accumulation of mismanaged industrial burned residue, particularly in developing countries. Recycling these wastes as a sustainable building material seems to be a potential solution not only to the pollution problem, but also to the cost of green building design. In order to develop sustainable construction materials, industrial and incinerated leftover materials are being used. The goal of this research is to find out more about the probability of replacing natural soil in brick production with burned industrial waste, such as Cupola Slag and fly ash. This study is based on various mix proportions for making bricks keeping constant cement by 10 %. Brick mixture was prepared with cupola slag and fly ash for various proportions. From the five distinct mixes with variable CS from 80% to 60%, the M1 mix with 80 % CS, 10% FA, 10% Cement had the highest compressive strength 4.5 N/mm^2. Compressive strength for burnt clay bricks is 3.5 N/mm^2 which is less than cupola slag bricks, while the brick mix M5 (60 CS: 30 FA: 10 cement) had the lowest water absorption and density 6.53 % and 1350.57 kg/m^3. This study reveals that used of cupola slag and fly ash in combination gives satisfactory results to be used in making sustainable bricks. This study also reflects the use of burnt residue due to developed sustainable building blocks.

Selection and peer-review under responsibility of the scientific committee of the Sustainable Materials and Practices for Built Environment.

1. Introduction

As a result of urbanization, a large quantity of solid waste was produced, and disposal of this waste became a big issue. Dumping and land-filling of solid waste causes environmental deterioration such as ground water contamination due to leaching, soil pollution, and human health concerns. In recent years, solid waste utilization has grown in potential to recycle valuable materials while reducing solid waste volume, other pollutants, and disposal costs. Brick is a widely utilized building material all over the world. Brick plays an essential part in the construction sector due to its exceptional qualities like as low cost, high strength, and long durability [1]. Because of the high demand for building materials, particularly in the previous decade as a result of rising population, there is a gap in demand–supply management of these resources. As a result, experts are working to create and develop sustainable alternative building material options to suit the ever-increasing demand. Lightweight construction materials low-cost and environmentally friendly are becoming increasingly popular in the construction sector has demanded research on ways to do so while still following the standards material criteria. [2]. Approximately 960 million tonnes of solid waste are created per annum in India as waste material of industrial, mining, and mining operations [3]. Various industrial and agricultural wastes are now being used to create building blocks that provide a long-term answer for the construction sector [4]. Cupola slag is a waste product produced by the cast iron industry when molten steel is alienated from impurities in cupola furnaces [5]. During the cast iron production process in cupola furnaces, roughly 57 percent of the waste is produced. Industry produces between 50 and 3000 tonnes of C.I [6]. In concrete, cupola slag has been used as a partial cement substitute [7]. Cupola slag was also employed in concrete to evaluate its behavior as a partial replacement for both coarse and fine aggregate combinations [8]. For increasing various thermo-mechanical properties several types of bricks such as burnt clay bricks, fly ash bricks, stone masonry, refractory bricks, solid sand lime bricks, blocks, and thermos acoustic bricks can be employed [9]. Different waste materials were used to make sustainable bricks, including co-fired blended ash, spent mushrooms compost, electric arc furnace

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Article

Experimental Evaluation of Industrial Mushroom Waste Substrate Using Hybrid Mechanism of Vermicomposting and Effective Microorganisms

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Abstract: Mushroom waste substrates are highly resistant lignocellulosic wastes that are commercially produced by industries after harvesting. These wastes produce large environmental challenges regarding disposal and, thus, require treatment facilities. In the present article, the effect of *Eisenia-fetida*-based vermicomposting and an effective microorganism solution on the mushroom waste substrate were investigated using four different composting mixtures: mushroom waste [MW] substrate composting with effective microorganisms [MW+EM], raw mushroom waste [RWM] substrate composting with effective microorganisms [RMW+EM], mushroom waste substrate composting with vermicomposting and effective microorganisms [MW+V+EM], and raw mushroom waste substrate composting with vermicomposting and effective microorganisms [RWM+V+EM]. This article discusses the structural and physiochemical changes at four samples for 45 days (almost six weeks) of composting. The physical and chemical parameters were monitored during composting and provided information on the duration of the process. The results indicated pH (7.2~8), NPK value (0.9~1.8), and C:N ratio < 14, and heavy metals exhibited a decreasing trend in later stages for all sets of compost materials and showed the maturity level. FTIR spectra revealed that all four samples included peaks for the -OH (hydroxy group) ranging from 3780 to 3500 cm^{-1} and a ridge indicating the C=C (alkenyl bond) ranging from 1650 to 1620 cm^{-1} in compost. The X-ray diffraction spectrum clearly shows how earthworms and microbes break down molecules into cellulose compounds, and the average crystallinity size using Scherrer's equation was found to be between 69.82 and 93.13 nm. Based on the experimental analysis, [RWM+V+EM] accelerated the breakdown of organic matter and showed improvement compared with other composts in compostable materials, thus, emphasizing the critical nature of long-term mushroom waste management and treatment.

Keywords: mushroom waste; vermicomposting; effective microorganisms; XRD method; FTIR method

1. Introduction

Mushroom farming is a green enterprise since it recycles the waste from farms, animals breweries, and other sources while producing fruit bodies with unique nutritional and medicinal properties [1] Every year, 6–7% more global mushroom production is grown in

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Utilization of phosphogypsum and rice husk to develop sustainable bricks

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ABSTRACT

Rapid industrialization and advancement in technology have led to the creation of bulk loads of waste material. Subsequently, the management of these waste materials has been a topic of major concern due to their complex treatment processes. As a result, utilizing these wastes with new ideas has presented viable solutions to global concerns in recent years. One of them is the utilization of waste materials in manufacturing sustainable brick. In the present study, phosphogypsum (PG), rice husk ash (RHA), and cement are used in different proportions [PG-65% to 82.5%, RHA-2.5% to 15%, cement-15% to 20%] to develop sustainable bricks. The developed sustainable bricks were tested as per the Indian and ASTM Standards. Findings revealed that the compressive strength and water absorption value of composition 'H' [PG(77.5%), RHA(7.5%), CEMENT(15%)] meet the requirement of IS 3495:1992. The designed sustainable brick of composition 'H' is shown to have a higher specific heat capacity than commercially available fly ash bricks (FAB) and burnt clay bricks (BCB); hence the developed sustainable brick (composition H) is found to be thermally insulated. Present research can be used by various resource persons who are active in developing sustainable construction materials or bricks from industrial wastes.

Selection and peer-review under responsibility of the scientific committee of the Sustainable Materials and Practices for Built Environment.

1. Introduction

Bricks contain the majority of the embodied energy in a unit of a wall. They are the fundamental building unit of any structure. The interest in developing bricks from diverse industrial or agricultural wastes has increased because population expansion outpaces available housing. The production of building materials has an irreversible impact on the environment. The construction industry's growth is reliant on finite natural resources, thus forcing manufacturers to seek alternative solutions. Due to the increased demand for construction materials, several academics or researchers are attempting to turn industrial wastes into sustainable construction materials. Recycling and reusing these wastes in developing sustainable construction materials may help to reduce reliance on natural resources, conserve non-renewable resources, improve population health and security, and reduce waste disposal costs. The most efficient use of waste materials in the creation of sustainable bricks is a great approach to solve the problem of waste storage while also cutting the cost of construction materials. Globally, different waste materials are produced in industries viz. chemical solvents, paints, agricultural wastes, paper products, industrial by-products, metals, construction wastes, and radioactive wastes. A variety of these wastes has been used for manufacturing sustainable materials like agro-industrial wastes [1], granulated blast-furnace slag, waste paper pulp, waste steel slag, rice husk ash, expanded polystyrene [2], etc. Some of them have become prime waste materials for brick production, and others are still undergoing research works. In this study, statistics about phosphogypsum (PG) and rice husk ash (RHA) have been described to get a general idea of the potentiality of these waste materials. The PG comes from phosphoric acid factories' filtration process [3,4]. Approximately 4–6 Tonnes [5] of PG is generated per ton of P_2O_5 recovered. If PG is dumped in an open area, it could endanger the ecosystem. The handling and control of PG is also a critical challenge in plants owing to their massive volumes, as well as the likelihood of dust and heavy metals emissions. [6] There are 11 phosphoric acid pro-

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Performance evaluation of microbial fuel cell using novel anode design and with low-cost components

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Microbial fuel cells (MFCs) have proven to be an effective technology for treatment of waste water with the additional advantage of electricity generation. Although the power density obtained has increased manyfold over the past decade, the cost of treatment and cost of electricity generation need to be brought down to make the process feasible. In the present research, an attempt was made to use locally available, low-cost and effective materials for the construction of an MFC using novel anode architecture. The MFC was made using multiple membranes in a single cell. The special design of the anode proved to be very effective in obtaining a higher power density. A volumetric power density of 2002 mW/m^3 could be achieved without the use of any chemical catholyte. The corresponding coulombic efficiency obtained was 13.17%. When a chemical catholyte was used, the power density increased to 5201 mW/m^3, an increase by more than 2.5 times. The corresponding coulombic efficiency of the MFC also increased to 29.16%. Such novel anode architecture could take this technology a step forward for practical implementation to harvest carbon dioxide neutral electricity from waste water. The performance of the MFC in the removal of chemical oxygen demand (COD) from waste water was found to be 93.9–97.75%, which is highly satisfactory. The removal efficiency was found to be independent of the initial COD of the substrate.

Keywords: energy/microbial fuel cell/power density

Notation

K_s	half-velocity constant (mg/l)
k	maximum specific substrate utilisation rate (day^{-1})
r_{su}	rate of substrate utilisation (mg/(l day))
S	substrate concentration (mg/l)
X	biomass concentration (mg/l)

Introduction

The changing nature of industrial waste water characteristics and their impact on human health and environment are the most important concerns in waste water treatment. In aerobic treatment of waste water, the costs of treatment of sludge, nutrients and energy are prohibitive and, hence, pose challenges to the engineers. Anaerobic treatment of waste water is an alternative strategy, the main advantage being the low volume of sludge generated and low electricity consumption along with simultaneous generation of methane (biogas). However, anaerobic treatment of domestic waste water, many times, is considered not feasible due to low strength or biochemical oxygen (O_2) demand concentrations. Simultaneously, the increasing demand for energy with the increase in population has forced mankind to look for alternative sources of energy, which need to be environmentally sustainable (Hozenuzzaman *et al.*, 2015; Sonell, 2015).

Conversion of organic matter to biofuels is another option for simultaneous treatment of waste water and energy recovery. A whole range of biofuels and related bioproducts can be produced by means of microbiological fermentation. Bioethanol, biogas and hydrogen gas are the major biofuels. Bioethanol has emerged as the most promising fuel to replace fossil fuel in recent years (Stafford *et al.*, 2018).

Microbial fuel cells (MFCs) represent relatively a new approach for waste water treatment along with the advantage of recovering energy in the form of direct electricity. An MFC uses biomass through bacteria and generates electricity. Compared with other biofuel options, an MFC has the scope to convert 1 kg of organic matter into 3 kWh of electrical energy, that too in a single step, unlike two or more steps for all other biofuels, implying that the highest efficiency of conversion of biomass to electricity can be achieved in MFCs (Cheng and Logan, 2011). Another important advantage of an MFC is the lower sludge yield compared with that of aerobic processes, which is caused by the reduced energy available for biomass growth as a significant part of the substrate energy is converted to electrical power. In MFCs, the sludge yield range from 0.07 to 0.22 g biomass chemical oxygen demand (COD) per gram of substrate COD, compared with 0.4 g biomass COD per gram of substrate COD removed for aerobic treatment (Rabaey and Verstraete, 2005).

An MFC is a type of hybrid system and is very different from traditional aerobic or anaerobic waste-water-treatment systems. At the microbial level, this is an anaerobic treatment technology. The bacteria must be grown in an anaerobic environment to produce electricity. However, since oxygen is used at the cathode end, it is also an aerobic system, although oxygen is not directly used for microbial respiration; rather, it is required only for reduction of proton, or other cations, to support cathodic reaction.

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REVIEW PAPER

Improvement in Energy Efficiency of CPV Module by Way of various Active and Passive Cooling Techniques

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Abstract In a solar cell, amount of light not converted into electricity gets converted into heat. This waste heat induces thermal stresses and increases temperature of the solar cell. Operating temperature of the cell plays vital role in the efficiency, power output and service life. Multi-junction tandem MJT cell is a concentrated photo voltaic cell. It is the most efficient PV cell reported so far in the world. Power output and efficiency of MJT cell depends on the operating temperature. Performance of the solar cell decline with rise in operating temperature. Maximum power, voltage, efficiency and long life can be achieved by effective cooling and by operating the MJT at standard test condition of the cell. Various active and passive cooling techniques reviewed in the present paper. In passive cooling; effectiveness of extended surface, heat pipe and micro fins covered, whereas in active cooling Peltier effect cooling, compressed air, etc., covered. This study will enable us to explore effective cooling system for proposed MJT CPV system to achieve best possible efficiency. The review explores new insight of potential techniques to improve yield of the CPV.

Keywords Concentrated photovoltaic module · Multi-junction solar cell · Active cooling · Passive cooling

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List of Symbols

A	Area (m^2)
CR	Concetration ratio
$G(\lambda)$	Spectral DNI ($W/m^2/nm$)
q_{heat}	Heat power (W)
P_m	Maximum power output (W)
P_{in}	Incident power
V_{oc}	Open circuit voltage
MJT	Multijunction tandem
CPV	Concentrated photovoltaic

Greek Letters

λ	Wavelenght (nm)
η_{opt}	Optical efficiency
η_{cell}	Cell efficiency

Abbreviations

InGaAs	Indium gallium arsenide
InGaP	Indium gallium phosphide
Ge	Germanium

Introduction

The merit of livelihood of humankind in any nation mostly depends on the commercial broadening of particular nation, which in revolve hang on the power accessibility and power expenditure. The power stipulation in almost all of the nation are reach out by crude oil and coal but their accessibility is restricted. Reformation of power hoarded in the crude oil into applicable formation constructs detrimental toxic waste, and they escort to greenhouse effect, which leads to the crucial intimidation for entire universe. Increasing global demand for power also increases the crude oil prices which lead need of fast moving toward solar energy resources.

Implementation of multi-objective Jaya optimization for performance improvement in machining curve hole in P20 mold steel by sinking EDM

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Abstract

Purpose – Machining of curved channels using electrical discharge machining (EDM) is a novel approach. In this study, an experimental setup was designed, developed and mounted on die-sinking EDM to manufacture curve channels in AISI P20 mold steel.

Design/methodology/approach – The effect of specific machining parameters such as peak current, pulse on time, duty factor and lift over material removal rate (MRR) and tool wear rate (TWR) were studied. Multi-objective optimization was performed using Taguchi technique and Jaya algorithm.

Findings – The experimental results revealed current and pulse on time to have the predominant effect over material removal and tool wear diagnostic parameters with contributions of 39.67, 32.04% and 43.05, 36.52%, respectively. The improvements in material removal and tool wear as per the various optimization techniques were 35.48 and 10.91%, respectively.

Originality/value – Thus, Taguchi method was used for effective optimization of the machining parameters. Further, nature-based Jaya algorithm was implemented for obtaining the optimum values of TWR and MRR.

Keywords Electro discharge machining, Curve hole, Material removal rate (MRR), Tool wear rate (TWR), Analysis of variance (ANOVA), Jaya algorithm

Paper type Research paper

1. Introduction

Electrical discharge machining (EDM) is one of the most widely used non-traditional machining technique. Because of its non-contact machining nature, it is independent of the material characteristics pertaining to the workpiece. Hence, it is extensively used to shape hard mold making workpieces, especially in aviation industries (Gohil and Puri, 2017). In the case of injection molding process of plastics, solidification of the product occurs by applying mold cooling. Mold cooling is intern achieved by flowing coolant (water) through channels made in mold. Cooling channels are commonly manufactured by creating multiple straight holes. In some situations, designers use straight holes instead of curve holes. Therefore, the profile of a cooling channel renders a polygonal line. These straight holes restrict the degree of freedom in their shape and position. To solve these problems, it is requisite to design and develop a new method for machining curve channels and to put the process in real-world practice.

To achieve aforesaid objective, certain procedures have been developed for machining curve channels and can produce curved holes (Fukui and Kinoshita, 1989). The authors presented a unique L- and U-shape hole making process, which uses a modest mechanism (consist of a machining electrode, helical spring, shaft, pulleys, wires, fixtures, etc.) connected to conventional EDM. The device with tool electrode moves beside a curve path while performing EDM. A key feature of the device is that, it can machine a curve channel between two drilled holes perpendicular to each other. It was also reported that the upgraded device can cut U-shape and slant holes; those are impossible to make by traditional machining processes (Ishida and Takeuchi, 2002; Ishida and Takeuchi, 2008).

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Simultaneous Scheduling of Machines, Tool Transporter and Tools in a Multi Machine Flexible Manufacturing System Without Tool Delay Using Crow Search Algorithm

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Abstract

This paper deals with machines, tool transporter (TT) and tools simultaneous scheduling in multi machine flexible manufacturing system (FMS) with the lowest possible number of copies of every tool type without tool delay taking into account tool transfer times to minimize makespan (MSN). The tools are stored in a central tool magazine (CTM) that shares with and serves for several machines. The problem is to determine the lowest possible number of copies of every tool variety, allocation of copies of tools to job-operations, job-operations' sequencing on machines and corresponding trip operations of TT, including the dead heading trip and loaded trip times of TT without tool delay for MSN minimization. This paper proposes nonlinear mixed integer programming (MIP) formulation to model this simultaneous scheduling problem and crow search algorithm (CSA) built on the crows' intelligent behavior to solve this problem. The results have been tabulated, analyzed and compared.

Keywords: Scheduling of machines, tool transporter and tools; FMS; no tool delay; crow search algorithm; makespan; optimization techniques.

1. Introduction

Manufacturing companies are expected to handle growing product complexities, shorter market time, new technologies, global competition threats, and quickly changing situation. FMS is setup to deal with manufacturing competition. FMS is an integrated production system consisting of multipurpose machine tools which are computer numerical controlled (CNC), linked to an automated material handling system (MHS) [1]. FMS aims to be flexible in manufacture without undermining the product quality. The flexibility of the FMS relies on the flexibilities of CNC machines, automated MHS, and control software. FMSs have been categorized into distinct kinds as per their workflow patterns, size, or manufacturing type. Four kinds of FMS are described from the planning and control point of perspective: single flexible machines (SFM), flexible manufacturing cells (FMC), multi-machine FMS (MMFMS), and multi-cell FMS (MCFMS) [2]. Advantages, such as reductions in cost, enhanced utilizations, decreased work-in-process, etc have already been proved by existing FMS implementations [3]. Use of resources is improved by scheduling tasks so as to reduce the MSN [4]. One way to achieve high productivity in FMS is to solve scheduling problems optimally or near optimally.

Tool loading is a complicating issue in scheduling problems since the number of tool copies are limited and may be smaller than the number of machines due to economic restrictions. Job and tool scheduling is an important problem for production systems. Inefficient planning of job scheduling and tool loading may lead to under utilization of capital intensive machines, and high level of machine idle time [5]. Therefore, efficient scheduling of jobs and the tools enables a manufacturing system to increase machines' utilization and decrease their idle times. There are a number of studies on the machines and tools scheduling. Tang and Denardo [6] solved the problem of determining job sequence and tools which are placed before every job is processed on machine for minimization of tool switches. Chandra et al [7] proposed a practical approach for deciding the sequence of jobs and tools for minimization of the total set up and processing times to make sure that jobs are completed before their delivery dates. Song et al [8] mentioned heuristic algorithm for allocating tools and parts for minimization of tool switches between machines where every part needs to visit only one machine for its complete processing. Roh and Kim [9] examined allotment of part and tool, and scheduling issues for entire tardiness minimization under

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Compression deformation analysis of cellular lattice structure for structural optimization in additive manufacturing

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Abstract

Additive manufacturing has Cellular structures as its prominent component because of their ability to overshadow the solid ones on account of more strength-to-weight ratio, porous and light-weight nature. A lattice structure called vintile was designed and the effect of change in unit size, lattice kernel position, volume reduction coefficient, and cellular structure optimization on mechanical properties were discussed in this study. Samples with different cell sizes, lattice kernel positions, were 3-D printed using Polylactic acid (PLA) material on MakerBot Replicator Plus 3D printer. Finite element analysis (FEA) and experimentation work was performed on the designed cellular structures so as to make the estimation and evaluation of the mechanical properties of these cellular structures. Output of the work shown that the vin tile lattice topology cellular structure with lattice kernels on both sides of the central hole geometry bears less stress and very little deformation than the other cellular structures with kernels on only either side. Experimental results were in conformation with simulation results. The study does not limit itself to design of cellular structure only but also compared mechanical behavior through volume reduction coefficient (VRC) and surface area coefficient (SAC). Final testing of vin tile cellular structures was done using FEA and experimental work have been carried out on fabricated samples. The results of both concluded that the optimized cellular structure had less stress and deformation than the non-optimized cellular structure.

Keywords

Cellular structure; Lattice kernel; Additive manufacturing; Finite element analysis; Structural optimization

QUALITY PAPER

Application of graph-theoretic approach for the evaluation of lean-six-sigma (LSS) critical-success-factors (CSFs) facilitating quality-audits in Indian small & medium enterprises (SMEs)

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Abstract

Purpose – One of the major challenges for developing countries is the lack of mechanisms for the evaluation of critical success factors (CSFs) of quality initiatives, which hampers the journey toward sustainability. Lean Six Sigma (LSS) has been one of the most widely used initiatives supporting quality improvement with wastes reduction and facilitating sustainability. To expedite LSS and its spread, it is important to evaluate key CSFs. Accordingly, the purpose of this paper is to provide an approach for the evaluation of LSS-CSFs for Indian small and medium enterprises (SMEs).
Design/methodology/approach – The paper uses a graph theoretic approach and demonstrates the evaluation of LSS-CSFs by proposing an index. The development of index is illustrated using a set of seven prioritized CSFs based on the literature review paper (Lande *et al.*, 2016).
Findings – This study guides about the translation of CSFs in the form of an index (number) and will benefit both researchers and practitioners, who wish to study the role of key CSFs for implementation and audit requirements for sustainability.
Research limitations/implications – Authors remain confined only to Indian SMEs.
Originality/value – LSS possesses the potential to enhance the performance of manufacturing SMEs, but its evaluation is not easy. This attempt for offering a useful evaluation scheme involving CSFs, in the areas of LSS in developing country contexts, is the first. The approach also facilitates both quality audits and benchmarking between different sets of CSFs. The approach is generalizable and can be extended in other areas.

Keywords Critical success factors, Small and medium enterprises, Indian, Lean Six Sigma, Graph theory
Paper type Research paper

1. Introduction

The concept of sustainable development (SD) is understood and practised as a commitment, which ultimately gets translated into actions based on the nature of improvement initiatives, from the top management of the organizations that seek sustained business excellence while

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Performance evaluation of CNC turning process for tool tip temperature and tool wear by Taguchi method

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ABSTRACT

The performance of the CNC turning process is experimentally evaluated in this paper. The independent variables are feed rate, depth of cut, nose radius, tool type, and environmental condition. Three different levels of predictors are selected. The dependent variables are TTT (tool tip temperature) and TW (tool wear). The machine is run at 1337 RPM. The chatter in the spindle is included as an uncontrollable variable (Noise Factor) with three different values. The number of observations is calculated by Taguchi Method. The experimentation is conducted on CNC Spinner Lathe Machine. The responses are measured by a Non-contact laser gun and Canny Method in MATLAB software. The analysis is performed by Taguchi philosophy and ANOVA. The best setting for responses is identified by the main effect plot. The prediction of the output parameters at optimum levels is done by additive model. Minimum Tool Tip Temperature (50.545 °C) is achieved when Environmental condition is at high level (minimum quantity lubrication), Nose Radius is at low level (0.4 mm), Feed rate is at low level (0.15 mm/rev), Depth of cut is at low level (0.5 mm) and tool type is at high level (CVD Coated insert). Minimum Tool Wear (0.0401 mm) is achieved when Environmental condition is at high level (minimum quantity lubrication), Nose Radius is at high level (1.2 mm), Feed rate is at high level (0.35 mm/rev), Depth of cut is at low level (0.5 mm) and tool type is at high level (CVD Coated insert).

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1. Introduction

Nowadays, it is very important to satisfy the end-users (Customers) as much as product quality is considered. Quality is nothing but the measure of performance of product after selling to the customer. And productivity is very crucial to the manufactures, when profit is considered. Both quality and productivity are contradictive in nature. Hence it becomes necessary to identify the best setting of factors related process/product that will satisfy both quality and productivity. Multi-objective optimization is a tool which helps to achieve this.

In machining process, especially in turning, milling and drilling, condition of cutting tool decides the quality of surface finish and MRR (Material removal rate). TTT and TW decide the condition of cutting tool. If the tool is not damaged (wear), the predefined value of quality characteristics can be achieved. But if the machining is done with damaged cutting tool, even if the optimal setting is used, the quality of finished products get degraded. Hence, in this paper, the tool tip temperature and tool wear are considered for performance evaluation of Turing process. AISI 4340 is used as workpeice material and coated (PVD & CVD) as well as uncoated inserts are used as cutting tool. Shilpa B. Sahare *et al.* [1], this paper described the use of Taguchi philosophy to optimize milling process for the workpeice Al2024. A comparative study is done for different type of lubrications though experimentation. A flow rate was the key factor for performance evaluation of lubrication. A regression

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Additive manufacturing (3D printing): Recent progress on advancement of materials and challenges

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ABSTRACT

Design flexibility, product customization, waste reduction, and the capability to construct complex components, and efficient prototyping, are all advantages of 3D printing or additive manufacturing (AM). Because the area is continually expanding, it is necessary to conduct periodic assessments of one's perceptive of AM processes and their progression. Additive manufacturing has enormous promise for a wider application, particularly in medical, aerospace, and automotive industries. To meet this demand, this article provides a thorough assessment of the evolution of materials in Additive Manufacturing (AM) and the issues connected with them. The innovatory uses of AM in aircraft, biomedical, defensive constructions and buildings were particularly emphasised. It starts with an introduction to several AM methods, then highlights the trajectory of their advancement. Material demands, significant developments in recently discovered materials, and prospective applications are all examined in depth and summarised. Finally, this review concluded by outlining the primary problems currently experienced in the use of AM materials and offering insights into the important potential and disadvantages it offers, like standard for upcoming research and innovation.

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1. Introduction

Additive manufacturing (AM) has emerged as a revolutionary tool to generate things with complicated shapes by layering materials as per CAD model data. Various parts could only be remodelled with improved performance and manufactured effectively without assembly because of the AM's lower-volume, customized manufacture, and enormous design freedom. Components of multiple parts can now be fabricated economically without assembly redesigned with improved performance [1]. This is true across several industries [2-5], including automotive [6-10], medical engineering [11-14], aerospace [15-22], and consumer goods [23-25]. AM is also seen as an ecologically friendly production process, with the ability to cut 525.5 Mt of total CO_2 emissions by 2025 [26]. This progression is aided by continuous advances in AM-specific software and printer hardware, and an expansion of the existing materials palette [27-29]. The use of such additive manufacturing (AM) in product innovation can lower lead times by up to 90% and manufacturing costs upto 70%. By such impressive profit, the world market for AM is expected to cross approximately $23 billion by 2023, with a 22 % compounding growth annually [30].

Recent advancements allowed companies to make 3D printing machinery at a reasonable cost; as a result, these technologies are now available in many research facilities, educational institutions, and even households [31]. The ease of access to AM equipment enables engineers and researchers to create items by integration of various materials. The goal is to incorporate physical,

Abbreviations: 3DP, Three Dimensional Printing; ABS, Acrylonitrile-Butadiene-Styrene; ALM, Additive Layer Manufacturing; AM, Additive Manufacturing; BMG, Bulk Metallic Glass; CAD, Computer Aided Design; CSL, Ceramic Stereolithography; DED, Direct Energy Deposition; DMD, Directed-Energy Deposition; EHDP, Electro Hydro Dynamic Printing; FFF, Fused Filament Fabrication; FMEA, Federal Emergency Management Agency; FRC, Fiber-Reinforced Concrete; LBM, Laser Beam Melting; LED, Light Emitting Diode; LOM, Laminated Object Manufacturing; MPa, Mega Pascal; OPC, Ordinary; PA, Polyamide; PBF, Powder Bed Fusion; PC, Polycarbonate; PLA, Polylactic Acid; PVA, Polyvinyl Alcohol; RP, Rapid Prototyping; SAC, Sulpho aluminate Cement; SEM, Scanning Electron Microscope; SLS, Selective Laser Sintering; SLG, Selective Laser Gelation; SLM, Selective Laser Melting; UV, Ultra Violet.

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Application of ANN modelling for optimisation of surface quality and kerf taper angle in abrasive water jet machining of AISI 1018 steel

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ABSTRACT

Abrasive water jet machining (AWJM) is the modern machining method used in various industrial applications. In this paper, an attempt has been made to determine optimum AWJM parameters using artificial neural network (ANN). Flow rate of abrasive, stand-off distance and traverse speed are used as input parameters for machining of AISI 1018 steel. Experimental data are used for training and testing of ANN. A feed forward ANN is established using the experimental data obtained during the AWJ machining of steel. Surface roughness (R_a) and kerf taper angle (θ) are estimated, on the basis of ANN performance and regression analysis. The regression plots of both responses show more than 97% of agreement among the estimated values and experimental data. Later on, novel approach of model optimisation is executed using univariate analysis on inputs to ANN to get the optimal AWJM process parameters. Optimal response solution is obtained as surface roughness (R_a) = 2.46 μm and taper angle (θ) = 1.25° at flow rate (A_f) = 450 g/min; stand-off distance (S_d) = 3 mm and traverse speed (T_v) = 85 mm/min. The study shows that the ANN is proficient tool for deciding the optimum AWJ machining parameters.

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KEYWORDS
Abrasive water jet machining; surface quality; kerf taper angle; artificial neural network

1. Introduction

Demand of high-quality products has always been increasing, and therefore, manufacturing industries are facing various challenges using traditional machining tools. To overcome these challenges, unconventional machining processes came into existence, which includes the processes such as electro-thermal processes, electrochemical processes, mechanical processes and chemical processes. Abrasive water jet machining (AWJM) is one such an unconventional form of machining process in which the mechanical energy of abrasive particle along with water is used as a tool to remove material from work piece. Researchers have evaluated the performance of AWJM based on surface quality, kerf characteristics and material removal rate, which basically depends on independent parameters such as nozzle pressure, diameter of the nozzle, feed rate, stand-off distance, transverse speed, etc. [1,2].

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Optimization of green sand process for quality improvement in castings by using combination of Taguchi Techniques-GRA-PCA

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Abstract

The castings produced by a sand casting process have multiple quality features. The quality of a casting always depends upon proper controlling of enormous parameters involved in the process as well as proper combination among these parameters, while some of the defects are found persisting and difficult to avoid. Controlling the process to avoid the rejections of cast components due to the presence of such persisting defects mainly depends on the right understanding of the parameters associated with it. In the work presented in this paper, the primary focus is on the optimization of essential parameters of the green sand process to minimize the occurrences of these persisting defects in gray iron automotive components through experimental investigation using effective approach. The study applies the Taguchi's 'Design of Experiments' approach in combination with grey relational analysis (GRA) and principal component analysis (PCA) for determining the optimal level of parameters to minimize the defects Shrinkage porosity (SP), blowholes (BH), sand inclusion (SI), scabbing (SC) and low hardness (LH), which are persisting in the foundry industry producing cylinder heads and other castings required in the automotive, factory situated in central India. Optimal levels of parameters were determined by the single grey relational grade (GRG) obtained from GRA for overall improvement in multi-quality characteristics. PCA is used to determine the corresponding weighting values of each performance. The outcomes of this study assure that the approach used in this work, is useful to foundry industries to minimize the persisting casting defects.

Keywords

Green sand process; Persisting casting defects; Process parameters; Taguchi orthogonal array; Grey relational analysis (GRA); Principal component analysis (PCA); Analysis of variance: ANOVA

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Experimental investigation of different electrical configurations and topologies for Photovoltaic system

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Keywords:
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Electrical configuration
Topology
Shading pattern

ABSTRACT

The recent solar technology offers clean, economic andenvironment friendly energy applications to society. Photovoltaic (PV) modules are directly converted the incident solar radiations into electrical energy. These modules are connected in different electrical configurations and topologies. These configurations and topologies are decided as per the power requirement. The selection of variety of electrical configurationsand type of topologies arecritical for performance of the PV system. This research paper aims to Experimental investigationthe different PV array configurations (Series Parallel and Total cross Tied) with two different topologies (4SX5P and 5SX4P) in non-shading and partially shaded condition. It is observed that impedance of solar panel and input resistance playing important role in achieving maximum power output of PV system. The 4Sx5P topology shows the maximum power of 12 W is observed at 8 am for uniform condition and 11.7 W is at 9:30 a.m. for partial shaded. Similarly 18.57 W at 9:15 a.m. for uniform condition and 15.26 W at 10:45 a.m. are observed for partial shaded condition of 5Sx4P topology. The power generated in both topologies is almost following the same pattern. From above graph it is clear that approximately 9–13% power variation was observed in uniform and partial shading condition for both the topologies.

Selection and peer-review under responsibility of the scientific committee of the International Symposium on Materials of the Millennium: Emerging Trends and Future Prospects.

1. Introduction

Energy is the most important factor for the economic as well as social and technological development of both developing and developed countries [1]. Mostly we are depending on different non renewable energy sources for satisfying our daily energy demand. In non-renewable energy sources fossil fuel are playing crucial role for managing these demands. But scarcity of fossil fuel, continuous price hike and environmental concern are the major bottle neck for usingthese for a long time. Detail literature review shows that lot of work was already carried out for minimizing the adverse effect of fossil fuels but these efforts are not enough as per different published reports on global disturbance. In recent year's renewable energy sources like solar energy, wind energy, bio gas and fuel cell technology are showing potential for bridging the gap of future energy demands with environmental concern. These energy sources having their own challenges and at the same time also providing different opportunities. Zero carbon emission, easy availability and environment friendlyare the important characteristics which attract lot of research on renewable energy sources.

Recently it is observed that solar technology is one of the most promising areas for future energy demand. Solar energy can be used in a direct or indirect way for producing the energy. In indirect utilization of solar energies like wind energy, hydro energy, ocean energy etc. observe that solar energy having secondary effect on production. Photoelectric and photo thermal are the direct conversion of energy from solar radiation. Photoelectric conversion direct directly converts the incident radiation into electrical energy while the photo thermal conversion directly convert the incident radiation into thermal energy. On grid, off grid and hybrid solar power plant are works on the principle of photoelectric conversion. Solar water heater, solar cooker are working on the principle of solar photo thermal conversion.

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Shielded metal arc welding of AISI 409M ferritic stainless steel: study on mechanical, intergranular corrosion properties and microstructure analysis

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Abstract

Purpose – The purpose of this study is on AISI 409 M ferritic stainless steel (FSS) which is developing a preferred choice for railway carriages, storage tanks and reactors in chemical plants. The intergranular corrosion behavior of welded SS 409 M has been studied in H_2SO_4 solution (0.5 M) with the addition of NH_4SCN (0.01 M) with different heat input. As this study is very important in context of various chemical and petrochemical industries.

Design/methodology/approach – The microstructure, mechanical properties and intergranular corrosion properties of AISI 409 M FSS using shielded metal arc welding were investigated. Shielded metal arc welding with different welding current values are used to change the heat input in the joints resulted in the microstructural variations. The microstructure of the welded steel was carefully inspected along the width of the heat-affected zone (HAZ) and the transverse-section of the thin plate.

Findings – The width of heat affected zone (3.1,4.2 and 5.8 mm) increases on increasing the welding heat input. Due to change in grain size (grain coarsening) as HAZ increased. From the microstructure, it was observed that the large grain growth which is dendritic and the structure become finer to increase in welding heat input. For lower heat input, the maximum microhardness value (388HV) was observed compared with medium (351 HV) and higher heat input (344 HV), which is caused by a rapid cooling rate and the depleted area of chromium (Cr) and nickel (Ni). The increase in weld heat input decreases tensile strength, i.e. 465 MPa, 440 MPa and 418 MPa for low, medium and high heat input, respectively. This is because of grain coarsening and chromium carbide precipitation in sensitized zone and wider HAZ. The degree of sensitization increases (27.04%, 31.86% and 36.08%) to increase welding heat input because of chromium carbide deposition at the grain boundaries. The results revealed that the higher degree of sensitization and the difference in intergranular corrosion behavior under high heat input are related to the grain growth in the HAZ and the weld zone.

Originality/value – The study is based on intergranular corrosion behavior of welded SS 409 M in H2SO4 solution (0.5 M) with the addition of NH4SCN (0.01 M) with different heat input which is rarely found in literature.

Keywords Microstructure, Hardness, SS 409M, SMAW, Hardness, HAZ, Intergranular corrosion

Paper type Research paper

1. Introduction

Ferritic stainless steel (SS) 409 M is modified version of AISI 409 M with a lower carbon content (0.03%) and with a very

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Effect of number of welding passes on the microstructure, mechanical and intergranular corrosion properties of 409M ferritic stainless steel

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Abstract

Purpose – This paper aims to study the effect of number of welding passes on microstructure, mechanical and corrosion properties of 409 M ferritic stainless steel. Shielded metal arc welding (SMAW) process is used to weld two metal sheets of 409 M having 3 mm thickness as bead-on-plate with single, double and triple passes. Microstructures were observed at transverse section with the help of optical microscope and with increasing number of passes grain growth, and the width of heat-affected zone (HAZ) increases. The results of tensile tests revealed that as number of passes increases, there is reduction in tensile strength and ductility. Double loop electrochemical potentiokinetic reactivation (DL-EPR) test revealed that as number of passes increases, the degree of sensitization increases. This is due to the deposition of chromium carbides at the grain boundaries and the associated depletion of chromium.

Design/methodology/approach – Three welded plates of single, double and triple pass were welded by SMAW process. From three welded plates (single, double and triple passes), samples for microstructural examination were cut in transverse direction (perpendicular to welding direction) with the help of wire-cut electrical discharge machine (EDM). The welded plates were sliced using wire-cut EDM along transverse direction for preparing optical microscopy, tensile testing, microhardness and DL-EPR testing specimens.

Findings – From the microstructure, it was observed that the large grain growth, which is dendritic, and the structure become finer to increase in number of welding passes. As number of passes increases, the width of HAZ increases because of the higher temperature at the welded zone. The tensile strength decreases to increase the number of welding passes because of grain coarsening and chromium carbide precipitation in sensitized zone and wider HAZ. The maximum microhardness value was observed for single-pass weld as compared to double- and triple-pass welds because of the fast cooling rate. The degree of sensitization increases to increase the number of passes because of chromium carbide deposition at the grain boundaries.

Originality/value – The authors declare that the manuscript is original and not published elsewhere, and there is no conflict of interest to publish this manuscript.

Keywords 409M ferritic stainless steel, Shielded metal arc welding, Number of welding passes, Tensile test, Microhardness and degree of sensitization, Degree of sensitization, Microhardness

Paper type Research paper

1. Introduction

Ferritic stainless steels (FSS) are the most extensively used group of stainless steels because of their noble corrosion resistance compared to mild steel and is less expensive compared to

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Experimental and finite element analysis of temperature distribution in 409 M ferritic stainless steel by TIG, MIG and SMAW welding processes

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ABSTRACT

In this study, three different arc welding processes, namely tungsten inert gas (TIG), metal inert gas (MIG) and shielded metal arc welding (SMAW) processes, are used to weld 409 M ferritic stainless steel. K-type thermocouples are located in the area of heat-affected zone by drilling blind holes in a plate at a distance of 3 mm and 7 mm from the weld line, revealing the contours of the temperature distribution of the weld. The experimental results are compared with the results of simulations using ANSYS by Goldak heat source model. The temperature is experimentally measured in the heat-affected region with the help of a thermocouple. The temperature distribution profile by the finite element method using ANSYS is compared with the experimental temperature distribution profile with the heat source. The experimental and simulation results for TIG, MIG and SMAW welding processes have been found to be excellent.

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KEYWORDS
TIG; MIG; SMAW; 409 M ferritic stainless steel; temperature distribution; ANSYS

1. Introduction

Ferritic Stainless Steels (FSSs) contain 11–30% of Chromium (Cr) along with other alloying elements, especially molybdenum. The welding of the high-chrome FSSs has rapid grain growth at temperatures of more than 928°C [1]. The large grains absorb the smaller grains and grow more. The resulting thick grain structures are very sensitive to crack [2,3]. 409 M FSS can be used in various applications such as in automobile industries, shipbuilding industries, storage vessels, and so on [4]. 409 M FSS is becoming preferred choice in manufacturing of railway waggons and carriages [5,6]. The various researchers have simulated the welding process and compared with experimental results and observed a valuable solution to predict the thermal profile distribution in the weld.

Dean Deng et al. [7] welded modified 9Cr-1Mo steel pipes with three passes: first two by gas tungsten arc welding (GTAW) and one by gas metal arc welding (GMAW) by using TGS-9Cb and MGS-9Cb filler wire, respectively. The experimental and simulation

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QUALITY PAPER

Application of graph-theoretic approach for the evaluation of lean-six-sigma (LSS) critical-success-factors (CSFs) facilitating quality-audits in Indian small & medium enterprises (SMEs)

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Abstract

Purpose – One of the major challenges for developing countries is the lack of mechanisms for the evaluation of critical success factors (CSFs) of quality initiatives, which hampers the journey toward sustainability. Lean Six Sigma (LSS) has been one of the most widely used initiatives supporting quality improvement with wastes reduction and facilitating sustainability. To expedite LSS and its spread, it is important to evaluate key CSFs. Accordingly, the purpose of this paper is to provide an approach for the evaluation of LSS-CSFs for Indian small and medium enterprises (SMEs).
Design/methodology/approach – The paper uses a graph theoretic approach and demonstrates the evaluation of LSS-CSFs by proposing an index. The development of index is illustrated using a set of seven prioritized CSFs based on the literature review paper (Lande *et al.*, 2016).
Findings – This study guides about the translation of CSFs in the form of an index (number) and will benefit both researchers and practitioners, who wish to study the role of key CSFs for implementation and audit requirements for sustainability.
Research limitations/implications – Authors remain confined only to Indian SMEs.
Originality/value – LSS possesses the potential to enhance the performance of manufacturing SMEs, but its evaluation is not easy. This attempt for offering a useful evaluation scheme involving CSFs, in the areas of LSS in developing country contexts, is the first. The approach also facilitates both quality audits and benchmarking between different sets of CSFs. The approach is generalizable and can be extended in other areas.

Keywords Critical success factors, Small and medium enterprises, Indian, Lean Six Sigma, Graph theory
Paper type Research paper

1. Introduction

The concept of sustainable development (SD) is understood and practised as a commitment, which ultimately gets translated into actions based on the nature of improvement initiatives, from the top management of the organizations that seek sustained business excellence while

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Effect of number of welding passes on the microstructure, mechanical and intergranular corrosion properties of 409M ferritic stainless steel

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Department of Plastic technology, Central Institute of Petrochemicals Engineering and Technology, Korba, India

Abstract

Purpose – This paper aims to study the effect of number of welding passes on microstructure, mechanical and corrosion properties of 409 M ferritic stainless steel. Shielded metal arc welding (SMAW) process is used to weld two metal sheets of 409 M having 3 mm thickness as bead-on-plate with single, double and triple passes. Microstructures were observed at transverse section with the help of optical microscope and with increasing number of passes grain growth, and the width of heat-affected zone (HAZ) increases. The results of tensile tests revealed that as number of passes increases, there is reduction in tensile strength and ductility. Double loop electrochemical potentiokinetic reactivation (DL-EPR) test revealed that as number of passes increases, the degree of sensitization increases. This is due to the deposition of chromium carbides at the grain boundaries and the associated depletion of chromium.

Design/methodology/approach – Three welded plates of single, double and triple pass were welded by SMAW process. From three welded plates (single, double and triple passes), samples for microstructural examination were cut in transverse direction (perpendicular to welding direction) with the help of wire-cut electrical discharge machine (EDM). The welded plates were sliced using wire-cut EDM along transverse direction for preparing optical microscopy, tensile testing, microhardness and DL-EPR testing specimens.

Findings – From the microstructure, it was observed that the large grain growth, which is dendritic, and the structure become finer to increase in number of welding passes. As number of passes increases, the width of HAZ increases because of the higher temperature at the welded zone. The tensile strength decreases to increase the number of welding passes because of grain coarsening and chromium carbide precipitation in sensitized zone and wider HAZ. The maximum microhardness value was observed for single-pass weld as compared to double- and triple-pass welds because of the fast cooling rate. The degree of sensitization increases to increase the number of passes because of chromium carbide deposition at the grain boundaries.

Originality/value – The authors declare that the manuscript is original and not published elsewhere, and there is no conflict of interest to publish this manuscript.

Keywords 409M ferritic stainless steel, Shielded metal arc welding, Number of welding passes, Tensile test, Microhardness and degree of sensitization, Degree of sensitization, Microhardness

Paper type Research paper

1. Introduction

Ferritic stainless steels (FSS) are the most extensively used group of stainless steels because of their noble corrosion resistance compared to mild steel and is less expensive compared to

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ARTICLE

Estimation and control of surface quality and traverse speed in abrasive water jet machining of AISI 1030 steel using different work-piece thicknesses by RSM

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ABSTRACT

Abrasive water jet machining (AWJM) is an unconventional cutting method used in different industrial applications. The motive of this paper is to investigate the effect of traverse speed on surface roughness for a particular workpiece thickness. Three different plates of AISI 1030 steel as work-piece with thicknesses 4 mm, 6 mm and 8 mm are used to evaluate surface quality of cutting. Three response models for respective thicknesses are generated and checked on the basis of their prediction ability. It showed 8.71%, 8.11% and 7.83% error for surface roughness for three different thicknesses, respectively. Post validation, desired surface roughness values are placed in the response models for prediction of respective traverse speeds for three different thicknesses and represented in a graphical manner. This paper will help the AWJ machining operator to find out the precise cutting speed for achieving desired surface roughness.

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KEYWORDS
Abrasive water jet machining; Taguchi method; surface roughness; response surface methodology

1. Introduction

Abrasive water jet machining (AWJM) is used for cutting various components of machines used in industrial as well as domestic applications. In the AWJM process, material is eradicated through excising and distorting erosive wear method, wherein the work material is collided by a high velocity of water jet with accelerating abrasive particles (Dumbhare et al. 2018). Here, every hard abrasive particle works as a cutting tool. It is ordinarily used in cutting of ferrous, non-ferrous alloys, glass, granite, etc. because it offers very small-sized heat-affected zone with negligible distortion and burrs (Liu et al. 2004). AWJM has many advantages over other cutting methods such as high flexibility, no thermal damages, high machining adaptability with and minimum cutting forces (Wang 2010). The greatest advantages of AWJM over other cutting methods are higher material removal rate with minimal thermal defects and no hazardous slag (Ramulu et al. 2015; Mayuet et al. 2015; Kartal and Gokkaya 2013)

In AWJM, due to fine abrasive particles and lesser cutting forces and deformations, good surface quality is achieved even at low thickness of material and low cutting speed. Due to demand of good surface quality for thinner components, this becomes an important factor in selecting the process and to control the manufacturing cost (Dumbhare et al. 2018; Çaydaş and Hascalık 2008; Selvakumar, Prakash, and Lenin 2018). Researchers have used various techniques for estimation and optimisation of surface roughness using AWJM process parameters. The literature study in this regard is discussed in following paragraph.

Selvan et al. (Selvan, Raju, and Sachidananda 2012) studied the effect of process parameters such as water pressure, flow rate of abrasive, traverse speed and stand-off distance on surface roughness in AWJM. Design of experiment was carried out using Taguchi method. They have recommended high water pressure, high flow rate of abrasive and minimum traverse speed and stand of distance for getting smooth surface. Begic-Hajdarevic et al. (Begic-Hajdarevic et al. 2015) studied AWJ machining of aluminium and reported the consequences of mass flow rate of abrasive, traverse speed and material thickness on the surface roughness. They assessed that traverse speed is major influencer of the surface roughness at the bottom portion of the cut. Aultrin et al. (Aultrin 2014) performed the machining of aluminium alloy. They established a second-order polynomial model considering the water pressure, standoff distance, orifice diameter, flow rate of abrasive and focusing nozzle diameter for prediction of surface roughness and material removal rate (MRR) using RSM. The

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Implementation of multi-objective Jaya optimization for performance improvement in machining curve hole in P20 mold steel by sinking EDM

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Sachin Ambade
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Abstract

Purpose – Machining of curved channels using electrical discharge machining (EDM) is a novel approach. In this study, an experimental setup was designed, developed and mounted on die-sinking EDM to manufacture curve channels in AISI P20 mold steel.

Design/methodology/approach – The effect of specific machining parameters such as peak current, pulse on time, duty factor and lift over material removal rate (MRR) and tool wear rate (TWR) were studied. Multi-objective optimization was performed using Taguchi technique and Jaya algorithm.

Findings – The experimental results revealed current and pulse on time to have the predominant effect over material removal and tool wear diagnostic parameters with contributions of 39.67, 32.04% and 43.05, 36.52%, respectively. The improvements in material removal and tool wear as per the various optimization techniques were 35.48 and 10.91%, respectively.

Originality/value – Thus, Taguchi method was used for effective optimization of the machining parameters. Further, nature-based Jaya algorithm was implemented for obtaining the optimum values of TWR and MRR.

Keywords Electro discharge machining, Curve hole, Material removal rate (MRR), Tool wear rate (TWR), Analysis of variance (ANOVA), Jaya algorithm

Paper type Research paper

1. Introduction

Electrical discharge machining (EDM) is one of the most widely used non-traditional machining technique. Because of its non-contact machining nature, it is independent of the material characteristics pertaining to the workpiece. Hence, it is extensively used to shape hard mold making workpieces, especially in aviation industries (Gohil and Puri, 2017). In the case of injection molding process of plastics, solidification of the product occurs by applying mold cooling. Mold cooling is intern achieved by flowing coolant (water) through channels made in mold. Cooling channels are commonly manufactured by creating multiple straight holes. In some situations, designers use straight holes instead of curve holes. Therefore, the profile of a cooling channel renders a polygonal line. These straight holes restrict the degree of freedom in their shape and position. To solve these problems, it is requisite to design and develop a new method for machining curve channels and to put the process in real-world practice.

To achieve aforesaid objective, certain procedures have been developed for machining curve channels and can produce curved holes (Fukui and Kinoshita, 1989). The authors presented a unique L- and U-shape hole making process, which uses a modest mechanism (consist of a machining electrode, helical spring, shaft, pulleys, wires, fixtures, etc.) connected to conventional EDM. The device with tool electrode moves beside a curve path while performing EDM. A key feature of the device is that, it can machine a curve channel between two drilled holes perpendicular to each other. It was also reported that the upgraded device can cut U-shape and slant holes; those are impossible to make by traditional machining processes (Ishida and Takeuchi, 2002; Ishida and Takeuchi, 2008).

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RESEARCH ARTICLE

Novel curved trajectory machining using VOEDM process – experimental study and statistical optimisation thereof

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ABSTRACT

This paper presents a novel Variable Oscillating EDM process through a mechanism provided on the Z-axis numerical control EDM for machining the curvature channel. The specific trajectory is machined inside the oil hardening non-shrinking steel workpiece through the curved copper electrode. In order to execute the experiments, critical input machining parameters (sparking current, pulse on time, pulse off time, and swing sensitivity) and output process characteristics (Electrode wear rate and material removal rate) are selected. Taguchi experimental design (L9) is used to design the experiments. The pulse off time has a significant effect on VOEDM process characteristics. Analysis of variance is used to identify the significant contributions of selected parameters. It identifies the major contributing factor to be the pulse off time for EWR (50.33%) and MRR (34.78%). The machining parameters optimised using regression analysis adopting a forward selection method. Finally, confirmation runs are performed to evaluate the results of optimal combination of machining parameters with output characteristics. The average experimental values at optimum conditions for achieving minimum EWR and maximum MRR are 0.000194mm^3/min and 0.000397mm^3/min, respectively. Further, SEM was used for analysing the material behaviour of workpiece. The experimental results confirm the validity and sustainability of the VOEDM process.

ARTICLE HISTORY
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KEYWORDS
VOEDM; Taguchi method; optimisation; curved electrode; regression analysis

1. Introduction

Electrical discharge machining (EDM) is a spark erosion machining process in which the material is removed from the workpiece through a series of sparks from the electrode while being immersed in a liquid dielectric medium [1]. It is widely used in the manufacturing of complex geometry in hard material parts that are extremely difficult to machine [2]. Kunieda et al. discussed the recent trends that occurred in the EDM process by focussing

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Shielded metal arc welding of AISI 409M ferritic stainless steel: study on mechanical, intergranular corrosion properties and microstructure analysis

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Abstract

Purpose – The purpose of this study is on AISI 409 M ferritic stainless steel (FSS) which is developing a preferred choice for railway carriages, storage tanks and reactors in chemical plants. The intergranular corrosion behavior of welded SS 409 M has been studied in H_2SO_4 solution (0.5 M) with the addition of NH_4SCN (0.01 M) with different heat input. As this study is very important in context of various chemical and petrochemical industries.

Design/methodology/approach – The microstructure, mechanical properties and intergranular corrosion properties of AISI 409 M FSS using shielded metal arc welding were investigated. Shielded metal arc welding with different welding current values are used to change the heat input in the joints resulted in the microstructural variations. The microstructure of the welded steel was carefully inspected along the width of the heat-affected zone (HAZ) and the transverse-section of the thin plate.

Findings – The width of heat affected zone (3.1,4.2 and 5.8 mm) increases on increasing the welding heat input. Due to change in grain size (grain coarsening) as HAZ increased. From the microstructure, it was observed that the large grain growth which is dendritic and the structure become finer to increase in welding heat input. For lower heat input, the maximum microhardness value (388HV) was observed compared with medium (351 HV) and higher heat input (344 HV), which is caused by a rapid cooling rate and the depleted area of chromium (Cr) and nickel (Ni). The increase in weld heat input decreases tensile strength, i.e. 465 MPa, 440 MPa and 418 MPa for low, medium and high heat input, respectively. This is because of grain coarsening and chromium carbide precipitation in sensitized zone and wider HAZ. The degree of sensitization increases (27.04%, 31.86% and 36.08%) to increase welding heat input because of chromium carbide deposition at the grain boundaries. The results revealed that the higher degree of sensitization and the difference in intergranular corrosion behavior under high heat input are related to the grain growth in the HAZ and the weld zone.

Originality/value – The study is based on intergranular corrosion behavior of welded SS 409 M in H2SO4 solution (0.5 M) with the addition of NH4SCN (0.01 M) with different heat input which is rarely found in literature.

Keywords Microstructure, Hardness, SS 409M, SMAW, Hardness, HAZ, Intergranular corrosion

Paper type Research paper

1. Introduction

Ferritic stainless steel (SS) 409 M is modified version of AISI 409 M with a lower carbon content (0.03%) and with a very

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Design of a Bulk Driven Gain Boosting Technique Operational Amplifier for Low Power and High Swing Applications.

- **Source:** Journal of Active & Passive Electronic Devices . 2021, Vol. 16 Issue 2, p165-175. 11p.

- **Author(s):** KAKDE, SANDEEP; THAKARE, RAJESH; KAMBLE, SHAILESH; PATIL, MANOJ; U. S., PAVITHA

- **Abstract:** In this paper, a Bulk Driven Gain Boosting (BDGB) technique has been analyzed which is further employed in the design of a novel operational amplifier to enhance the gain and at the same time, a nested compensation technique is also used to improve the bandwidth without consuming extra power. The proposed operational amplifier circuit has been designed in sub threshold region and is biased with very less current at the first stage; an extra biasing circuit with gate to drain connected transistors is also designed to bias the last stage. The proposed configuration achieves open loop gain of 70dB, CMRR of 144dB, PSRR of 70dB and the unity gain bandwidth of 11MHz at 5pF load capacitance. The output swing is more than 650mV at 0.8V supply voltage consuming only 2.5µW static power. The gain/swing performance of the proposed low-voltage OPAMP would be therefore good enough not to require another amplifying stage in many high-speed, high swing and low-power applications.

Review Paper on Micro-Camera Based Airotor

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Abstract

With the Advancement of Technology the present invention related to the Dental Airotor including Micro-camera for capturing and recording the inner view of mouth so that doctors can treat the patients more conveniently. This Airotor also going to have LED light which can incorporated into hand-piece for improvement of visibility and comfort of working.Wireless transmission of capture image or live feeding of treatment Site to destination device so that it will increase the operability for the dentist during treatment. In general this Airotor are used for various purpose such as Oral cleaning, Tooth decay and Plug removal. Due to high speed the friction creates significant heat within bur and with the help of cooling system can be prevent. With this innovative technique those hard to reach and hard to see area are going to be more accessible.

Keywords

Micro-Camera, Airotor (dental hand-piece), LED, Hand-piece Body, Camera Sensor.

Introduction

A dental airotor is a handheld & a mechanical type of device shown in figure 1.which is used to perform a variety of common dental tasks such as removing decay, polishing fillings, performing cosmetic dentistry and altering prostheses. The airotor itself consists of internal mechanical parts which performs a rotational force and provide power to the cutting tip usually a dental burr. This type of apparatus is used to perform various dental operations.

Journal of Optoelectronics Laser

Detection and Classification of Diabetes from a massive data with the implementation of real-time cloud-based Machine Learning System

Vilas D. Alagdeve, Pydimarri Padmaja, T.Coumaressin, Javangula Vamsinath, Sathiya Priya S, V Naresh Kumar Reddy

Keywords: Classifiers, Advanced Deep Learning Algorithm, Diabetes, Big Data analysis, cloud management, Machine learning.

Abstract

To infect a human there are a lot of different diseases that are spreading all over the world, at any case a human got affected by a major health issue. Some of the reports are been expressed that among the world population nearly 20% of people got affected by Diabetes. The major cause for the spread of Diabetes is the secretion of insulin in the body which automatically converts the sugar to protein and gets over limited. Identifying such a kind of disability at the previous stage is the hardest thing. Instead of trying different treatments here, researchers has given such an amazing report statement which identifies the classification of diabetes with the major data report at the same time storing such important data with a cloud platform for future predictions. In this research Advanced Deep Learning Algorithm is implemented to perform the Diabetes detection and classification.

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More Citation Formats

An Algrithm to Reduced Operational Complexity of Cyclotomic Fourier Transform

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Abstract

The paper presents an algorithm, difficulty arises in efficient computation of discrete Fourier transform over Galois field is measured. Method for reduction of additive complexity in Cyclotomic fast Fourier transform is proposed. The approach presented in proposed algorithm is initially sort even matrix then identify the identical terms present in the equations and replace them with a new variable. Comparitive analysis of Proposed algorithm with existing available methods is done and expérimental result shows that the proposed algorithm reduces operational complexity of Cyclotomic Fourier Transform.

Keywords:- Additive complexity, Common Expression, Elimination, Fast Fourier Transform.

I. INTRODUCTION

Fourier exploration is process of decomposing a signal into oscillatory components. Conventional Fourier Transform schemes are Fourier transform (FT), Fourier series (FS), Discrete Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT). Fourier examination is the procedure to dividing the signal in to combination of frequency values and recreating the signal from those frequency values. When discrete signals are used to restore both signal and its frequency domain components then, it is called discrete Fourier Transform (DFT). DFT is computed by dividing finite length time domain signal into finite length frequency domain components. Discrete Fourier Transform have wide application in digital processing applications. The application of DFT is useful in many emerging fields but calculating it directly from above definition is often too slow to be practical.

A Fast Fourier transform algorithm is used to calculate discrete Fourier Transform and inverse Fourier transform by factorizing DFT matrix into a product of sparse factors (Mac Williams, F.J. and N.J.A, 1977) Fast Fourier transforms are generally used for many claims in engineering, science, and mathematics fields.

The Fast Fourier Transform, a quick algorithm, is one reason why the DFT has evolved into a fundamental for calculated computing (FFT). The Fast Fourier Transform was created for complex, finite fields. The discrete Fourier Transform has numerous uses in the complex and Galois fields of signal processing.DFT in complex field can be computed through butterfly architecture using various fast Fourier transform algorithms. The length N is the number of

Area Efficient Architectures for Two Dimensional Digital filters using High Level Transformation

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Abstract

Today's consumer electronics market is significantly dominated by Digital signal processing (DSP) architectures. The field of DSP has a very wide range of applications from mobile telephones, high-definition TV, multimedia, digital cameras, biomedical instrumentations, global positioning system, digital radio, speech recognition and many more. Modern DSP systems are so skilled that they can perform complex and computationally demanding signal processing responsibilities at speeds suitable for real-time operation. Opt for the correct algorithm and architecture, there implementation approach and synthesis procedure are very important for designing any dedicated architectures for DSP applications. Area, power consumption and speed are very critical features for the complex systems designed for consumer electronic market. In this paper, we present novel use of folding and retiming, the high-level transformation techniques to reduce the number of strong arithmetic operation of DSP architectures. We have shown that we can design circuits which are more efficient by taking up high-level transformations. A comparison is done between the folded architecture and the conventional architecture. The power consumption can be reduced up to 52% in folded and conventional architectures.

Keywords:-Digital signal processing (DSP) architectures, high-level transformations, folding and retiming.

I.INTRODUCTION

Performance of the DSP systems can be enhanced by high-level architecture transformations. Different high-level transformation techniques can be used to design DSP architectures which include parallel processing, pipelining, retiming, folding, unfolding and interleaving. Using these high-level architecture transformation techniques any DSP algorithm can be designed to manage a tradeoff among different parameters as area, speed, and power [1], [5]. The creation of a DSP algorithm gets customized with High-level transformations, but the original functionality is maintained. Area reduction parameters can be achieved by the folding transformation. The folding transformation is used to analytically

Comparative Analysis of Binary , Ternary and Quaternary logic Gates

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Abstract

In computer architecture design Arithmetic Logic unit (ALU) is one of the most important structure. For the design of ALU basic circuits are must. So in this paper we have implemented binary , ternary and quaternary logic basic gates which are used in the design of VLSI technology. Comparative analysis of binary , ternary and quaternary logic basic gates based on power consumption, area and delay is done . Power consumption required for quaternary logic is 51.78 % less as compared to binary and 26.59 % less as compared to ternary logic. Delay required for quaternary logic is 9.1 % less as compared to binary and 9.8 % less as compared to ternary logic.

Keywords:- Quaternary logic. Quaternary inverter. NMIN, NMAX. Quaternary Xor

I. INTRODUCTION

Higher radix values are known as multiple valued logic system. In general radix choice is accessible in actual or conceptual domain. Both may be different , the choice mostly determined by ease of manipulation of variables in conceptual domain & manipulation of current, charge ,voltage, etc in actual circuits. At conceptual level one has to deal with issues like notation, operational, description, design & optimization methods. At actual level issues like use of physical space ,noise margins & conversion with binary are to be sorted out.Multiple values are usually monotonic & separated in an established sequence at nominally equal intervals. There are several conventions for representing the multiple values as compared to binary tabular & mapping techniques are useful in MVL. The major problem in case of MVL is of size due to increased number of values to be tabulated. Hence it is necessary to have functional notation for compact description of functions of more than one variable.[1]

There are many sets of operators that are proved to be functionally complete. In the design of circuits for MVL one has to choose the set of operators that is convenient to implement. The next step is to find basic circuit elements that can be used to implement the operators.MVL based memories may be fabricated having more storage density. Interconnection carries more information for the same silicon area as binary circuits .This leads to reduced complexity of interconnection & circuits. The result is reduction of number of pins & power consumption. The packaging density & data processing speed increases.MVL may be used for modeling of faults in current binary VLSI chips.The current dominance of binary technology is due to the availability of two valued electronics devices & circuits .The BJT & FET are highly suitable for binary circuits. There is a lack of similar electronics devices for MVL. If some new technology like electro optics provides a

Design and Implementation of Channel for Communication System using Quasi-Cyclic Low Density Parity Check Codes

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***Abstract*—Low density parity check codes (LDPC) can be applied in number of recent communication applications due to it's a performance close to the Shannon limit. LDPC have superior error correcting ability which leads to efficient and reliable communication. In this paper a subclass of LDPC codes whose parity check matrices consists of circulant permutation matrices called Quasi-cyclic LDPC codes is used . In the present work channel for quasi-cyclic low density parity check (QC-LDPC) based is designed. The channel is capable of correcting single bit as well as multi bits errors. The channel architecture is described using Verilog, synthesized and performed place and route for the design using Xilinx ISE 13.1.**

***Keywords*—Forward Error Correction (FEC),LDPC,QC-LDPC, communication system ,Channel**

I. INTRODUCTION

The digital communication system is used to transmit data source to destination through a wired or wireless channel, the consistency of received data depends on the channel medium. The channel medium can introduces an error in the transmitted data. Shannon proved that the reliable communication is possible only if the data rate is less than the channel capacity. The basic communication system shows transfer of information from source to destination. The source encoder transforms the source output to a binary digits information sequence. The role of the channel encoder is that the information sequence from the source encoder is encoded using different error detection and error correction techniques. Channel encoding adds redundant symbols to the information to be transmitted before modulation. At channel, the channel noise or interference might affect the transmission information changing some symbols. The received information is demodulated first and the channel decoder transforms the received information sequence into a binary sequence using different decoding algorithms. The source decoder transforms the estimated sequence of transmitted sequence to the destination.

The two main methods of error detection and correction are Automatic Repeat request (ARQ) and Forward Error Correction (FEC).In ARQ method we have to retransmit the data, if any error has occurred at the receiver. The retransmission of data results into a delayed, high cost and low throughput system. In FEC method we have to add redundant bits to a message. These redundant bits at, the receiver can detect and correct the errors. [3]. Forward-error-correction(FEC) method leads to high throughput, high speed and less power system. FECs are suitable for elongated distance communication like satellite or deep space communication. They are also used in wireless communication system, storage devices [4]. Several coding techniques of forward error-correction schemes can be used for the error correction. As per evaluation of error correction codes, Hamming codes were invented first in 1950. They have a capacity to detect up to two-bit errors and correct one-bit error.

In 1959, BCH codes were introduced which belong to a class of cyclic error-correcting codes. Later, the Reed-Solomon codes were used in CDs, DVDs and hard disks because of their good burst error correction property. Robert Gallager introduced a new code known as Low-Density Parity Check Codes (LDPC) .But it was ignored up to 1990's due to convolutional codes. David MacKay rediscovered LDPC in the mid-nineties. In latest years the LDPC codes hit all existing codes with significant error correction capabilities, less hardware complexity with developments in VLSI[1].

LDPC codes are adopted by some recent communications standards such as WLAN, Mobile WiMAX, DVB-S2 and, 10GBaseT[2]. In this work, we have implemented structured Quasi-Cyclic Low-density parity check codes. Quasi-Cyclic has been proposed to reduce the complexity of LDPC while obtaining the similar performances. In QC-LDPC codes, the parity check matrix is a sparse matrix as it consists of less number of one's but the generator matrix is not a sparse matrix[7]. Quasi-Cyclic LDPC structured codes have received substantial importance due to their stretchy hardware implementation features

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Optimization of elliptic curve scalar multiplication using constraint based scheduling

Pravin Zode [a], Raghavendra Deshmukh [b]

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Highlights

- Data dependency graph of point addition and point doubling are modified to get the optimized Area-Delay Product.
- Constraint based scheduling is used to achieve maximum optimization.
- Hierarchical blocks of scalar multiplications are carefully scheduled for optimized Area-Delay-Product improvement.
- FPGA is used for hardware rapid prototyping and implementation.

Abstract

Elliptic Curve Cryptography is public key cryptography that features smaller keys, ciphertexts, and signatures and is faster than RSA at the same security level. Scalar multiplication is the main and the most compute-intensive operation in the generation of keys. Point Addition, Doubling and Inversion are the basic operations for scalar multiplication. Inversion is a very expensive operation as compared to multiplication, addition and squaring in the finite fields with an affine coordinate system. López-Dahab coordinates are the best alternative to reduce the inversion overhead in scalar computation. Area, Delay and Power trade-offs are the main

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SIRA: Scale illumination rotation affine invariant mask R-CNN for pedestrian detection

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Abstract
In this paper, we resolve the challenging obstacle of detecting pedestrians with the ubiquity of irregularities in scale, rotation, and the illumination of the natural scene images natively. Pedestrian instances with such obstacles exhibit significantly unique characteristics. Thus, it strongly influences the performance of pedestrian detection techniques. We propose the new robust Scale Illumination Rotation and Affine invariant Mask R-CNN (SIRA M-RCNN) framework for overcoming the predecessor's difficulties. The first phase of the proposed system deals with illumination variation by histogram analysis. Further, we use the contourlet transformation, and the directional filter bank for the generation of the rotational invariant features. Finally, we use Affine Scale Invariant Feature Transform (ASIFT) to find points that are translation and scale-invariant. Extensive evaluation of the benchmark database will prove the effectiveness of SIRA M-RCNN. The experimental results achieve state-of-the-art performance and show a significant performance improvement in pedestrian detection.

Keywords Computer vision · Mask R-CNN · Pedestrian detection · Deep learning · CNN · Neural network

1 Introduction

In the past few decades, the world has been observing the threats to security in urban areas, which has expanded the pertinence of vision-based surveillance systems enough to detect pedestrians in high-density areas. Pedestrian detection has countless applications in computer vision. The obvious application is video surveillance [1].

Need and importance of Pedestrian detection Recently, due to the COVID-19 pandemic, surveillance systems have been used to monitor crowded places. It helps to identify hot spots (the areas where the virus infection spreads more opportunities). Owing to human interaction in highly congested areas, the chances of the spread of the COVID-19 virus increase. Therefore, the demand for pedestrian detection systems has increased. However, the current state-of-the-art installed system requires a conventional manual inspection of the video, which is in most cases time-consuming and infeasible. Pedestrian detection is an essential and important task in any intelligent video surveillance system because it provides information for semantic understanding of video scenes. The focus of the researchers is to make it smarter and use deep learning to move from passive surveillance to active surveillance. The author proposes several promising frameworks to improve the accuracy and speed of pedestrian detection. Nevertheless, the deep learning framework still has room for improvement.

Need and importance of Pedestrian detection The detection accuracy is affected by various changes such as human body appearance, trajectory, posture, abrupt motion, scale changes, complex background, pedestrian deformation, partial or complete occlusion, shadows, etc. In this area, it is still an unresolved problem. Different factors related to the video capture method, such as low frame rate, unavailability of color information, camera sensor stability, compression technology, etc., directly affect the quality of the video sequence. It may limit the design of object detection algorithms. In addition, different cameras have different sensors, lenses, resolutions, and frame rates, resulting in different image quality. A low-quality image sequence can affect moving object detection algorithms. In some cases, different parts of a moving object might have different movements in terms of speed and orientation. When detecting moving

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Mathematical simulation for the formulation of synthesis of PMN-PZN ceramics at different sintering temperature with reliability of density measurement

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ABSTRACT

This paper discusses the approach to formulate mathematical model (MM) for synthesis of any ceramic and to decide reliability of density measurement. In the research of basic science, the majority of operations are still executed manually which needs to be focused and develop a mathematical relation which simulate the real input and output data directly. The advantages and limitations of the developed mathematical models are identified and the models are classified in terms of range of application and goals. In this study, a generalized experimental data based model developed to simulate the contemporary techniques for the purpose of study, compression, inducing generalized approach for the mathematical model of ceramic synthesis. The findings indicate that the topic understudy is of great importance, as no such approach of experimental data based mathematical simulation is adopted for the formulation of synthesis of ceramics so far. Thus the results of this experimental research would be useful to industry for manufacturing of multilayer capacitors.

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KEYWORDS
Mathematical model; columbite method; sintering temperature; dielectric properties

1. Objective of investigation

Current study was focused on mathematical model for characterization of ceramics of binary compositions 0.6PMN–0.4PZN synthesized by columbite method [1]. Lead based pervoskite ferroelectric relaxors like lead magnesium niobate $Pb(Mg_{1/3}\ Nb_{2/3})O_3$ (PMN) and lead zinc niobate $Pb(Zn_{1/3}Nb_{2/3})O_3$(PZN) are attractive candidates for applications such as multilayer capacitors (MLC), actuators and medical ultrasonic transducers due to its high dielectric constant, broad dielectric maxima, high electrostrictive strain response and relative low firing temperature [2–6].

It is know that any mathematical model is a simulation process of any phenomenon. Mathematical model is vital process of the final system which is in reality a collection of conceptual, physical, mathematical, visualization, and possibly statistical sub-models [7]. Quantitative results from mathematical models can easily be compared with observational data to identify the strength of the model and weaknesses. To estimate

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Dielectric relaxation study of aqueous glycol ethers with water using time domain reflectometry technique in the frequency range 10 MHz to 50 GHz

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ABSTRACT

The Complex permittivity spectra of glycol ether (GE) compounds such as ethylene glycol mono-methyl ether (EGME), ethylene glycol ethyl ether (EGEE) and ethylene glycol butyl ether (EGBE) with water mixture over entire concentration range and at 25 °C has been determined using Time Domain Reflectometry technique in the frequency range 10 MHz to 50 GHz. The complex permittivity spectra for GE–water were fitted in Cole–Davidson model. The Static dielectric constant (ε_0), Relaxation time (τ), effective Kirkwood correlation factor (g^{eff}), excess permittivity (ε_0^E) and Bruggeman factor (f_B) have been calculated by non-linear least square fit method. The intermolecular interactions between GE-water binary mixtures suggest the non-linear behavior of dielectric parameters. The contribution of hydrogen bonding interactions among the solute-solvent mixtures is confirmed by Excess properties and Bruggeman factor.

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KEYWORDS
Ethylene glycol mono-methyl ether; ethylene glycol ethyl ether; ethylene glycol butyl ether; complex permittivity; Kirkwood correlation factor; excess dielectric properties; Bruggeman factor

1. Introduction

Molecular interactions in the liquid and nature of rotational dynamic were provided by Dielectric Relaxation Spectroscopy (DRS) [1]. Glycol ethers (GE) is very interesting class of solvent having ether, that is, oxygen (–O–) and hydroxyl (–OH–) group. The hydroxyl group can act as proton donor as well as acceptor. Aqueous solutions of GE have a wide range of chemical, biological, pharmaceutical, industrial and condensed matter physics applications because GE and water molecules have the H-bond sites and they can enter into intra and intermolecular hydrogen bonding giving rise to different conformations [2–5]. Literature survey indicates that the glycol ethers has been studied in pure form and non-polar solvents such as dioxane, benzene and carbon tetrachloride but dielectric relaxation behavior of these systems in aqueous solution is scarce [6–8]. The molecules of these compounds have several hydrogen bonding sites which may leads to different conformations through intra and intermolecular interactions. The local structures of hydrogen bonding liquids are complicated due to molecular clusters and

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Effect of lanthanum dopant on pyroelectric characteristics of lead germanate ($Pb_5Ge_3O_{11}$) single crystals

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ABSTRACT

In this article, the behavior of pyroelectric coefficient and spontaneous polarization with temperature have been studied for pure (LG), 0.5 wt% (LG1) and 1 wt% (LG2) lanthanum doped lead germanate ($Pb_5Ge_3O_{11}$) single crystals. These crystals were grown by method of controlled cooling of the melt. The pyroelectric coefficient of grown crystals was measured over a temperature range 40–300 °C, which shows a change in sign negative to positive for LG and LG1 while for LG2 it shows only negative sign for a said temperature range. The observed results of pyroelectricity and spontaneous polarization in pure and doped materials are discussed. The comparative study of room temperature values of pyroelectric coefficient measured by various methods, spontaneous polarization and figure of merit is presented in this paper.

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KEYWORDS
Pyroelectric coefficient; doping effect; spontaneous polarization

1. Introduction

Ferroelectric materials have become potentially useful for device applications. Out of numerous electrical, optical, and mechanical properties of these materials, the pyroelectric study is both of primary and applied interest. Ferroelectrics are pyroelectrics predominantly because of large temperature dependent of spontaneous polarization.

$Pb_5Ge_3O_{11}$ has become a desirable material for device application due to large spontaneous polarization and its reversibility. Being an optically active ferroelectric, it is useful for electro-optic devices. These crystals are uniaxial ferroelectric which undergoes second order phase transition at 177 °C, at which crystal symmetry changes from hexagonal, $P\bar{6}$ to trigonal, $P3$ [1–5]. An intense study has been carried out in this material by large number of researchers from past five decades, due to application of its physical properties in pure and applied sciences. This compound has a potential utility as pyroelectric material, in ferroelectric memory devices and for hologram recording and readout [6]. Several researchers have used various methods for study of pyroelectric effect in different materials.

In Chynoweth dynamic method [7], the crystal under study, heated by exposure to a strong light pulse, generates a pyroelectric current given by

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Effect of lanthanum oxide addition on physical, electrical and dielectric properties in lithium borosilicate glasses

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ABSTRACT

In the present study, lanthanum oxide doped lithium borosilicate glasses were synthesized using standard melt-quenching technique. The synthesized glass materials were characterized by XRD, FTIR, density calculation, Electrical and dielectric properties measurements. The amorphous nature of the studied glasses was established through XRD spectra. FTIR spectra were used to investigate the different functional groups. Improvements in density and molar volume values were reported as the La_2O_3 content increased, it can be attributed to higher molecular weight of La_2O_3. Numerous other physical parameters such as lanthanum ion concentration (N), internuclear distance (r_i), polaron radius (r_p), and field intensity (F) were determined using density values and are discussed in detail here. Electrical conductivity and dielectric measurements were carried out by impedance spectroscopy. The dynamical processes taking place in the glass system was studied by introducing conductivity and composition scaling. The dielectric constant (ε') and dielectric loss ($Tan\ \delta$) with frequency at various temperatures are extensively explored. There is a fairly good correlation among the physical parameters, FTIR, electrical conductivity and dielectric properties for the glasses studied in the present work.

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KEYWORDS
Borosilicate glasses; density; electrical conductivity; dielectric loss; dielectric constant

1. Introduction

Borosilicate glasses are the most powerful glass system in terms of technical, industrial and science applications [1]. Glasses of this form are common in many applications ranging from chemical resistance for laboratory glassware, interface materials for encapsulation of hazardous nuclear waste, optical components, and sealing materials [2]. The ionic conductivity in glasses has been widely recognized in past few years and particular interest has been centered on lithium conducting glasses owing to their availability as strong and stable electrolytes in lithium batteries [3]. In addition, lithium borosilicate glasses are often used owing to their superior glass forming properties in comparison to many other conventional structures, they are an ideal host for rare earth oxides. [3]. Because rare earth oxide doped borosilicate glasses are known to have different unique properties, they may be used to produce devices with specific attributes [4].

Lanthanum Oxides (La_2O_3) constitutes 14.1% of total rare earth content resources [5]. Lanthanum oxide is expected to have the ability to modify glass network [5]. This

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On the Real Time Object Detection and Tracking

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Abstract

Object detection and tracking is widely used for detecting motions of objects present in images and video. Since last so many decades, numerous real time object detection and tracking methods have been proposed by researchers. The proposed methods for objects to be tracked till date require some preceding information associated with moving objects. In real time object detection and tracking approach segmentation is the initial task followed by background modeling for the extraction of predefined information including shape of the objects, position in the starting frame, texture, geometry and so on for further processing of the cluster pixels and video sequence of these objects. The object detection and tracking can be applied in the fields like computerized video surveillance, traffic monitoring, robotic vision, gesture identification, human-computer interaction, military surveillance system, vehicle navigation, medical imaging, biomedical image analysis and many more. In this paper we focus detailed technical review of different methods proposed for detection and tracking of objects. The comparison of various techniques of detection and tracking is the purpose of this work.

Keywords: Object Detection, Tracking, Segmentation, and Video processing

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Packrat Parsing with Dynamic Buffer Allocation

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Abstract

Packrat parsing is a type of recursive decent parsing with guaranteed liner time parsing. For this, memoization technique is implemented in which all parsing results are memorized to avoid repetitive scanning of inputs in case of backtracking. The issue with this technique is large heap consumption for memoization which out weigh the benefits. In many situations the developers need to make a tough decision of not implementing packrat parsing despite the possibility of exponential time parsing. In this paper we present our developed technique to avoid such a tough choice. The heap consumption is upper bounded since memorized results are stored in buffer, capacity of which is decided at runtime depending on memory available in the machine. This dynamic buffer allocation is implemented by us in Mouse parser. This implementation achieves stable performance against a variety of inputs with backtracking activities while utilizing appropriate size of memory for heap.

Keywords: Packrat parsing, Parsing Expression Grammars, parser generators, backtracking.

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Isonumber based Iso-Key Interchange Protocol for Network Communication

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Summary
Key exchange protocol (KEP) is an essential setup to secure authenticates transmission among two or more users in cyberspace. Digital files protected and transmitted by the encryption of the files over public channels, a single key communal concerning the channel parties and utilized for both to encrypt the files as well as decrypt the files. If entirely done, this impedes unauthorized third parties from imposing a key optimal on the authorized parties. In this article, we have suggested a new KEP term as isokey interchange protocol based on generalization of modern mathematics term as isomathematics by utilizing isonumbers for corresponding isounits over the Block Upper Triangular Isomatrices (BUTI) which is secure, feasible and extensible. We also were utilizing arithmetic operations like Isoaddition, isosubtraction, isomultiplication and isodivision from isomathematics to build iso-key interchange protocol for network communication. The execution of our protocol is for two isointegers corresponding two elements of the group of isomatrices and cryptographic performance of products eachother. We demonstrate the protection of suggested isokey interchange protocol against Brute force attacks, Menezes et al. algorithm and Climent et al. algorithm.

Keywords:
Cryptography, Block Isomatrix, Isomathematics, Isonumber, Isounit.

1. Introduction

Now a days, the security is main concern in large open network. To set up a private channel among two users' needs to interchange a mutual secret key [2]. It is feasible in limited and small network but not possible in large and broad networks like internet. The public-key cryptography (PKC) offers a technique to permit secret session keys to be interchange over an unprotected network in which each user holds key pair comprising of a non-secret key and a secret key such that only non-secret keys are published in network. Diffie–Hellman offered first feasible PKC in 1976 [3]. Number theory problems are the attraction in cryptographic researcher to build prominent PKC in which at least two user, user-I utilize the user-II non-secret key and encrypts the information and then transmits to user-II. After getting the encrypted text, the user-II can decrypt the information with utilizing of his/her secret key [4].

Meshram C. [5-8] developed certain PKC schemes which are depends on solving discrete logarithm problem and integer factoring problem along with its generalization. Moreover offered specific designs for identity-based cryptography [09-15]. Blake I. and Climent J., independently study the Elliptic Curve discrete logarithm problem which is one of the main problems where PKC are constructed [16-17]. Meshram A. [18-20] proposed certain cryptographic schemes based on suzuki 2-group and dihedral group.

Recently, Meshram C. [21] introduce Quadratic Exponentiation Randomized PKC based on Partial Discrete Logarithm Problem. Meshram A. recommended $\mathcal{KEP}$ constructed on isoring isopolynomials coefficient [22]. Dani M. recommended $\mathcal{SISK}$ based $\mathcal{KEP}$ for protected transmission [23] and $\mathcal{KEP}$ based on $\mathcal{SIFK}$ [24]. Thatere A. recommended isoryptosystem constructed on $\mathcal{SIFK}$ [25].

2. Motivations and Organization

In this article, we have proposed an isokey interchange protocol based on isonumbers for corresponding isounits over $\mathcal{BUTI}$. The primary thought of this article is to examine, for two isointegers $\hat{a}$ and $\hat{b}$ with elements of the group of isomatrices $\widehat{\mathcal{H}}_1$and $\widehat{\mathcal{H}}_2$, the cryptographic performance of products of the nature $\widehat{\mathcal{H}}_1^{\hat{a}}$ $\widehat{\mathcal{H}}_2^{\hat{b}}$.

The rest of the article is coordinated in various sections. In section 3, we have reviewed the prerequisite background for article. Section 4, describes the suggested isokey Interchange Protocol. Section 5, investigate the security analysis of suggested isokey Interchange Protocol. Finally, in section 6, we have concluded the article.

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3. Mathematical Background and Material

In this section, we have describes the definition such as Isomathematics, arithmetic operations in modern mathematics, arithmetic operations in Santilli's isomathematics, $\mathcal{BUTI}$ and order of the elements.

3.1 Santilli's Isomathematics [26]

Isomathematics is a generalization of arithmetic operations in modern mathematics. Utilizing isomathematics, we have shown that, two multiplied by two is equal to twenty-eight (for inverse of isounit $\hat{\mathcal{T}} = 7$).

3.2 Operations in Modern Mathematics

Addition, subtraction, multiplication and division are arithmetic operations in modern mathematics. In modern mathematics, "0" and "1" are additive unity and multiplicative unity respectively such that

$\rho + 0 = \rho,$
$\rho - 0 = \rho,$
$\rho^0 = 1,$
$\rho \times 1 = 1 \times \rho = \rho,$
$\rho \div 1 = \rho,$
$1 \div \rho = \frac{1}{\rho},$
$\rho \times \sigma = \rho\sigma,$
$\rho \div \sigma = \frac{\rho}{\sigma}$ etc.

3.3 Operations in Santilli's Isomathematics

Isoaddition $\hat{+}$, isosubtraction $\hat{-}$, isomultiplication $\hat{\times}$ and isodivision $\hat{\div}$ are arithmetic operations in isomathematics and describe as follows;

$\rho \,\hat{+}\, \sigma = \rho + \hat{\mathcal{K}} + \sigma,$
$\rho \,\hat{-}\, \sigma = \rho - \hat{\mathcal{K}} - \sigma,$
$\rho \,\hat{\times}\, \sigma = \rho\hat{\mathcal{T}}\sigma,$ and
$\rho \,\hat{\div}\, \sigma = \left(\frac{\rho}{\sigma}\right)\hat{\mathcal{I}}.$

Where, i) $\hat{\mathcal{T}}\hat{\mathcal{I}} = 1, \hat{\mathcal{T}}$ is called inverse of isounit $\hat{\mathcal{I}} \neq 1$ and ii) $\hat{\mathcal{K}}$ is called isozero.

3.4 $\mathcal{BUTI}$

An isomatrices $\hat{\mathcal{H}}_{\hat{v}}(\mathcal{Z}_{\hat{q}})$ of size $v \,\hat{\times}\, v$, $\hat{\mathcal{H}}_{\hat{u}}(\mathcal{Z}_{\hat{q}})$ of size $u \,\hat{\times}\, u$ and $\hat{\mathcal{H}}_{\hat{u}\times\hat{v}}(\mathcal{Z}_{\hat{q}})$ of size $u \,\hat{\times}\, v$ for isoprime number $\hat{q}$, isonumbers $\hat{u}, \hat{v} \in \mathcal{N}(\mathcal{Z}_{\hat{q}})$ and invertible isomatrices $\mathcal{L}_{\hat{u}}(\mathcal{Z}_{\hat{q}})$ of size $u \,\hat{\times}\, u$, $\mathcal{GL}_{\hat{v}}(\mathcal{Z}_{\hat{q}})$ of size $v \,\hat{\times}\, v$.

Define isomatrix $\hat{\mathrm{H}} = \begin{Bmatrix} \hat{\alpha} & \hat{\gamma} \\ \hat{0} & \hat{\beta} \end{Bmatrix}$,

$\hat{\alpha} \in \hat{\mathcal{H}}_{\hat{u}}(\mathcal{Z}_{\hat{q}}), \hat{\beta} \in \hat{\mathcal{H}}_{\hat{v}}(\mathcal{Z}_{\hat{q}}), \hat{\gamma} \in \hat{\mathcal{H}}_{\hat{u}}\, \hat{\mathcal{H}}_{\hat{u}\times\hat{v}}(\mathcal{Z}_{\hat{q}}),$

with subset $\hat{\Theta} = \begin{Bmatrix} \hat{\alpha} & \hat{\gamma} \\ \hat{0} & \hat{\beta} \end{Bmatrix}$,

$\hat{\alpha} \in \mathcal{GL}_{\hat{u}}(\mathcal{Z}_{\hat{q}}), \hat{\beta} \in \mathcal{GL}_{\hat{v}}(\mathcal{Z}_{\hat{q}}), \hat{\gamma} \in \hat{\mathcal{H}}_{\hat{u}}\, \hat{\mathcal{H}}_{\hat{u}\times\hat{v}}(\mathcal{Z}_{\hat{q}})$

By utilizing property [28], we have compute isopowers of these $\mathcal{BUTI}$ to find the order of the subgroup generated by a isomatrix $\hat{\mathcal{H}} \in \hat{\Theta}$.

For non negative isointeger $\hat{p}$ and isomatrix $\hat{\mathcal{H}} = \begin{bmatrix} \hat{\alpha} & \hat{\gamma} \\ \hat{0} & \hat{\beta} \end{bmatrix} \in \hat{\Theta}$,

Define $\hat{\mathcal{H}}^{\hat{p}} = \begin{bmatrix} \hat{\alpha}^{\hat{p}} & \hat{\gamma}^{(\hat{p})} \\ \hat{0} & \hat{\beta}^{\hat{p}} \end{bmatrix}$, where

$$\hat{\gamma}^{(\hat{p})} = \begin{cases} 0 & if\ \hat{p}=0 \\ \sum_{\hat{j}=1}^{\hat{p}} \hat{\alpha}^{\hat{p}-\hat{j}}\hat{\gamma}\hat{\beta}^{\hat{j}-1} & if\ \hat{p}\geq 1. \end{cases}$$

i) If $\hat{0} \leq \hat{d} \leq \hat{p}$ then $\hat{\gamma}^{(\hat{p})} - \hat{\alpha}^{\hat{d}}\hat{\gamma}^{(\hat{p}-\hat{d})} + \hat{\gamma}^{(\hat{d})}\hat{\beta}^{\hat{p}-\hat{d}}\hat{\gamma}^{(\hat{p})} = \hat{\alpha}^{(\hat{p}-\hat{d})}\hat{\gamma}^{(\hat{p})} + \hat{\gamma}^{(\hat{p}-\hat{d})}\hat{\beta}^{\hat{d}}$

ii) If $\hat{d} = 1$ then $\hat{\gamma}^{(\hat{p})} = \hat{\alpha}\hat{\gamma}^{(\hat{p}-1)} + \hat{\gamma}\hat{\beta}^{\hat{p}-1}$ or
$\hat{\gamma}^{(\hat{p})} = \hat{\alpha}^{\hat{p}-1}\hat{\gamma} + \hat{\gamma}^{(\hat{p}-1)}\hat{\beta}$

For isointegers $\hat{c}, \hat{e}$; define $\hat{c} + \hat{e} \geq \hat{0}$,
$\hat{\gamma}^{(\hat{c}+\hat{e})} = \hat{\alpha}^{\hat{c}}\hat{\gamma}^{(\hat{e})} + \hat{\gamma}^{(\hat{c})}\hat{\beta}^{\hat{e}}.$

3.5 Order of the elements

In this subsection [28-29], we have define the way to guarantee the maximum order of group generated by the isomatrix $\hat{\mathcal{H}} = \begin{bmatrix} \hat{\alpha} & \hat{\gamma} \\ \hat{0} & \hat{\beta} \end{bmatrix} \epsilon\, \hat{\Theta}$.

Suppose that monic isopolynomial
$\hat{h}(\hat{y}) = \hat{c}_0 + \hat{c}_1\hat{y} + \cdots . + \hat{c}_{\hat{w}-1}\hat{y}^{\hat{w}-1} + \hat{y}^{\hat{w}} \in \mathcal{Z}_{\hat{q}}[\hat{\gamma}].$

i) If $\hat{h} \in \mathcal{Z}_{\hat{q}}$ is an irreducible isopolynomial, then the order of the isomatrix $\bar{\hat{\alpha}}$ is identical to the order of any root of $\hat{h}$ in $\mathrm{F}_{\hat{q}^{\hat{w}}}$ and the order of $\bar{\hat{\alpha}}$ divides $\hat{q}^{\hat{w}} - 1$.

ii) If $\hat{h} \in \mathcal{Z}_{\hat{q}}$ is a primitive isopolynomial, the order of $\bar{\hat{\alpha}}$ is precisely $\hat{q}^{\hat{w}} - 1$.

To design of block isomatrices $\bar{\hat{\alpha}} = \begin{bmatrix} \overline{\hat{\alpha}_1} & \hat{0} & \hat{0} \\ \hat{0} & \overline{\hat{\alpha}_2} & \hat{0} \\ \hat{0} & \hat{0} & \overline{\hat{\alpha}_{\hat{k}}} \end{bmatrix}$ suggested by Odoni et al. [30], for different primitive isopolynomials in $\mathcal{Z}_{\hat{q}}$ of degree $\hat{w}_j$ and $\bar{\hat{\alpha}}_j$ is the companion matrix of $\hat{h}_j$, and $\hat{h}_j$, for $j = 1,2,\ldots,\hat{k}$.

Since, order of each block $\bar{\hat{\alpha}}_{\mathrm{i}}$ is $\hat{q}^{\hat{w}_j} - 1$, so the order of $\bar{\hat{\alpha}}$ is lcm$(\hat{q}^{\hat{w}_1} - 1, \hat{q}^{\hat{w}_2} - 1, \ldots, \hat{q}^{\hat{w}_{\hat{k}}} - 1)$.

For companion isomatrices $\overline{\bar{\hat{\alpha}}}, \bar{\hat{\beta}}$ and
$\hat{h}(\hat{y}) = \hat{c}_0 + \hat{c}_1\hat{y} + \cdots . + \hat{c}_{\hat{u}-1}\hat{y}^{\hat{u}-1} + \hat{y}^{\hat{u}}$,
$\hat{f}(\hat{y}) = \hat{e}_0 + \hat{e}_1\hat{y} + \cdots . + \hat{e}_{\hat{v}-1}\hat{y}^{\hat{v}-1} + \hat{y}^{\hat{v}}$ be two primitive polynomials in $\mathcal{Z}_{\hat{q}}[\hat{\gamma}]$. For two invertible

isomatrices $\widehat{\mathcal{R}}$ and $\widehat{\mathcal{S}}$, define $\widehat{\alpha} = \widehat{\mathcal{R}}^{-1}\overline{\widehat{\alpha}}\,\widehat{\mathcal{R}}$ and $\widehat{\beta} = \widehat{\mathcal{S}}^{-1}\overline{\widehat{\beta}}\,\widehat{\mathcal{S}}$ such that the order of $\widehat{\mathcal{H}}$ is lcm$(\widehat{q}^{\widehat{u}} - 1, \widehat{q}^{\widehat{v}} - 1)$.

4. Suggested Isonumber based Isokey Interchange Protocol

Suppose that $\widehat{\mathcal{H}}_1 = \begin{bmatrix} \widehat{\alpha}_1 & \widehat{\gamma}_1 \\ \widehat{0} & \widehat{\beta}_1 \end{bmatrix} \in \widehat{\Theta}$ with orders $\widehat{z}_1$ and $\widehat{\mathcal{H}}_2 = \begin{bmatrix} \widehat{\alpha}_2 & \widehat{\gamma}_2 \\ \widehat{0} & \widehat{\beta}_2 \end{bmatrix} \in \widehat{\Theta}$ with orders $\widehat{z}_2$, are two isometrix. For isonumbers $\widehat{m}$; $\widehat{n} \in \mathcal{N}$, define the following notation; $\widehat{\alpha}_{\widehat{m}\widehat{n}} = \widehat{\alpha}_1^{\widehat{m}}\widehat{\alpha}_2^{\widehat{n}}$, $\widehat{\beta}_{\widehat{m}\widehat{n}} = \widehat{\beta}_1^{\widehat{m}}\widehat{\beta}_2^{\widehat{n}}$, and $\widehat{\psi}_{\widehat{m}\widehat{n}} = \widehat{\alpha}_1^{\widehat{m}}\widehat{\gamma}_2^{(\widehat{n})} + \widehat{\gamma}_1^{(\widehat{m})}\widehat{\beta}_2^{\widehat{n}}$.

If two clients Taylor and Eileen wish to interchange an isokey, they may implement the following algorithm:

1) Taylor and Eileen consent on isounit $\widehat{\jmath}$, $\widehat{q} \in \mathcal{N}$, $\widehat{\mathcal{H}}_1 \in \widehat{\Theta}$ with orders $\widehat{z}_1$ and $\widehat{\mathcal{H}}_2 \in \widehat{\Theta}$ with orders $\widehat{z}_2$.

2) Taylor select two arbitrary isonumber $\widehat{u}; \widehat{v} \in \mathcal{N}$ such that $1 \le \widehat{u} \le \widehat{z}_1 - 1$, $1 \le \widehat{v} \le \widehat{z}_2 - 1$.

And numerate $\widehat{\alpha}_{\widehat{u}\widehat{v}}$, $\widehat{\beta}_{\widehat{u}\widehat{v}}$, $\widehat{\psi}_{\widehat{u}\widehat{v}}$ for constructing $\widehat{\psi} = \begin{bmatrix} \widehat{\alpha}_{\widehat{u}\widehat{v}} & \widehat{\psi}_{\widehat{u}\widehat{v}} \\ \widehat{0} & \widehat{\beta}_{\widehat{u}\widehat{v}} \end{bmatrix}$.

(3) Taylor refers $\widehat{\psi}$ to Eileen.

(4) Eileen select two arbitrary isonumber $\widehat{a}, \widehat{b} \in \mathcal{N}$ such that $1 \le \widehat{a} \le \widehat{z}_1 - 1$, $1 \le \widehat{b} \le \widehat{z}_2 - 1$.

And numerate $\widehat{\alpha}_{\widehat{a}\widehat{b}}$, $\widehat{\beta}_{\widehat{a}\widehat{b}}$, $\widehat{\psi}_{\widehat{a}\widehat{b}}$ for constructing $\widehat{\chi} = \begin{bmatrix} \widehat{\alpha}_{\widehat{a}\widehat{b}} & \widehat{\psi}_{\widehat{a}\widehat{v}} \\ \widehat{0} & \widehat{\beta}_{\widehat{a}\widehat{b}} \end{bmatrix}$.

(5) Eileen refers $\widehat{\chi}$ to Taylor.

(6) Then the isomatrices $\widehat{\psi}$ is non-secret keys for Taylor and the isomatrices $\widehat{\psi}$ is non-secret keys for Eileen.

(7) Taylor numerate $\widehat{K}_{\text{Taylor}} = \widehat{\alpha}_1^{\widehat{u}}\widehat{\alpha}_{\widehat{a}\widehat{b}}\widehat{\gamma}_2^{(\widehat{v})} + \widehat{\alpha}_1^{\widehat{u}}\widehat{\psi}_{\widehat{a}\widehat{b}}\widehat{\beta}_2^{\widehat{v}} + \widehat{\gamma}_1^{(\widehat{u})}\widehat{\beta}_{\widehat{a}\widehat{b}}\widehat{\beta}_2^{\widehat{v}}$.

(8) Eileen numerate $\widehat{K}_{\text{Eileen}} = \widehat{\alpha}_1^{\widehat{a}}\widehat{\alpha}_{\widehat{u}\widehat{v}}\widehat{\gamma}_2^{(\widehat{b})} + \widehat{\alpha}_1^{\widehat{a}}\widehat{\psi}_{\widehat{a}\widehat{u}}\widehat{\beta}_2^{\widehat{b}} + \widehat{\gamma}_1^{(\widehat{a})}\widehat{\beta}_{\widehat{u}\widehat{v}}\widehat{\beta}_2^{\widehat{b}}$.

Following proof shows that $\widehat{K}_{\text{Taylor}} = \widehat{K}_{\text{Eileen}}$.

If $\widehat{K}_{\text{Taylor}} = \widehat{\alpha}_1^{\widehat{u}}\widehat{\alpha}_{\widehat{a}\widehat{b}}\widehat{\gamma}_2^{(\widehat{v})} + \widehat{\alpha}_1^{\widehat{u}}\widehat{\psi}_{\widehat{a}\widehat{b}}\widehat{\beta}_2^{\widehat{v}} + \widehat{\gamma}_1^{(\widehat{u})}\widehat{\beta}_{\widehat{a}\widehat{b}}\widehat{\beta}_2^{\widehat{v}}$ and $\widehat{K}_{\text{Eileen}} = \widehat{\alpha}_1^{\widehat{a}}\widehat{\alpha}_{\widehat{u}\widehat{v}}\widehat{\gamma}_2^{(\widehat{b})} + \widehat{\alpha}_1^{\widehat{a}}\widehat{\psi}_{\widehat{a}\widehat{u}}\widehat{\beta}_2^{\widehat{b}} + \widehat{\gamma}_1^{(\widehat{a})}\widehat{\beta}_{\widehat{u}\widehat{v}}\widehat{\beta}_2^{\widehat{b}}$, then $\widehat{K}_{\text{Taylor}} = \widehat{K}_{\text{Eileen}}$.

As, $\widehat{\psi} = \begin{bmatrix} \widehat{\alpha}_{\widehat{u}\widehat{v}} & \widehat{\psi}_{\widehat{u}\widehat{v}} \\ \widehat{0} & \widehat{\beta}_{\widehat{u}\widehat{v}} \end{bmatrix} = \widehat{\mathcal{H}}_1^{\widehat{u}}\widehat{\mathcal{H}}_2^{\widehat{v}}$,

$\widehat{\chi} = \begin{bmatrix} \widehat{\alpha}_{\widehat{a}\widehat{b}} & \widehat{\psi}_{\widehat{a}\widehat{v}} \\ \widehat{0} & \widehat{\beta}_{\widehat{a}\widehat{b}} \end{bmatrix} = \widehat{\mathcal{H}}_1^{\widehat{a}}\widehat{\mathcal{H}}_2^{\widehat{b}}$

$\widehat{\mathcal{H}}_1^{\widehat{u}} = \begin{bmatrix} \widehat{\alpha}_1^{\widehat{u}} & \widehat{\gamma}_1^{(\widehat{u})} \\ \widehat{0} & \widehat{\beta}_1^{\widehat{u}} \end{bmatrix}$,

$\widehat{\mathcal{H}}_1^{\widehat{a}} = \begin{bmatrix} \widehat{\alpha}_1^{\widehat{a}} & \widehat{\gamma}_1^{(\widehat{a})} \\ \widehat{0} & \widehat{\beta}_1^{\widehat{a}} \end{bmatrix}$

$\widehat{\mathcal{H}}_2^{\widehat{v}} = \begin{bmatrix} \widehat{\alpha}_2^{\widehat{v}} & \widehat{\gamma}_2^{(\widehat{v})} \\ \widehat{0} & \widehat{\beta}_2^{\widehat{v}} \end{bmatrix}$ and

$\widehat{\mathcal{H}}_2^{\widehat{b}} = \begin{bmatrix} \widehat{\alpha}_2^{\widehat{b}} & \widehat{\gamma}_2^{(\widehat{b})} \\ \widehat{0} & \widehat{\beta}_2^{\widehat{b}} \end{bmatrix}$

Suppose that, $\widehat{\mathcal{H}}_{\text{Taylor}} = \widehat{\mathcal{H}}_1^{\widehat{u}}\widehat{\chi}\widehat{\mathcal{H}}_2^{\widehat{v}} = \begin{bmatrix} \widehat{\alpha}_{\widehat{a}} & \widehat{K}_{\text{Taylor}} \\ \widehat{0} & \widehat{\beta}_{\widehat{a}} \end{bmatrix}$ and

$\widehat{\mathcal{H}}_{\text{Eileen}} = \widehat{\mathcal{H}}_1^{\widehat{a}}\widehat{\psi}\widehat{\mathcal{H}}_2^{\widehat{b}} = \begin{bmatrix} \widehat{\alpha}_{\widehat{a}} & \widehat{K}_{\text{Eileen}} \\ \widehat{0} & \widehat{\beta}_{\widehat{a}} \end{bmatrix}$

Then, $\widehat{\mathcal{H}}_{\text{Taylor}} = \widehat{\mathcal{H}}_1^{\widehat{u}}\widehat{\chi}\widehat{\mathcal{H}}_2^{\widehat{v}} = \widehat{\mathcal{H}}_1^{\widehat{u}}\widehat{\mathcal{H}}_1^{\widehat{a}}\widehat{\mathcal{H}}_2^{\widehat{b}}\widehat{\mathcal{H}}_2^{\widehat{v}} = \widehat{\mathcal{H}}_1^{\widehat{a}}\widehat{\mathcal{H}}_1^{\widehat{u}}\widehat{\mathcal{H}}_2^{\widehat{v}}\widehat{\mathcal{H}}_2^{\widehat{b}} = \widehat{\mathcal{H}}_1^{\widehat{a}}\widehat{\psi}\widehat{\mathcal{H}}_2^{\widehat{b}} = \widehat{\mathcal{H}}_{\text{Eileen}}$

Hence, $\widehat{K}_{\text{Taylor}} = \widehat{K}_{\text{Eileen}}$ hold i.e., the isokey interchange protocol is successful achieved.

5. Suggested Isonumber based Isokey Interchange Protocol

If foe incapable to find isounit then suggested isokey interchange protocol secure and if foe capable to find isounit then following attack is secure.

Brute force attacks: For large order for $\widehat{\mathcal{H}}_1$ and $\widehat{\mathcal{H}}_2$ as 1024 bits then Brute force attacks not applicable.

Menezes and Wu algorithm [31]: Since no isomatrix powers are published over network. Thus Menezes and Wu algorithm is not feasible for the suggested protocol.

Climent et al. algorithm [32]: For identity isomatrix $\mathcal{I}_{\widehat{w}}$ of size $\widehat{w}$ and null matrix $\widehat{0}_{\widehat{w}}$ of the same size, an equation

$\widehat{\zeta}_{\widehat{\mathcal{H}}}(\widehat{\mu}) = \det(\widehat{\mu}\mathcal{I}_{\widehat{w}} - \widehat{\mathcal{H}}) = \widehat{c}_0 + \widehat{c}_1\widehat{\mu} + \widehat{c}_2\widehat{\mu}^2 \ldots\ldots + \widehat{c}_{\widehat{w}-1}\widehat{\mu}^{\widehat{w}-1} + \widehat{\mu}^{\widehat{w}}$

is the characteristic equation for isomatrix $\widehat{\mathcal{H}} \in \mathcal{GL}_{\widehat{w}}(\mathcal{Z}_{\hat{q}})$.

Then

$\hat{\zeta}_{\widehat{\mathcal{H}}}(\widehat{\mathcal{H}}) = \hat{c}_0 + \hat{c}_1\widehat{\mathcal{H}} + \hat{c}_2\widehat{\mathcal{H}}^2 \ldots\ldots + \hat{c}_{\widehat{w}-1}\widehat{\mathcal{H}}^{\widehat{w}-1} + \widehat{\mathcal{H}}^{\widehat{w}} = \hat{0}_{\widehat{w}}$,

Meanwhile two different characteristic equations for two different isomatrices, so the attack based on Cayley–Hamilton theorem is not feasible for the suggested protocol.

The inefficiency of this type of attack is guaranteed by Alvarez R et al [1].

6. Conclusion

In this article, we have suggested a new isokey interchange protocol based on isomathematics; utilizing isonumbers for corresponding isounits and for isointegers $\widehat{\boldsymbol{a}}$, $\widehat{\boldsymbol{b}}$; the behavior of isomatrix isoproducts of the type $\widehat{\mathcal{H}}_1^{\widehat{a}}\,\widehat{\mathcal{H}}_2^{\widehat{b}}$, where $\widehat{\mathcal{H}}_1$; $\widehat{\mathcal{H}}_2$ over $\mathcal{BUTI}$ with a large sufficient order as, for example, 1024 bits. Large isoprime isonumbers are absence in suggested protocol which is one of the primary asset of this protocol. Moreover, Brute force attacks, Menezes and Wu algorithm and Climent et al. algorithm are infeasible in suggested isokey interchange protocol.

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Coupled fixed point theorem in quasi metric space

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Abstract. In the present paper a unique common coupled fixed point theorem has been proven for quasi metric space with modified - ω distance function. This result is improvement, modification and extension in the study of quasi metric space. An example has been given to illustrate the work.

Keywords: fixed point, quasi-metric space, coupled fixed point, modified-ω distance.

1. Introduction and preliminaries

The fixed point theory is one of the important topics of functional analysis. The whole metric fixed point theory based on a very powerful theorem Banach Contraction principle [5]. Since then many researchers worked on it and develop the results in different directions.

Bhaskar and Lakshmikantham [6] initiated the concept of coupled fixed point in the following way:

Definition 1.1 ([6])**.** An element $(a, b) \in X \times X$ is called a coupled fixed point of mapping $J : X \times X \to X$ if $J(a, b) = a, J(b, a) = b$.

Further several researchers Lakshmikantham and Ciric [10], Choudhary and Kundu [8], Luong et al. [11], Razani and Parvaneh [12], Alsulami [3], Samet et al. [13], Alotaibi [2] extended the coupled fixed point theorems in partial order metric space under different constraints but it is not found in quasi metric space, so the authors are motivated towards the present work.

Remark 1. Every metric space is quasi metric space but the converse is not true.

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Remark 2. The results which are true for quasi metric space need not be true for metric space.
Wilson [16] introduced the concept of quasi metric space as here under:

Definition 1.2 ([16])**.** The function $q : X \times X \to [0, \infty)$ is a quasi-metric if it satisfies

(i) $q(a, b) = 0 \Leftrightarrow a = b$;

(ii) $q(a, b) \leq q(a, c) + q(c, b)$, for all $a, b, c \in X$.

The pair (X, q) is called quasi metric space.

The study of fixed point theorems on quasi metric space further continued by Aydi, et al. [4], Bilgili, et al. [7], Shatanawi, et al. [14], Shatanawi, et al. [15], Alegre, et al. [1].

Definition 1.3 ([4,9])**.** A sequence $\{a_l\}$ converges to $a \in X$if $\lim_{l\to\infty} q(a_l, a) = \lim_{l\to\infty} q(a, a_l) = 0$.

Definition 1.4 ([9])**.** Let $\{a_l\}$ be a sequence in X. Then:

(i) $\{a_l\}$ is called left Cauchy if for any $\delta > 0, \exists N_0 \in N$, such that $q(a_l, a_m) < \delta \forall l \geq m > N_0$

(ii) $\{a_l\}$ is called right Cauchy if for any $\delta > 0, \exists N_0 \in N$,such that $q(a_l, a_m) < \delta \forall m \geq l > N_0$.

Definition 1.5 ([4,9])**.** $\{a_l\}$ is called Cauchy sequence if for any $\delta > 0, \exists N_0 \in N$ such that $q(a_l, a_m) \leq \delta \forall l, m > N_0$ or $\{a_l\}$ is right and left Cauchy.

Definition 1.6 ([1])**.** The modified -ω distance on (X, q) is a function $p : X \times X \to [0, \infty)$ which satisfies the following

(Q1) $p(a_1, a_2) \leq p(a_1, a_3) + p(a_3, a_2), \forall a_1, a_2, a_3 \in X$.

(Q2) $p : X \to [0, \infty)$is lower semi continuous$\forall a \in X$.

(Q3) $\forall \varepsilon > 0 \exists \delta > 0$ such that $p(a_1, a_2) \leq \delta, p(a_2, a_3) \leq \delta \Rightarrow q(a_1, a_3) \leq \varepsilon \forall a_1, a_2, a_3 \in X$.

2. Main result

The aim of this paper is to establish coupled fixed point theorems in quasi metric space.

Theorem 2.1. *Let (X, q) be a complete quasi metric space equipped with an mw distance mapping p, also J and K: $X \times X \to X$ be two continuous functions such that the pair (J, K) satisfy*

$$p\{J(a,b), K(c,d)\} \leq h \max\{p(a, J(a,b)), p(c, K(c,d))\}, \tag{2.1}$$

$$p\{K(a,b), J(c,d)\} \leq h \max\{p(a, K(a,b)), p(c, J(c,d))\}. \tag{2.2}$$

here $h \in [0,1)$. Then J and K have unique common coupled fixed point.

Proof. Let $a_{2l+1} = J(a_{2l}, b_{2l}), b_{2l+1} = J(b_{2l}, a_{2l})$,

$$a_{2l+2} = K(a_{2l+1}, b_{2l+1}), b_{2l+2} = K(b_{2l+1}, a_{2l+1}).$$

Now, to prove that $p(a_l, a_{l+1}) = 0$ or $p(a_{l+1}, a_l) = 0$ and $p(b_l, b_{l+1}) = 0$ or $p(b_{l+1}, b_l) = 0$.
Case I. Consider $p(a_l, a_{l+1}) = 0$, for $l = 2n$,

$$\begin{aligned} p(a_{2n+1}, a_{2n+2}) &= p\{J(a_{2n}, b_{2n}), K(a_{2n+1}, b_{2n+1})\}, \\ &\leq h \max\{p(a_{2n}, J(a_{2n}, b_{2n})), p(a_{2n+1}, K(a_{2n+1}, b_{2n+1}))\} \\ &= h \max\{p(a_{2n}, a_{2n+1}), p(a_{2n+1}, a_{2n+2})\}. \end{aligned}$$

(i) If $p(a_{2n}, a_{2n+1})$ is maximum, then $p(a_{2n+1}, a_{2n+2}) = 0$.

(ii) If $p(a_{2n+1}, a_{2n+2})$ is maximum, then $p(a_{2n+1}, a_{2n+2}) = 0$,

$$p(a_{2n+1}, a_{2n+2}) = 0. \tag{2.3}$$

Now,

$$\begin{aligned} p(b_{2n+1}, b_{2n+2}) &= p\{J(b_{2n}, a_{2n}), K(b_{2n+1}, a_{2n+1})\} \\ &\leq h \max\{p(b_{2n}, J(b_{2n}, a_{2n})), p(b_{2n+1}, K(b_{2n+1}, a_{2n+1}))\} \\ &= h \max\{p(b_{2n}, b_{2n+1}), p(b_{2n+1}, b_{2n+2})\}. \end{aligned}$$

(i) If $p(b_{2n}, b_{2n+1})$ is maximum then $p(b_{2n+1}, b_{2n+2}) = 0$.
(ii) If $p(b_{2n+1}, b_{2n+2})$ is maximum then $p(b_{2n+1}, b_{2n+2}) = 0$,

$$p(b_{2n+1}, b_{2n+2}) = 0. \tag{2.4}$$

Now,

$$\begin{aligned} p(a_{2n+2}, a_{2n+1}) &= p\{K(a_{2n+1}, b_{2n+1}), J(a_{2n}, b_{2n})\} \\ &\leq h \max\{p(a_{2n+1}, K(a_{2n+1}, b_{2n+1})), p(a_{2n}, J(a_{2n}, b_{2n}))\} \\ &= h \max\{p(a_{2n+1}, a_{2n+2}), p(a_{2n}, a_{2n+1})\}. \end{aligned}$$

(i) $p(a_{2n+1}, a_{2n+2})$ is maximum then $p(a_{2n+2}, a_{2n+1}) = 0$.
(ii) If $p(a_{2n}, a_{2n+1})$ is maximum then $p(a_{2n+2}, a_{2n+1}) = 0$,

$$p(a_{2n+2}, a_{2n+1}) = 0. \tag{2.5}$$

Similarly one can show that

$$p(a_{2n}, a_{2n+2}) = 0, p(b_{2n}, b_{2n+2}) = 0 \tag{2.6}$$

using Q1. From (2.1.5), (2.1.6) and Q3,

$$q(a_{2n}, a_{2n+1}) = 0 \begin{cases} \therefore q(a_l, a_{l+1}) = 0 \Rightarrow a_l = a_{l+1} = J(a_l, b_l), \\ q(b_l, b_{l+1}) = 0 \Rightarrow b_l = b_{l+1} = K(b_l, a_l). \end{cases} \tag{2.7}$$

(a_l, b_l) is coupled fixed point.

Also, (2.1.8) $p(a_{2n}, a_{2n+1}) \leq p(a_{2n}, a_{2n+2}) + p(a_{2n+2}, a_{2n+1}) = 0$. From (2.1.3), (2.1.8) and Q3

$$\begin{aligned} &q(a_{2n}, a_{2n+2}) = 0, \\ &q(a_{2n+1}, a_{2n+2}) \leq q(a_{2n+1}, a_{2n}) + q(a_{2n}, a_{2n+2}) = 0. \end{aligned} \tag{2.8}$$

Similarly, $q(b_{2n+1}, b_{2n+2}) \leq q(b_{2n+1}, b_{2n}) + q(b_{2n}, b_{2n+2}) = 0$. Hence,

$$\begin{aligned} &a_{2n} = a_{2n+1} = a_{2n+2} \Rightarrow a_l = a_{l+1} = a_{l+2} \\ &\Rightarrow a_l = J(a_l, b_l) = K(a_{l+1}, b_{l+1}), \end{aligned}$$

when $l \to \infty$, as J and K are continuous $a = J(a, b) = K(a, b)$.

Also, $b_{2n} = b_{2n+1} = b_{2n+2} \Rightarrow b_l = b_{l+1} = b_{l+2} \Rightarrow b_l = J(b_l, a_l) = K(b_{l+1}, a_{l+1})$, when $l \to \infty$, as J and K are continuous $\Rightarrow b = J(b, a) = K(b, a)$. Thus, (a, b) is common coupled fixed point of J and K.

Case II: When l is odd, $l = 2n + 1$,

$$\begin{aligned} &p(a_{2n+1}, a_{2n+2}) = 0, \\ &p(a_{2n+2}, a_{2n+3}) = p\{K(a_{2n+1}, b_{2n+1}), J(a_{2n+2}, b_{2n+2})\} \\ &\leq h \max\{p(a_{2n+1}, K(a_{2n+1}, b_{2n+1})), p(a_{2n+2}, J(a_{2n+2}, b_{2n+2}))\} \\ &= h \max\{p(a_{2n+1}, a_{2n+2}), p(a_{2n+2}, a_{2n+3}))\}. \end{aligned} \tag{2.9}$$

This implies

$$p(a_{2n+2}, a_{2n+3}) = 0. \tag{2.10}$$

Also, it can be proved that

$$p(a_{2n+3}, a_{2n+2}) = 0, p(b_{2n+2}, b_{2n+3}) = 0, p(b_{2n+3}, b_{2n+2}) = 0. \tag{2.11}$$

Now, by Q1

$$p(a_{2n+1}, a_{2n+3}) \leq p(a_{2n+1}, a_{2n+2}) + p(a_{2n+2}, a_{2n+3}) = 0. \tag{2.12}$$

From (2.1.12), (2.1.13) and Q_3

$$q(a_{2n+1}, a_{2n+2}) = 0. \tag{2.13}$$

Also, $q(a_{2n+1}, a_{2n+3}) = 0$. Similarly, $q(b_{2n+1}, b_{2n+2}) = 0$ and $q(b_{2n+1}, b_{2n+3}) = 0$. From (2.1.10), (2.1.11) and Q_3

$$\begin{aligned} &q(a_{2n+1}, a_{2n+3}) = 0, a_{2n+1} = a_{2n+2} = a_{2n+3} \Rightarrow a_l = a_{l+1} = a_{l+2} \\ &\Rightarrow a_l = J(a_l, b_l) = K(a_{l+1}, b_{l+1}). \end{aligned} \tag{2.14}$$

Similarly, one can prove that $\Rightarrow b = J(b, a) = K(b, a)$. Thus, (a, b) are common coupled fixed point of J and K.

Similarly, one can show that if $p(a_{l+1}, a_l) = 0$, (a, b) are common coupled fixed point of J and K. Now, assume that $p(a_l, a_{l+1}) \neq 0, p(a_{l+1}, a_l) \neq 0$. Then,

$$\begin{aligned} &p(a_{2n+1}, a_{2n}) = p((Ja_{2n}, b_{2n}), K(a_{2n+1}, b_{2n+1})) \\ &\leq h \max\{p(a_{2n}, J(a_{2n}, b_{2n})), p(a_{2n+1}, K(a_{2n+1}, b_{2n+1}))\} \\ &= h \max\{p(a_{2n}, a_{2n+1}), p(a_{2n+1}, a_{2n+2})\}. \end{aligned} \tag{2.15}$$

(i) If $p(a_{2n}, a_{2n+1})$is maximum, then $p(a_{2n+1}, a_{2n+2}) \leq hp(a_{2n}, a_{2n+1})$.

(ii) If $p(a_{2n+1}, a_{2n+2})$ is maximum, then $p(a_{2n+1}, a_{2n+2}) = 0$, which is contradiction.

Hence, $p(a_{2n+1}, a_{2n+2}) \leq hp(a_{2n}, a_{2n+1})$. By similar process we can prove that

$$p(a_{2n}, a_{2n+1}) \leq hp(a_{2n-1}, a_{2n}).$$

Also, we can prove

$$p(b_{2n+1}, b_{2n+2}) \leq hp(b_{2n}, b_{2n+1})$$

and

$$p(b_{2n}, b_{2n+1}) \leq hp(b_{2n-1}, b_{2n}).$$

Thus,

$$p(a_l, a_{l+1}) \leq hp(a_{l-1}, a_l) \text{ and } p(b_l, b_{l+1}) \leq hp(b_{l-1}, b_l). \tag{2.16}$$

Now,

$$\begin{aligned} &p(a_{l+1}, a_l) = p(J(a_l, b_l), K(a_{l-1}, b_{l-1})) \\ &\leq h \max\{p(a_l, J(a_l, b_l), p(a_{l-1}, K(a_{l-1}, b_{l-1}))\} \\ &= h \max\{p(a_l, a_{l+1}), p(a_{l-1}, a_l)\}, \\ &p(a_{l+1}, a_l) \leq hp(a_{l-1}, a_l). \end{aligned} \tag{2.17}$$

Repeating l times

$$p(a_{l+1}, a_l) \leq h^l p(a_1, a_0). \tag{2.18}$$

Also, one can prove

$$p(a_l, a_{l+1}) \leq h^l p(a_0, a_1). \tag{2.19}$$

Similarly, we can prove that $p(b_{l+1}, b_l) \leq h^l p(b_1, b_0)$and $p(b_l, b_{l+1}) \leq h^l p(b_0, b_1)$. Thus, as $l \to \infty, p(a_l, a_{l+1}) = 0, p(a_{l+1}, a_l) = 0, p(b_l, b_{l+1}) = 0, p(b_{l+1}, b_l) = 0$. Now, to prove $\{a_l\}$ and $\{b_l\}$ are Cauchy sequences, we need to prove $\lim_{s,t\to\infty} p(a_s, a_t) = 0$, for each $s, t \in N$.

Case I: If s is odd and t is even with $s < t$, then

$$\begin{aligned} &p(a_s, a_t) = p(Ja_{s-1}, b_{s-1}), K(a_{t-1}, b_{t-1}) \\ &\leq h \max\{p(a_{s-1}, J(a_{s-1}, a_{s-1})), p(a_{t-1}, K(a_{t-1}, a_{t-1}))\} \\ &= h \max\{p(a_{s-1}, a_s), p(a_{t-1}, a_t)\} \\ &= hp(a_{s-1}, a_s). \end{aligned}$$

Thus, we have $p(a_s, a_t) \leq h^s p(a_0, a_1)$.

Let $s, t \to \infty$. Then,

$$\lim_{s,t\to\infty} p(a_s, a_t) = 0, \tag{2.20}$$

with $s < t$. Similarly $\lim_{s,t\to\infty} p(b_s, b_t) = 0$, with $s < t$.

Case II: If s is odd and t is even with $s > t$

$$\begin{aligned} &p(a_s, a_t) = p(J(a_{s-1}, b_{s-1}), K(a_{t-1}, b_{t-1})) \\ &\leq h \max\{p(a_{s-1}, J(a_{s-1}, b_{s-1})), p(a_{t-1}, K(a_{t-1}, b_{t-1}))\} \\ &= h \max\{p(a_{s-1}, a_s), p(a_{t-1}, a_t)\} \\ &= hp(a_{t-1}, a_t). \end{aligned}$$

Thus, $p(a_s, a_t) \leq h^t p(a_0, a_1)$.

Let $s, t \to \infty$. Then

$$\lim_{s,t\to\infty} p(a_s, a_t) = 0, \tag{2.21}$$

with $s > t$. Similarly $\lim_{s,t\to\infty} p(b_s, b_t) = 0$ with $s > t$.

By similar argument, one can show for s even and t odd, for $s < t$ and $s > t$ $\lim_{s,t\to\infty} p(a_s, a_t) = 0$ and $\lim_{s,t\to\infty} p(b_s, b_t) = 0$.

Now, we show that $\{x_l\}$ is right Cauchy sequence. Consider the following cases:

(i) If $l, r \in N$ such that l is odd and r is even with $r > l$, then we have $\lim_{l,r\to\infty} p(a_l, a_r) = 0$ from (2.1.19).

(ii) If $l, r \in N$ such that l is even and r is odd with $r > l$, then we have $\lim_{l,r\to\infty} p(a_l, a_r) = 0$ from (2.1.21).

(iii) $l, r \in N$ such that l and r both are even with $r > l$,then we have $p(a_l, a_r) \leq p(a_l, a_{l+1}) + p(a_{l+1}, a_r)$. Thus, $\lim_{l,r\to\infty} p(a_l, a_r) = 0, l > r$.

(iv) If $l, r \in N$ such that l and r both are even with $r > l$ then, we have $p(a_l, a_r) \leq p(a_l, a_{r+1}) + p(a_{r+1}, a_r)$. Thus, $\lim_{l,r\to\infty} p(a_l, a_r) = 0, l > r$.

Hence, $\{a_l\}$ is right Cauchy sequence. With similar argument $\{b_l\}$ is right Cauchy sequence and also $\{a_l\}$,$\{b_l\}$ are left Cauchy sequences. Hence $\{a_l\}$ and $\{b_l\}$ both are Cauchy sequences.

Since (X, q) is complete quasi metric space, therefore $\lim_{l\to\infty} p(a_{2l}, a) = 0 = \lim_{l\to\infty} p(a, a_{2l})$

Now, $a = \lim_{l\to\infty} a_{2l+1} = \lim_{l\to\infty} J(a_{2l}, b_{2l}) = J(a, b)$ and $b = \lim_{l\to\infty} b_{2l+1} = \lim_{l\to\infty} J(b_{2l}, a_{2l}) = J(b, a)$. Thus, (a, b) is coupled fixed point of J and with similar argument it can be shown that (a, b) is coupled fixed point of K.

Hence, (a, b) is common coupled fixed point of J and K. To prove uniqueness first we have to prove $p(v, v) = 0$,

$$p(v, v) = p\{J(v, v), K(v, v)\} \leq h \max\{p(v, J(v, v)), p(v, K(v, v))\} = hp(v, v).$$

Thus, $p(v, v) = 0$.

Let (a, b) and (a', b') be two coupled fixed points of J and K, $J(a, b) = K(a, b) = a$ and $J(b, a) = K(b, a) = b$, $J(a', b') = K(a', b') = a'$ and $J(b', a') = K(b', a') = b'$.

Now,

$$\begin{aligned} p(a, a') &= p\{J(a, b), K(a', b')\}, \leq h \max\{p(a, J(a, b)), p(a', K(a', b'))\} \\ &= h \max\{p(a, a), p(a', a')\} = 0. \end{aligned}$$

Thus, $a = a'$, similarly we can show that $b = b'$. This implies $(a, b) \equiv (a', b')$. □

Hence, (a, b) is unique common coupled fixed point of J and K.

Corollary 2.2. *Let (X, q) be a complete quasi metric space equipped with an mw distance mapping p and $J{:}X \times X \to X$ be continuous function such that:*

(i) $p\{J(a, b), J(c, d)\} \leq h \max\{p(a, J(a, b)), p(c, J(c, d))\}$, *where* $h \in [0, 1)$. *Then J has unique common coupled fixed point.*

Proof. Consider $K = I$ (Identity map), we get the result. The following example validate our result. □

Example 2.3. Let $X = (0, 3] p(a, b) = \frac{a+2b}{8}, q(a, b) = \frac{a+3b-2}{4}, J(a, b) = 4a + 3b - 15, K(a, b) = 3a + 2b - 10$. Here, q is quasi metric space,p is modified-ω distance function.

L.H.S. $= p\{J(a, b), K(c, d)\} = p(4a + 3b - 15, 3c + 2d - 10) = \frac{1}{8}(4a + 3b + 6c + 4d - 35)$

R.H.S. $=h\max\{p(a,J(a,b)),p(c,K(c,d))\}=h,\max\{p(a,4a+3b-15),p(c,3c+2d-10)\}=h\max\{\frac{9a+6b-30}{8},\frac{7c+4d-20}{8}\}=\frac{h}{8}\max\{9a+6b-30,7c+4d-20\}$. Condition (i) and (ii) of theorem are satisfied. Also, $J(2,3)=2=K(2,3), J(3,2)=3=K(3,2)$. Thus, $(2,3)$ is coupled common fixed point of J and K.

Conclusion. A unique common coupled fixed point theorem proved for quasi metric space.

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Research Article

Numerical Solution of 2nd Order Boundary Value Problems with Dirichlet, Neumann and Robin Boundary Conditions using FDM

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Abstract. In many fields of science and engineering, to determine the harmonic motion, damped and forced variation, current from electric circuit, 2nd order ODE is required to solve. Solving the ODE with complicated boundary condition that occur in engineering problems is a great challenges analytically. Therefore, numerical technique *finite difference method* (FDM) is very popular and important for solving the boundary value problems. In this article three different conditions as Dirichlet, Neumann and Robin (mixed) boundary conditions are applied in initial-boundary problem. FDM is used to solve ODE boundary value problems. Error calculation, stability, convergence are also explained. To test the accuracy numerical solutions are verified with analytical solution and error is calculated at each point for different mesh grid size as mesh grid size is decreased result will give the accuracy.

Keywords. Finite difference scheme, Dirichlet condition, Convergence, Neumann condition, Mixed condition, Stability

Mathematics Subject Classification (2020). 65M06, 65N06

1. Introduction

In science and engineering several problems are occurred in mathematically analyzing ordinary differential equations which are satisfying particular condition. Only a selected class of differential equations can be solved analytically. These problem consists differential equation and complicated conditions which not to be solved in practically, in general on can get some

closed form solution, and hence can use numerical methods for solving such differential equations. Some researchers studied in this field like Balagurusamy [5], Hildebrand [6], Jain [7], Levy [9], Sastry [11, 12], Scheid [13] developed the FDM for determining the initial-boundary values problems. Second order, third order BVM with ordinary differential equation for Dirichlet boundary condition is solved by Lakshmi [8], Muhammad [9], Siddiqi [14], and Xu [15]. Adak [1–4] studied finite difference methods to solve partial differential equation with convergence of numerical techniques.

From previous research it is cleared that the most of boundary value problems with Dirichlet boundary condition are investigated. Hence, the main focus of this article, well-posed (Dirichlet boundary condition) as well as ill-posed (Neumann and Robin boundary condition) problems has been determined.

2. Boundary Value Problems

A *boundary value problem* (BVP) consists an ODE or PDE and specific *boundary condition* (BC) in physically.

We begin by discussing various types of boundary conditions that can be imposed. A BVP which only has one independent variable is an ODE but we consider BVP in dimensions we need to use PDE.

Throughout this article, linear non-homogeneous second order ODE is considered defined by

$$u'' + r(x)u' + s(x)u = t(x), \quad a < x < b\,. \tag{2.1}$$

Corresponding to ODE (2.1), there are three important boundary conditions. They are given by

Dirichlet Boundary Condition. If the values of the function are specified on the boundary in a BVP, this type of constraint is called Dirichlet boundary condition.
For example, $u(a) = \alpha$, $u(b) = \beta$ in domain $[a, b]$, where α and β are constant.

Neumann Boundary Condition. If the derivatives of the unknown function are specified on the boundary in a BVP, this type of constraint is called Neumann boundary condition.
For example, $u'(a) = \alpha$, $u'(b) = \beta$ in domain $[a, b]$, where α and β are constant.

Robin Boundary Condition. If a weighted combination at the function value and its derivative at the boundary is called Robin boundary condition or mixed boundary condition.
For example, $u'(a) + cu(a) = \alpha$, $u'(b) + du(b) = \beta$, where c and d are constants.

3. Finite Difference Approximation

In process of finite difference method to solve a BVP, derivatives are replaced by finite difference approximation in ODE with in the specific conditions. After simplifying finite difference approximations with initial-boundary conditions we get linear system of equations. Solving this system of equations desired solution of BVP is obtained.

The interval $[a,b]$ is discretized in x axis into n number of equally spaced subintervals with h for solving problem given by (2.1), so that

$$x_i = x_0 + ih, \quad i = 1,2,3,\ldots,$$

where $x_0 = a$, $x_n = b$.
At these points the corresponding value of u are denoted by

$$u(x_i) = u_i = u(x_0 + ih), \quad i = 0,1,2,\ldots,n.$$

Using Taylor's expansion, values of $u'(x)$ and $u''(x)$ at point $x = x_i$ is given by

$$u_i' = \frac{u_{i+1} - u_{i-1}}{2h} + O(h^2),$$

$$u_i'' = \frac{u_{i-1} - 2u_i + u_{i+1}}{h^2} + O(h^2).$$

The *ordinary differential equation* (ODE) (2.1) at point $x = x_i$ is denoted by

$$u_i'' + r_i u_i' + s_i u_i = t_i.$$

Substituting the expressions for u_i' and u_i'', we obtain

$$\frac{u_{i-1} - 2u_i + u_{i+1}}{h^2} + r_i \frac{u_{i+1} - u_{i-1}}{2h} + s_i u_i = t_i, \quad i = 1,2,\ldots,n,$$

where $u_i = u(x_i)$, $s_i = s(x_i)$.

Error Calculation. We first find the exact solution. Solve the given differential equation, that means, determine CF (Complementary Function) and PI (Particular Integral). Then different type of errors can be calculated by

$$\text{Absolute Error (AE)} = |\text{Exact solution} - \text{Numerical solution}|,$$

$$\text{Relative Error (RE)} = \frac{|\text{Exact solution} - \text{Numerical solution}|}{\text{Exact solution}},$$

$$\text{Percentage Error (PE)} = \frac{|\text{Exact solution} - \text{Numerical solution}|}{\text{Exact solution}} \times 100.$$

Stability of Numerical Method. If the difference value of the numerical result and the exact result tends to zero as number of iteration tends to infinity,then numerical method is said to be stable.

Convergence of Numerical Method. In iteration of numerical technique, if each successive iteration result is progressively closer to the exact result, it is known as *convergence*. A numerical method is not always given converging results. Convergence should be satisfied certain conditions. If these conditions are not satisfied, it is known as *divergence*.

Consistency of Numerical Method. If the finite difference representation converges to the differential equation to solve problem with mesh size tends to very small value, then a numerical scheme is called consistent.

We have explained the method with three types of boundary conditions. In several practical problems, derivative of boundary conditions may be specified, and this requires finite approximation in case of boundary condition which are described above. The following examples illustrate FDM to obtain the solution of BVP.

4. Test Problems and Verification

Problem 1 (Dirichlet Boundary Conditions)**.** *Solve the heat transfer ODE boundary value problem for a rod of length* 1 *unit. The governing equation is defined by* $u'' + u + 1 = 0,\ 0 \le x \le 1$, *with BC* $u(0) = 0$ *and* $u(1) = 0$. *Determine the value of* $u(0.5)$ *using finite difference method with sub-interval* $h = 0.5$ *and* $h = 0.25$. *Also, calculate error at each point using FDM.*

Solution. *Case* I: Consider $h = 0.5$.
Here interval is $0 \le x \le 1$, i.e., $[0, 1]$. We discretize the interval into subintervals with mesh size $h = 0.5$.
So $x_0 = 0$, $x_1 = x_0 + h = 0.5 = \frac{1}{2}$, $x_2 = x_0 + 2h = 1$.
There are only three values of x, so we have three points.
Dirichlet's boundary conditions are given by $u(0) = 0$ and $u(1) = 0$.
That means, $u(0) = u(x_0) = u_0 = 0$ and $u(1) = u(x_2) = u_2 = 0$.
We have to find $u(0.5) = u_1$.
The given differential equation is approximated as

$$\frac{u_{i-1} - 2u_i + u_{i+1}}{h^2} + u_i + 1 = 0.$$

$$\Rightarrow \quad u_{i-1} - (2 - h^2)u_i + u_{i+1} = -h^2, \quad i = 1, 2, \ldots, n-1 \tag{4.1}$$

Using boundary conditions $u_0 = 0$ and $u_n = u_2 = 0$. Since number of sub-interval $n = 2$ and unknown point is 1, then take $i = 1$.
Eq. (4.1) becomes $u_0 - \left(2 - \frac{1}{4}\right)u_1 + u_2 = -\frac{1}{4}$.
Using BCS (*boundary conditions*), $u_0 = 0$ and $u_2 = 0$

$$u_1 = u(0.5) = \frac{1}{7} = 0.142854.$$

Exact Solution. To find exact solution of the given differential equation

$$u'' + u + 1 = 0.$$

$$\Rightarrow \quad (D^2 + 1)u = -1.$$

$$\text{AE} \quad m^2 + 1 = 0 \ \text{ or } \ m = \pm i$$

$$\text{CF} \quad u_c = C_1 \cos x + C_2 \sin x$$

$$\text{PI} = \frac{1}{D^2 + 1}(-1) = -1$$

The general solution is

$$u(x) = C_1 \cos x + C_2 \sin x - 1. \tag{4.2}$$

Using BCS $u(0) = 0$ in eq. (4.2), we get

$$C_1 = 1.$$

Using BCS $u(1) = 0$ in eq. (4.2), we get

$$C_2 = 0.5463.$$

Therefore, the obtained exact solution is given by

$$u(x) = \cos x + (0.5463)\sin x - 1.$$

The value of y at $x = 0.5$ is

$$u(0.5) = 0.139493.$$

Error at $x = 0.5$ is $|0.139493 - 0.142854| = 0.003361$.

Case II: $h = 0.25$.

Here interval is $0 \le x \le 1$, i.e., $[0,1]$. We discretize the interval into subintervals with mesh size $h = 0.25$.

So $x_0 = 0$, $x_1 = x_0 + h = 0.25$, $x_2 = x_0 + 2h = 0.5$, $x_3 = x_0 + 3h = 0.75$, $x_4 = x_0 + 4h = 1$.

Using $h = 0.25$, eq. (4.1) becomes

$$u_{i-1} - \frac{31}{16}u_i + u_{i+1} = -\frac{1}{16}, \quad i = 1,2,\ldots,n-1. \tag{4.3}$$

Put $i = 1,2,3$ (unknown points) in eq. (4.3), system of linear equations is

$$u_0 - \frac{31}{16}u_1 + u_2 = -\frac{1}{16},$$
$$u_1 - \frac{31}{16}u_2 + u_3 = -\frac{1}{16},$$
$$u_2 - \frac{31}{16}u_3 + u_4 = -\frac{1}{16},$$

where $u_0 = 0$ and $u_4 = 0$ (due to BCS).

The above equations become

$$-\frac{31}{16}u_1 + u_2 = -\frac{1}{16},$$
$$u_1 - \frac{31}{16}u_2 + u_3 = -\frac{1}{16},$$
$$u_2 - \frac{31}{16}u_3 = -\frac{1}{16}.$$

Solving system of equations, we get

$$u_1 = y(0.25) = 0.10476,$$
$$u_2 = y(0.5) = 0.14031,$$
$$u_3 = y(0.75) = 0.10476.$$

Using eq. (**??**), exact solutions at each point are

$$u_1 = y(0.25) = 0.1041,$$
$$u_2 = y(0.5) = 0.1395,$$
$$u_3 = y(0.75) = 0.1041.$$

Errors are 0.0006, 0.0008, 0.0006 at $x = 0.25, 0.5, 0.75$.

Since the ratio of two errors in *Case* I and *Case* II is about 4, it follows that the order of convergence is h^2. These results show that the accuracy of numerical method depends upon

the mesh size h which is selected. As h is decreased, the accuracy increases but the number of equation to be increased for solving.

Problem 2 (Neumann Boundary Conditions)**.** *Solve the ill-posed BVP defined by* $u''(x)-(1-x)u'(x)+xu(x)=x$, $u'(0)=0$ *and* $u(1)=0$, *using finite difference method with mesh size* $h=\frac{1}{3}$.

Solution. Here interval is $0\le x\le 1$, i.e., $[0,1]$.
Points are given by $x_0=0$, $x_1=x_0+h=\frac{1}{3}$, $x_2=x_0+2h=\frac{2}{3}$, $x_3=x_0+3h=\frac{3}{3}=1$.
Therefore, $h=\frac{1}{3}$.
To solve the equation $u_i''+(1-x_i)u_i'+x_iu_i=x_i$ use finite difference approximation

$$\frac{u_{i-1}-2u_i+u_{i+1}}{h^2}+(1-x_i)\frac{u_{i+1}-u_{i-1}}{2h}+x_iu_i=x_i$$

$$\Rightarrow\quad (2-h+x_ih)u_{i-1}-(4-2h^2x_i)u_i+(2+1-x_ih)u_{i+1}=x_ih^2$$

$$\Rightarrow\quad \left(\frac{5}{3}+\frac{x_i}{3}\right)u_{i-1}-\left(4-\frac{2}{9}x_i\right)u_i+\left(3-\frac{x_i}{3}\right)u_{i+1}=\frac{x_i}{9} \tag{4.4}$$

Given boundary conditions are

$$u'(0)=0$$

$$\Rightarrow\quad u_0'=0$$

$$\Rightarrow\quad \frac{u_1-u_{-1}}{2h}=0$$

$$\Rightarrow\quad u_1=u_{-1}$$

$$u(1)=0$$

$$\Rightarrow\quad u_3=0$$

Putting $i=0,1,2$ (unknown points) in eq. (4.4), we get

$$\frac{5}{3}u_{-1}-4u_0+3u_1=0$$

$$6u_0-7u_1=0\quad (\text{because } u_1=u_{-1})$$

$$16u_0-\frac{106}{3}u_1+26u_2=\frac{1}{3}$$

$$17u_1-\frac{104}{3}u_2=\frac{2}{3}$$

Solving above three equations, we get the numerical approximations

$$u_0=-8.342,\ u_1=-7.15u_2=-3.986.$$

Problem 3 (Robin Boundary Conditions)**.** *Determine the temperature distribution from mixed BVP defined by* $u''(x)-xu(x)=0$, $0\le x\le 1$, *for* $u(x_i)$, $x_i=0$, $\frac{1}{3}$, $\frac{2}{3}$, *with BC* $u(0)+u'(0)=1$ *and* $u(1)=1$, *using finite difference method.*

Solution. Here interval is $0\le x\le 1$, i.e., $[0,1]$.
Points are given by $x_0=0$, $x_1=x_0+h=\frac{1}{3}$, $x_2=x_0+2h=\frac{2}{3}$, $x_3=x_0+3h=\frac{3}{3}=1$.
Therefore, $h=\frac{1}{3}$.

Mixed boundary conditions are given by $u(0)+u'(0)=1$ and $y(1)=1$.
That means, $u(0)+u'(0)=u(x_0)+u'(x_0)=1$ and $u(1)=u(x_3)=u_3=1$.
We have to find u_0, u_1, u_2.
The given differential equation is approximated as

$$\frac{u_{i-1}-2u_i+u_{i+1}}{h^2}=x_iu_i,$$

$$u_{i-1}-(2+h^2x_i)u_i+u_{i+1}=0, \quad i=0,1,2. \tag{4.5}$$

Putting $i=0,1,2$ (unknown points) in eq. (4.5), we get

$$\begin{aligned} &u_{-1}-2u_0+u_1=0, \quad (\text{because } x_0=0)\\ &u_0-\frac{55}{27}u_1+u_2=0, \quad \left(\text{because } x_1=\frac{1}{3}\right)\\ &u_1-\frac{56}{27}u_2+u_3=0. \quad \left(\text{because } x_2=\frac{2}{3}\right) \end{aligned} \tag{4.6}$$

The first boundary condition is

$$\begin{aligned} &u(0)+u'(0)=1\\ \Rightarrow\quad &u_0+u_0'=1\\ \Rightarrow\quad &u_0+\frac{u_1-u_{-1}}{2h}=1 \quad (\text{use centre difference approximation})\\ \Rightarrow\quad &2u_0+3(u_1-u_{-1})=1\\ \Rightarrow\quad &u_{-1}=\frac{2u_0+3u_1-2}{3} \end{aligned}$$

The second boundary condition is

$$u(1)=u_3=1.$$

Using BCS, eqs. (4.6) become the system of linear equations given by

$$\begin{aligned} &-2u_0+3u_1=1,\\ &u_0-\frac{52}{27}u_1+u_2=0,\\ &u_1-\frac{55}{27}u_2=-1. \end{aligned}$$

Solving the above equations, we get the numerical approximations

$$\begin{aligned} u_0=u(0)&=\frac{13}{55}=0.23636,\\ u_1=u(1/3)&=\frac{27}{55}=0.49091,\\ u_2=u(2/3)&=\frac{39}{55}=0.70909. \end{aligned}$$

5. Conclusion

This study focused in various boundary conditions to obtain solutions of 2nd order initial-boundary value problem with ODE. Finite difference method is used for predicting harmonic motion, damped and forced variation, current from electric circuit. In this study, three problems

are consider in various boundary conditions. The numerical results are examined with analytical results with Dirichlet condition for checking accuracy of numerical method. From the results it is cleared that the numerical results are very closer with exact results. Results also show that if the mesh size is reduced finite difference method will give the better accuracy. Hence, this technique can be successfully applied in more complicated domain in future work.

Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

All the authors contributed significantly in writing this article. The authors read and approved the final manuscript.

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ANALYSIS OF STUDENTS PERCEPTION ON IMPACT OF E-TRENDS IN EDUCATION

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Abstract
New Technologies has affected many areas and education in not an exception to it and infact it is giving new dimension to Teaching pedagogy especially in the technical field where students are going to become technocrats. Hence considering this aspect research has been undertaken to know the students perception on impact on E- Trends on Engineering Education in Nagpur. The objective of the research are: a)to identify E-Trend followed in the education b) Identify preference of Students on types of e-trend used c) Identification of students' perception regarding e-learning d) Identify the various advantages and outcome of e-learning perceived by students

Keywords : E – Education, Online Education, Engineering E Trend, E- Education perception

Introduction

There has been a substantial increase of usage of Internet, wifi internet access, smart phone, apps, digital TV, movies, series, videos and others devises in the recent time and users are enjoying consumption of digital technologies on a growing number of devices, either for the entertainment or for information centric activities. Considering this change of habit and enormous information which are available, it is imperative for education centre to adopt this technology to stay in tune with the changing time.

This study focuses on e trends aiming to shed some light on the perception of student on adoption of e trend. Digital content adoption is of special academic interest because it is a novel technological phenomenon.

Literature Review

Since last so many years, University education is evolving and adopting E – trends like Cloud Computing, Mobile learning, MOOC's (Massive open online courses), Open Content, Social Networking, Peer to peer assessment, Learning Management System and in house content authoring.With an advancement of technology and the internet, the world is becoming a storehouse of information where each and every information is just a click away. Institutions of higher education have embraced the Internet as an important vehicle for delivering courses and programs to a wide array of audiences.

In recent years, several studies have been published on eLearning (Waits & Lewis, 2003), wherein students who have been involved in eLearning courses are generally very positive about their experiences. Furthermore, studies show that students' perception of e-learning in university education may be influenced by several variables. Keller and Cernerud (2002) have traced age, gender, previous experience of computer, technology acceptance and individual learning styles as predictive factor while discussing the e learning acceptance by students. There are various theories of technology acceptance used to appreciate the perceptions of students.

Cristina(2017), this study found that users increase their satisfaction with digital technologies from the perceived ease of use and the content characteristics themselves; while loyalty, engagement and word of mouth are the main consequences of satisfaction.

Premises of the present study is concerned with digital native not necessarily mean one is willing digital learner. Hence, we proceeded with an important question to know the perception of student, their experience and expectation on the subject.
To be more precise, none of the previous research focused on the analysis of students perception on impact of e-trends on Engineering Education in Nagpur.

In this context, the present study aims to understand and analyse the perception on impact of e trends , as well as the consequences which can be derived from satisfaction. For this purpose, our study comprises of any kind of platform or device used for e learning to focus on the antecedent of satisfaction with e learning and its consequences.

Methodology
To achieve the purpose, Quantitative Research was conducted and 400 structured questionnaires were administered personally and online to various Person and out of which 256 were received and analysed for the purpose of this study.
The questionnaire was organized around four sections: a. Identification data, b. Preference of E- Learning method, c. perception on usability of e learning and current technologies in the class room, d.opinion about the advantages of latest e-trends in daily learning process, e. perception on consequences of e learning in interaction and collaboration, f. perception on possible outcome of E-trends and latest technologies on teaching and learning among students.

Research Finding
Demographic Features

Question	Response	Percentage
Gender	Male	74.2
	Female	25.8
Which pedagogy is more effective	Chalk & talk	51.8
	E-trends	48.2
Whether E- trends are used by faculties in the classroom	Yes	26.8
	No	73.2
Whether you are aware of the following e trends	Cloud Computing	19.5
	Mobile Learning	64
	Mooc's (Massive open Online Courses)	33.9
	Open Content	34.3
	Social Networking	47.9
	Peer to Peer Assessment	11.4
	Learning Management System(LMS)	21.2
	In house Content Authoring	16.1
Which of these E Trends you prefer the most or want to see in practice in your institute	Cloud Computing	35.3
	Mobile Learning	56.6
	Mooc's (Massive open Online Courses)	38.6

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Question	Response	Percentage
	Open Content	36.9
	Social Networking	46.2
	Peer to Peer Assessment	23.7
	Learning Management System(LMS)	32.9
	In house Content Authoring	52.7

The above data has been collected from students of engineering College especially from Civil Engineering and Mechanical engineering Branch which comprises of 74.2 % Male and 25.8 %. This ratio may be because of less female students are opting for Civil or Mechanical Engineering Brand. It is surprising to note that though we are talking about etrend but majority of the student i.e 51.8% still prefers the chalk and talk over e trend which may be because of the habit which has formed over the years or may be less number of faculties are using e trend which has been affirmed by the fact that only 26.8% of Faculty members use e trend in the class room. Through questionnaire it has also been identified that most of the students are aware of e trend in the following ranking : Mobile learning, social networking, open content, MOOC, Learning Management system, Cloud computing, Inhouse content authoring and only few students i.e 11.4 % are aware of Peer to peer assessment.
And when students were asked about which E trend they prefer the most. They have answered in the following ranking order : Mobile Learning, In house Content Authoring, Social Networking, MOOC, Open content, Cloud Computing, Learning Management System and in the last comes Peer to Peer Assessment.

To analyze the student's perception about use of technologies, we found that it is related more precisely on their perceived experience of learning. Perception of Students were college as their technology use might influence their perception towards using technology in educational contexts.

It is interesting to observed that as per the data students Perception of use of E- trends and current technologies in classroom is as per the sequential order of preference :

1. To organize and store information. 93.57%
2. To create visual presentations. 92%
3. To collect data and perform measurements. 91.57%
4. To support individualized learning. 91.2%
5. To plan or visuals of non-data products (eg. Diagrams, pictures, figures). 90.32%
6. To create visual displays of data/information (eg. Graphs,charts and maps) 89.56%
7. To analyze and interpret data. 88.76%
8. To communication information after investigation. 88.35%
9. To create models or simulations. 87.09%
10. To perform calculations. 86.12%

The data also reveals that the students perceived the advantages of latest E- Trends in their daily learning process in the following order :

1. It helps us in self learning and construct own knowledge. 95.95%
2. It helps in accessing, organizing and displaying data. 95.62%
3. It helps us to learn topics beyond curriculum. 95.6%
4. It provides lots of information and data. 94.82%
5. E-trends make learning process more intresting and exciting. 94.4%
6. They offer us room to dream big and achieve it. 93.18%
7. It helps in improved understanding of difficult to grasp concepts. 93.17%
8. E-trends can stimulate logical thinking. 92.28%
9. It helps us in delivering ideas and conclusions differently. 91.56%
10. It encourages revision and better communication. 90.4%

We have worked on the premises that Technology Enabled learning and classroom studies helped in greater interaction and collaboration and according to students it result for more opportunities for team work, Group and Sharing and only 27.89 % strongly agree and 63.35% that it will lead to joint construction of projects

On being asked about their opinion about E- Trends in Teaching. Majority of the respondents have revealed that it will provide more opportunities for team work and Faculty will be able to give more practical and technical knowledge, exposure to students with the help of technologies and only minority feel that by using e – trends in teaching pedagogy, faculties will be able to convey and express thoughts and knowledge more appropriately and easily.

According to the respondents the possible outcome of E- Trends and latest Technologies on teaching and learning among students can be in this sequential order .

1. Concepts Will be more clear to the students by implementing latest technologies 95.99%
2. Useful to generate new ideas and finding interesting solutions to problems. 93.95%
3. Good to organize individual work. 93.5%
4. learning process will be done better with the help of current technologies and trends. 92.8%
5. It is Useful to collect students opinion,explanations and reaction. 92.33%
6. Helps in organizing one's thoughts and share. 91.93%
7. Improved the logical thinking 91.9%
8. Helps students to make correct decisions in learning process. 91.87%
9. Interest and motivation will be developed easily in students with the help of E-trends during your Session 91.46%
10. Enhanced the cooperation and team work among students. 87.71%

It is observed that if the students had good experience of e learning it leads to affirmative confirmation and on the other hand poor experience lead to change of perception which result in avoidance of e- learning. Consequently, we tried to find out types of technology students use in their day to day life and their frequency of usage. We round that, the experience of student is quite satisfactory and there is a high ownership to digital devices along with its service and applications.

Majority of the Students (98.12%) revealed that they have a mecum and advanced experise in using a computer or laptap and same level of expertise is there towards use of internet (search engines, email).

Discussions

Universities are presently on a verge of immense change as they are required to educate more students coming from different background, different ages and needs. Information Technology and e learning are paving the way and considering as important for providing quality education and for this reason they are investing in ICT services and system. Adaptation of E- learning requires mainly IT infrastructure, Online Management System, Acadenmic Management System which needs to be integrated with learning management system and information management system. Despite having advantages of e learning it also involved lots of difficulture for both academicians and students. Though students are digital savy and use technology as an integral part of their day to day live however they use it extensively for searching, socializing and communication. Considering the result discussed in previous paper it is revealed that though the percentage of online courses website has grown and statistics further suggest that it will continue to be seen as storage house for easy distribution of course materials to students. However, students feels that proper learning environment/ spaces by teachers to be provided where they would find theoretical support and also link to other sources online. They also felt that effective strategy to be implemented for communication with the teachers. Finding also suggest that students are more open to innovation in learning process. From research it is found that there exist positive relationship between the expertise and perception of e learning and it has provided learning benefits to students.

However, we feel that though e learning is useful but is complicated and we need to take into account the proper environment under which this learning process is going to work, it is evident from this study that students perception

about e learning will improve once they derive some benefits and once it is one, there is likelihood that they will seek similar engaging experience

Conclusions

This study has investigated E trend followed in the education and analysed the perception of students regarding e learning and the various advantages perceived by them

This study investigated students' views on eLearning technology within non-formal and formal settings. Although the number of responses was not high 256 valid replies we are considering this as a first step to take it at a larger scale. It is clear that students are aware of the changes introduced by digital technologies and its impact on the learning process. It is clear that students are well equipped for usage of digital technologies and its impact on the learning process and they are already using these technologies as support to their learning process and they also understand that more coherent approach may prove even more effective.

However, this approach should be supported by teachers as they are organize and conduct the learning activity offline , same they needs to be adopted for online. There is further scope of research that empower well organized approach to e learning and strategy to be adopted for teachers training also.

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ECS Transactions

Review Article on Guillain Barre Syndrome

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Abstract

Guillain-Barré syndrome (GBS) is an autoimmune disease caused by a viral or viral infection and can be reduced. The most common HIV virus is Campylobacter June, which is a major cause of bacterial gastroenteritis worldwide. Immune-mediated immune responses may play a role in the development of GBS by interacting with brain tissue. Because the infected organism contains homologous epitopes, it initiates molecular and cell immune responses that interact with the ganglioside surface areas of the peripheral nerve (cell imitation). The immune response to epitopes in the upper layer of Schwann cells acts as a target for acute inflammatory demyelinating neuropathy (85%) caused by a reaction to epitopes found in the Schwann-cell surface or myelin. A strong axonal variation of GBS is caused by a reaction to epitopes found in the axonal membrane (15 percent of cases). Although caring for these people may be difficult, complete predictions are good. The basis of treatment is to provide the best

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Cyberpunk: A Dystopian, Dehumanized High-Tech Future In Indian SF Virus

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Abstract:

Cyberpunk -is a subgenre of science fiction project a future where humans are trapped in a dehumanized, high-tech future leading to a dystopian future. The Indian Science fiction by Jayant Narlikar titled Virus (2003) deals with cyberpunk and the destruction through it. The fiction raises the question of human existence on the earth with technological advancement. The objective of the present endeavor is to explore destruction through computer's. The fiction portrays a future where automation is affected with virus planted by extra- terrestrials; and how the future society and government will become wimpy and pathetic due to cyberpunk. It portrays a gloomy vision of the future where mankind can become a victim of cyberpunk which can lead to a dystopian dehumanized high-tech Future

Keywords – cyberpunk, extra-terrestrials, dystopian, society, humankind, education.

Introduction

Science fiction as a genre portrays scientific advancement with its utopian and dystopian shades. With advance infrastructure& technology the future of society will be dominated by computers; with an alarming bell of cyberpunk. The cyberpunk portrays a society dominated with computers. The website Britannica states, "cyberpunk a science fiction subgenre characterized by countercultural antiheroes trapped in a dehumanized high-tech future." 1(Britannica). Cyberpunk was derived from the word 'cybernetics'- the science of replacing human function with computerize once. The genre bloomed with the publication of William Gibson's novel **Neuromancer** (1984). In Indian SF we can trace the footprint of cyberpunk in Jayant Narlikar's fiction Virus. Narlikar who is a scientist and a SF writer efficaciously portrays the bleeding edge of computer advancement which is destroyed with a virus planted through an extra-terrestrial source.

The Indian SF titled Virus (2003) projects a dystopian future due to computer advancement. The rat race of human development had converted into a mouse race, leading to destruction of mankind. Virus presents the idea of sharing our space with an unknown who can possibly be technologically more advanced. The limited resources of planets will force everyone to explore further in the space, by overpowering others space. This rat race and the need of better place for survival are paving the path for cyber war. The fiction represents the combat of space with humans and extra-terrestrials through cyberpunk.

Virus as a 'cyber science' fiction deals with the effects of advanced cyber world on our future. Making a conscious effort to make us realized the consequences and effects of exploring in the space. Norman Rulif Augastine says, One of the most feared expression in modern times is 'The computer is down''[2]. Virus -the Indian cyber SF portrays such computer breakdown and its effects on the future of mankind. The fiction talks about a gigantic radio telescope project, VIRAT- a future project tracing the footprints of extraterrestrials .The landmark of every advancement and technology has its own adverse effects, project VIRAT was not untouched with it. Jayant Narlikar's through the fiction Virus projects a near future; where increased human dependency and development of cyber world will lead us to a dystopian future. Through the character named Francois Pecker's Narlikar'critical comment on automation,presenting the gravity of cyberpunk.

> This is what you get if you get it you put all your eggs in the computer basket." Muttered François to himself. "But will we learn anything from today's experience? Hardly!" (Narlikar28).[3]

Narlikar, as a scientist and a writer wish to cut the mustard with a conscious thought, towards the adverse effects of automation and human's ignorancetowards the adverse effects of computerization. The cyber world hit the ground to revolutionize our human life, but while advancing humans have lost their train of thoughts by ignoring the consequences. The fiction presents the dystopian side of 'machine revolution'throughVirus with a focus oncyber revolution with consciousness.

Through the fiction Virus Narlikardelineate the picture of destruction - without a weapon. The advance computerization has increased the possibility of a technical war.Our heart missed a beatwhile imaging a complete shutdown of a cyber word. The Cyber world have changed the way we live and the way we communicate. Cyber communication has reduced the space on earth creating a complex network of communication; which can be hacked, creating a threat personally, countrywide, globally and can also be a threat to our planet. Narlikar in his fiction refers it as a 'technical war'.He takes a leapinto the dark future with the cyberpunk.

Science fiction have projected the human life with technology either in an dystopian or an utopian way; so that while advancing with time and space we should anticipate of its consequences Through the SF Narlikar urges mankind to comprehend the futuristic problem that we would be facing in our nearest future with cyber development. With advancement anda human urge to find a new planet is paving a path of, space cyber war. Which would be initiated by extra-terrestrial, who are still unknow to us. Our space is full of surprises, the more we explore it the more we are left with new questions. In the Indian SF Virus, Narlikar focuses on cyber development with consciousness. The Indian SF portrays a futuristics plot where our planet is facing a cyber space war. Through Virus Narlikar is projecting a future where we will be witnessing the traces of extra- terrestrials, facing cyber war on the earth. Ratnakar Bhelkar inEncounter with extra-terrestrials in Jayant Narlikar's The Message from Aristarchus and Virus compares the approaches by Jayant Narlikar, Arthu C. Clark and H. G. Wells:

> Narlikar and Clake, both have to assert that human knowledge has limits and it does not comprehend everything in vast cosmos. Like H. G Wells and Arthur C. Clarke, Narlikar speculates that ET's are intelligent and powerful; pose a threat to human existence on the Earth and human endeavor(Bhelkar 18).[4]

The extra-terrestrial targeting our system will make us disable. Stephen Hawking's while talking about virus says, "I think computer virus should count as life. I think it says something about human nature that the only from of life we have created so far is parley destruction. We have created life as our own image"[5](Hawking). Cyber war will destroydestroymankind without any weapon. While portrayingthe devilish form of virus the character Jagtap in the fiction says,

> Sir, it is a computer programme that mingles with the existing programme in a computer. It seems to have a devilish design in the sense that it does not affect each and every time like a naughty boy sitting on a chair who advances his leg at random to trip whatsoever is passing him, this virus strikes unexpectedly. Where we see it in operation, we can take remedial measure to take it out. But that does not mean that it has gone forever.(Narlikar 101).

The fiction shatters the human's perspective of being the only advanced being in cosmos. Through Virus, Narlikar focuses on the adverse effect of automation leading to problems of cyberpunk. Jerry Michalski, Founder of REX, The Relationship Economy Expedition says, "Automation is Voldemort: the terrifying force nobody is willing to name"[6](Michalski). Every sphere of human life is automated. Cyberpunk is enough to destroy humanity in the future. Therefore, with every progressing steps, we need to think about its adverse effects on society present and future.

Space cyber war through an extra –terrestrial is projected by Narlikar in his Indian SF Virus . Ratnakar Bhelkar while talking about advancement, destruction and space war says,

> "The calamity of the invasion from the technologically progressed ET cannot not be averted and so human beings have to prepare to face colonial aggression by aliens and stresses the necessity to retain values as love for nation, co-operation, unity, tolerance and understanding. This stance is an alertness and remedy for it too"[7](Bhelkar 18).

A future with emense cyber development and a fear of space cyber war is an horrifying portrayal .The fiction express that advancement is important; the unknow is to be known, but to what extent? Development of cyber is essential unless its leads to destruction. Exploring the cyber world without conscience, is like a voyage of destruction. Talking about Narlikar's approach towards space cyber war due to extra-terrestrials and human existence Ratnakar Bhelkar says,

> Jayant Narlikarpossess an ambivalent view about ETs who are intelligent, and power and though they are benevolent or malevolent, human race has to prepare for the future cultural shocks in the garb of an alternative abode ETs. In both SF, TMFA, VRS fantasy functions as a preventive and alerts human race about an encounter with ETs. Narlikar's speculative vision of reality is that human society has to nourish the constructive values tolerance and constitute global policy for the survival and welfare of human society in the wake of encounter with ETs.[8] (Bhelkar 18)

Human wants clarity and certainty, but sometimes uncertainty fascinates us. In the process of –to know more and to learn more. The discovery of other planet is astonishedand excited and is fearful too. The web site 'SPACE.com' very clearly state about the approach towards the aliens, " When considering the prospect of alien life, humankind should prepare for the worst, according to a new study: Either we're alone, or any aliens out there are acquisitive and resource hungry, just like us."[9]("When considering the prospects of alien"). Future will ask us to make a difficult choice- a choice between advancement and existence of mankind.

The Indian SF of Narlikar's nurtures a vision of and a utopian future should be nurturedwhile scientific development is done. Being elite in the space is a myth; fiction like Virus is helping us project the near future were we can get acquainted to extra-terrestrial and its complex cyber system , the technical advancement used my human for further advancement can also turn as destruction through which the extra-terrestrial l can reach us . Jayant Narlikar alerts human society about the increased reliance on computers information technology devices will compel us to face the problem of cyberpunk and human survival. Cyber culture in the space of this Indian cyber science fiction has a threat of virus from the other planet, and raises the issue of political power, conscious and responsible leadership to save automation, business, farming's, military services and cyber culture. The space in this fiction deciphers that man is not the only intelligent being in cosmos; extra-terrestrials are more progressed than human beings. In future, human society has to prepare for cyber cultural shock, and search for an alternative space to inhabit, with the nourishment of the spirit of unity, equality, keeping aside differences.

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RESEARCH ARTICLE

Design of quasi-Z source converter for vehicle to vehicle to battery charging application

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Abstract

The Quasi-Z-source converter (QZSC) is the favorite dc-dc converter that can be applied to applications like EV battery charging, microgrid, distributed generator, etc. QZSC is the modified version of the Z-source converter (ZSC) which has the additional qualities of uninterrupted input current and a broad range of input voltage over ZSC. In this article, QZSC is especially developed for the dc-dc like vehicle-to-vehicle (V2V) battery charging application. Due to the availability of shoot-through conditions, QZSC overcomes the burden of the additional dc-dc booster, unlike a two-stage converter. This additional benefit of the shoot-through condition makes QZSC more worthy than a conventional converter. The elaborated design analysis of the QZSC is presented in this article which found reduced voltage stress across one of the capacitors, unlike the traditionalistic impedance source converter. The hardware prototype of QZSC is developed and experimental results are obtained. The experimental results are verified by using simulation and theoretical results. Experimental results suggest that the QZSC converter concept could be most suitable for the V2V battery charging applications. Simulation results are obtained for QZSC by using a matrix laboratory.

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DATA AVAILABILITY STATEMENT

No data are available.

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ORIGINAL PAPER

Sensorless voltage balancing method for modular multilevel converter

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Abstract

Modular multilevel converters (MMCs) have become prominent for high and medium power applications. The phase-disposition pulse width modulation (PDPWM) technique is a carrier-based method that generates good quality output. However, it has the inherent problem of uneven power distribution. Conventionally, this is solved by expensive voltage and current measurements. In this paper, a capacitor voltage balancing method is presented for MMC, which eliminates the need for voltage and current sensors. It also ensures uniform power distribution among the submodules (SMs). In addition, it needs only one carrier per phase, and one PWM reference, for either upper arm or lower arm to produce $N + 1$ level with N SMs per arm. The capacitor voltage balancing method is analyzed mathematically and verified for the MMC with two-level half-bridge SMs. The same method is also extended to the MMC with three-level flying capacitor SMs. MATLAB/SIMULINK simulations and experimental results on a laboratory prototype are presented to verify the theoretical concepts.

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DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Article

Performance enrichment of hybrid photovoltaic thermal collector with different nano-fluids

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Sourav Diwania · Rajeev Kumar · Maneesh Kumar · Show all 5 authors · Theyab R Alsenani

Abstract

This work manifests the influence of different nanoparticles on the photovoltaic-thermal (PVT) system. The hybrid PVT (hPVT) systems provide thermo-electric energy by utilizing the module heat. The module heat is recovered for controlling the cell temperature using coolant in the channel. This work examines the impact of the type and volume concentration of different nano-fluids on the cell temperature, outlet temperature, thermo-electric efficiency of hPVT collectors. Copper (Cu), titanium dioxide (TiO2), and silicon dioxide (SiO2) dispersed in pure water are considered nano-fluids in this study. The investigation reveals that the outcomes of the PVT collector with copper-water as nano-fluid are superior to the other nano-fluids considered in the study. At 0.012 kg/s mass flow rate (MFR), the thermo-electric efficiency of the hPVT collector is 1.645% and 6.239% higher than the thermo-electric efficiency of the PVT at an MFR of 0.002 kg/s. It is also observed that with a 4% vol. concentration of Cu in the base fluid, the thermo-electric efficiency is considerably better than the efficiency at 2% and base fluid.

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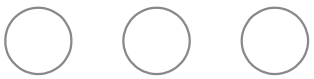

energies

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Article

Performance Investigation Based on Vital Factors of Agricultural Feeder Supported by Solar Photovoltaic Power Plant †

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Abstract: Solar photovoltaic (SPV) installations are growing in the distribution network due to the continuously decreasing prices of solar photovoltaic panels. Installing the SPV Plant on the distribution feeder supplying to the agricultural pumps is a challenging task due to the varying agricultural load pattern of the Agricultural Feeder (AG Feeder). Supply of power and demand creates potential challenges in the low voltage (LV) distribution system. This paper presents a case study of a 2 MW SPV connected to an agricultural feeder in India. Performance analysis has been carried out using field measurement data. The key parameters such as PV Penetration and Capacity Utilization Factor (CUF) are calculated for analysis. Parameters such as Grid Dependency of the load and PV Contribution have been introduced in this paper, which relates to the SPV system behavior more aptly. It is recommended that the Time of Day (ToD) metering with the lowest cost during the solar generation hours will make agricultural consumers shift their demand matching with solar generation hours. Extensive analysis of agricultural feeder connected SPV power plant indicates that the power supply has improved for the feeder during winter and summer months.

Keywords: agricultural feeder; low voltage distribution system; PV contribution; PV penetration; renewable energy system (RES); solar photovoltaic plant

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1. Introduction

The main economic activity in India is agriculture, and there is a significant area covered by fertile land. In addition, it is a densely populated country and needs large-scale production of food grains. India also receives clear solar radiation for around 300 days. Hence, solar energy and farming are a winning combination. The SPV systems are preferred in powering agricultural load [1], and it has been an essential driver for the 'Green Revolution' to increase the productivity of the farm.

In India, in order to promote the agricultural sector, the Ministry of New and Renewable Energy Sources (MNRE) has started the Pradhan Mantri Kisan Urja Suraksha evam Utthan Mahabhiyam (PM-KUSUM) for the development of farmers and for strengthening the rural distribution network. The scheme aims to promote the usage of solar pumps and grid-connected solar power in the agricultural sector. Through PM-KUSUM policy, the Gujarat state in India has announced the Suryashakti Kisan Yojna (SKY) scheme. Under SKY, farmers can install a net–metering SPV powered irrigation pump sets on the fields. This scheme offers several benefits to the farmers, such as well-planned use of water, increased crop cultivation due to the availability of power during the daytime, an additional source of income for the farmers, which results in an improved economy in rural areas [2].

It is very well known that the RES penetration in the LV distribution network has a positive impact, such as reducing the energy losses of distribution feeders, feeding peak

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Declaration by Head of Institute

I hereby declared that the data, information and support documents attached herewith are genuine and correct to my knowledge.

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