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3.3.2 Number of research papers per teachers in the Journals notified on UGC website during the last five years

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3.3.2 Number of research papers per teachers in the Journals notified on UGC website during the last five years

2019 - 2020

Laser micro-machined 28 GHz broad band single feed microstrip antenna for 5G mm-wave applications

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Abstract

Purpose – This paper aims to propose a laser micro-machined 4×4 elements microstrip array antenna suitable for 5 G millimeter wave (mm-wave) applications. Each patch element of the array is excited with same amplitude and phase that is achieved with proper novel impedance matching stub. The proposed antenna achieves a simulated gain of 13.15 dBi and a measured return loss of -24.80 dB at 28.73 GHz with a total bandwidth of 7.48 GHz. The designed antenna is directional with a directivity of 15.1 dBi at 28.73 GHz, whereas fabricated on a low cost FR4 substrate with a substrate thickness of 0.074λ mm. The antenna is realized with an aperture size of $2.24\lambda \times 3.26\lambda$.

Design/methodology/approach – The antenna structure starts from the design of single element called unit cell. The single element is designed using the transmission line model equations of a rectangular patch. To design a 28 GHz microstrip patch antenna, a dielectric material with lower permittivity and having thickness (h) less than 1 mm is required. This specification gives better gain and efficiency by reducing surface waves and mutual coupling between elements. The inset width is optimized to achieve the minimum reflection coefficient (S11). The single element has been arranged with a minimum spacing of $\lambda/2$ (5.3571 mm) in an H plane and E plane. It is connected using the microstrip lines with proper impedance matching. The four 2 × 2-sub array cell subsystems are connected with a corporate feed together formed the 4 × 4-array cell. Rectangular planar array method is used to arrange the elements in the 4 × 4 array cell.

Findings – The design concept is simple which includes the combination of corporate feed and insect feed. It is compact in size and easy to fabricate. The bandwidth of fabricated prototype antenna array is achieved as 7.48 GHz from 24.98 GHz to 32.46 GHz. The mutual coupling is very less though the antenna array is placed with minimum spacing between adjacent elements. This is because of the microstrip feeding structure with minimum phase shift. The gain can be further enhanced with increasing number of array element and proper designing of feed line. Owing to the advantages of low profile, wide bandwidth and high gain, the designed array will be potentially useful in 5 G wireless communications.

Originality/value – The measured antenna offers bandwidth 7.48 GHz (24.98 GHz-32.46 GHz) with centered frequency 28.73 GHz. The agreement between simulated and measured results is good. The VSWR is observed 0.32 < 2, offers good impedance matching and low mutual coupling. It gives better E-Field and H-field radiation patterns of the 4 \times 4 array antenna structure at 28 GHz. The total gain of 13.14 dBi is achieved at the center frequency. The total efficiency of 63.42 per cent is achieved with FR4 substrate.

Keywords 5G antennas, Beam forming, Impedance matching, Patch antenna array, Unit cell, Corporate feed

Paper type Research paper

1. Introduction

THE vast requirements of high-speed data communication systems have created huge demand for 5 G mm wave antennas (Zhu *et al.*, 2017; Praveena *et al.*, 2017). The licensed bands of 28, 37 and 39 GHz together with the unlicensed band of 64-71 GHz provides a wider spectrum for 5G networks (Federal Register, 2016). The availability of high data rate and large spectrum by its nature enhances the multiple user capability

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Circuit World

46/1 (2020) 6-12 © Emerald Publishing Limited [ISSN 0305-6120] [DOI 10.1108/CW-06-2019-0053] with high-speed communication. However, to achieve larger data rates at high frequencies require high bandwidth with better array gain and directivity against the path loss (Rangan *et al.*, 2014). To achieve these 5G requirements, several researches have been reported in the licensed spectrum recently where the desired performance is associated with multilayer structures and design complexities (Ali and Sebak, 2016; Chu and Guo, 2017; Ershadi *et al.*, 2016). In both the cases, the feeding of the antenna plays an important role. While direct feed structures possess compact structure and narrow bandwidth (Tsutsumi *et al.*, 2015), coupled feed structures (proximity and aperture-coupled) provide higher bandwidth

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Artificial Dielectric Superstrate Loaded Antenna for Enhanced Radiation Performance

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Abstract—This paper presents a novel engineered artificial dielectric superstrate for improving the radiation characteristics of a CPW-fed planar antenna. Even though the permittivity of the material used for the superstrate is only 4.4, it attains an effective permittivity of more than 18 because of the periodic pattern printed on it. Due to the high value of effective permittivity, an improvement in radiation pattern, impedance matching, and gain of the antenna are obtained. From the measured results, an impedance bandwidth of 374 MHz from 2.453 GHz to 2.827 GHz is observed for the antenna loaded with superstrate. The periodic pattern is fabricated on a substrate of thickness 1.6 mm, and it occupies an area of $56.45 \times 42.48 \text{ mm}^2$.

1. INTRODUCTION

The performance of printed circuit antennas used for outdoor applications were affected by environmental hazards, severe weather conditions, etc. A superstrate layer, also called a cover layer has been used to protect the antenna from these threats. Initially, it was assumed that when we used a cover layer, it would adversely affect the matching and radiation performance of the antenna. Alexopoulos and Jackson showed that by a proper selection of superstrate layer, it was possible to enhance the radiation parameters of printed antennas [1]. In [2], transmission line analogy was used to explain radiation from superstrate loaded antenna structure. There the authors established two dual resonance conditions for substrate-superstrate printed antenna geometry by which better gain could be achieved for a high value of permittivity or permeability of the superstrate. In [3], the authors performed a comparative study of three superstrates, namely double negative slab, frequency selective surface, and plain dielectric slab for improving directivity of microstrip antennas. The authors came to the conclusion that the physical mechanism behind directivity enhancement was not the focussing effect of superstrate alone. They attributed the directivity enhancement to the resonance resulting from Fabry-Perot resonant cavity formed by the superstrate and metallic ground plane. Researchers started showing greater interest in developing new methods by which antenna parameters can be improved by manipulating material parameters of superstrates as well as by other means [4–13, 16]. They successfully implemented superstrates in beam steering, enhancing gain, and improving bandwidth. Some authors proposed EBG structures as superstrates for improving antenna parameters [4, 5, 17]. But the thickness of the antenna was the main barrier for these structures. Kim et al. proposed a holey dielectric superstrate for enhancing the gain of a microstrip patch antenna [8]. The effective permittivity was controlled by changing the radius of holes in the superstrate so as to generate an in-phase electric field which resulted in improved gain.

In this paper, a technique for improving the radiation parameters of a CPW-fed planar antenna using a non-resonant superstrate is proposed. It is based on a novel engineered artificial dielectric with

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TECHNICAL PAPER



Investigation on Crash Analysis of a Frontal Car Bumper

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Abstract A new design and development of a bumper are proposed for a Hyundai i10 car. The developed bumper is analysed for crash worthiness. The performance is compared with different bumper materials, such as ABS, E-glass epoxy resin, and polyamide-30% glass fibres. In this work, impact and collision of a car are simulated and analysed using ANSYS explicit dynamics. The car is modelled using Pro-e and exported to ANSYS. The bumper is first analysed using the basic design and material. Thereafter, the analysis is done with the bumper with added reinforcement and change in material. Two cases of impact have been considered: they are full frontal impact barrier and half impact barrier. The purpose of the frontal crash analysis is to understand the impact of the crash. The new bumper design must be versatile enough to reduce the rider injury and keep intact throughout low-speed impact besides being stiff enough to dissipate the K.E. in highspeed impact. The bumper is a key structure for absorbing energy of collisions. The crash analysis simulation and results can be used to assess both the crashworthiness of current bumper and to analyse ways to boost the design.

Keywords Bumper · Frontal crash analysis · ANSYS explicit dynamics

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1 Introduction

An automobile's bumper is the front-most or rear-most part, intended to allow the vehicle to sustain an impact without harm to the vehicle's safety systems. They are not equipped for reducing damage to vehicle occupants in high-speed impacts but are progressively being designed to moderate damage to pedestrians struck by cars. In 1925, front and rear bumpers end up as standard equipment of the automotive. The bumpers throughout that point are straightforward metal beams attached to the front and rear of a car. Currently, they have evolved into complicated, engineered components that are integral to the protection of the vehicle in low-speed collisions. Today's plastic auto bumpers and fascia systems are aesthetically pleasing, while offering advantages to both designers and drivers. The bulk of modern plastic car bumper system fascia is made of thermoplastic olefins, polystyrene, polyesters, polypropylene, polyurethanes, polyamides, or blends of these with, for instance, glass fibres, for strength and structural rigidity. The prerequisites of a bumper are to absorb a great deal energy while impact, have good rust resistance, have high strength, light in weight, and simple to manufacture in large quantity.

Praveen and Belagali [1] presented the best material for bumper by doing the analysis for different bumper materials. The analysis was done for different materials like steel, carbon fibre along with adding different additions like honeycomb structure, foam. The conclusion of this paper is that, carbon fibre gives high strength to weight ratio in comparison of steel and dissipates energy. Its basic design with foam ensures pedestrian safety. Overall, it can be concluded that carbon fibre along with foam and honeycomb structure is better than normal design. Prabhakaran et al. [2] carried out a study between steel and composite

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AN OPTIMIZATION OF MICRO-DRILLING PARAMETERS IN CARBON FIBER REINFORCED POLYMER USING GREY RELATION ANALYSIS

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ABSTRACT

In the present investigation, the influence of drilling parameters such as feed rate, spindle speed, drill diameters in drilling is studied. Drilling experiments have been conducted with three sets of input process parameters such as cutting speed of 1800, 3800 and 5800 rpm, feed varied from 15, 25 and 35 mm/min in three steps using conventional twist drills of three different diameters of 0.6, 0.7 and 0.8mm respectively. A rectangular cross section of Carbon Fiber Reinforced Polymer (CFRP) of having dimensions 150mm x150 mm x 3mm is selected for performing drilling. For optimizing multiple responses, Grey Relational Analysis and Desirability Function are used in this study to optimize the machining process parameter. Multiple response characteristics of delamination factor and material removal rate can be converted into unique response using these methods.

KEYWORDS: CFRP, Grey Relation Analysis, & Delamination Factor

1. INTRODUCTION

Machining is the process by which a material is cut to the desired form (shape and size). The machining can be applied to different types of materials such as plastic, composite materials, wood and ceramics. A controlled material removal process is used to process a raw material of the desired shape and size. All products manufactured in the world have been processed directly or indirectly. Carbon fibre is drilled with various drills with a diameter of 0.7, 0.8, and 0.9 mm. Parameters such as spindle speed, feed and diameter vary for the study. The rate of material removal and the delamination factor are also discovered. The tool microscope is used to determine the delamination factor. The optimization is performed according to the Grey method. This method also allows determining the optimal process parameters to obtain a low surface roughness.

Bhojan et al., [1] studied the influence of tool rotation in friction stir welding of Metal Matrix Composites (MMCs). They concluded the experimental study in such a way that higher the tool rotation speed, higher is the hardness of the weld joint of the material. Bosco et al. [2] carried out the drilling exercises on glass fibre reinforced plastic sandwich composites. They optimized the drilling process parameters on delamination of sandwich composites. The test results indicate that the rate of feed is said to be the major influential factor that affects the delamination factor. The research contribution of Venkatesan et al., [3] investigates the machinability properties of hybrid metal matrix composite. The influence of input parameters were optimized through Response Surface Methodology (RSM). The results of experimental study conclude that surface roughness improved with feed rate variation. Experiments were conducted on AISI 304 steel by Nayak et al., [4] to

Mesoscopic analysis of reinforced concrete beams

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Abstract. Reinforced concrete can be considered as a heterogeneous material consisting of coarse aggregate, mortar mix and reinforcing bars. This paper presents a two-dimensional mesoscopic analysis of reinforced concrete beams using a simple two-phase mesoscopic model for concrete. The two phases of concrete, coarse aggregate and mortar mix are bonded together with reinforcement bars so that inter force transfer will occur through the material surfaces. Monte Carlo's method is used to generate the random aggregate structure using the constitutive model at mesoscale. The generated models have meshed such that there is no material discontinuity within the elements. The proposed model simulates the load-deflection behavior, crack pattern and ultimate load of reinforced concrete beams reasonably well.

Keywords: mesoscopic analysis; reinforced concrete beam; deep beam; two-phase

1. Introduction

Concrete is the most widely used material for construction. It is a composite material with complex behavior and a highly heterogeneous microstructure. For obtaining a better understanding of the macroscopic constitutive behavior of concrete, the effects of microstructure and properties of the individual components of concrete on the macroscopic material behavior have to be taken into account. Mesoscopic models have proven to be the most practical and useful approach to study the nonlinear behavior of concrete composition on the macroscopic properties (Nagarajan *et al.* 2010). A numerical approach to investigate the property of concrete at the mesoscopic level is given by Roelfstra (1989). A method of random computer generation of the particle system meeting the prescribed particle size distribution was developed by Bazant *et al.* (1990), using the assumption that the particles are elastic in nature and have only axial interactions, as in a truss. A lattice model is presented by Schlangen and Mier (1992) for the simulation of typical failure mechanism and crack face bridging in concrete. The influence of lattice element type and lattice orientation on the fracture pattern (Schlangen and Garboczi 1997) was investigated by simulating a shear loading experiment on a concrete plate.

A random aggregate generation procedure based on Monte Carlo's simulation principle was

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Secure Gray code-based reversible data hiding scheme in radiographic images

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Abstract: Transmitting medical information through a network for the purpose of tele-diagnosis involves greater risk of losing confidentiality and integrity of the information being transmitted. This paper presents a scheme that ensures reversibility of the cover image and also makes it suitable for the field of telemedicine. The methodology uses cryptographic and the steganographic methods. The proposed work decreases the overhead by reducing the size of the auxiliary data to be embedded which is used to achieve the reversibility of the cover image quality. The algorithm yields a reversible data hiding (RDH) scheme based on pixel value ordering (PVO). The methodology differs from other basic schemes as it uses Gray code instead of ordinary binary codes. It naturally suits for medical steganography as the carrier image can be reconstructed after extraction of the secret data and also the distortion caused due to embedding is very less. The method is also robust as one time pad cryptographic technique is used to generate the key.

Keywords: reversible data hiding; RDH; pixel value ordering; PVO; medical steganography; one-time pad; telemedicine.

Reference to this paper should be made as follows: Karthikeyan, B., Keerthy, S.V. and Hariharan, G. (2019) 'Secure Gray code-based reversible data hiding scheme in radiographic images', *Int. J. Electronic Security and Digital Forensics*, Vol. 11, No. 3, pp.347–362.

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Recent advances and investigation of efficient Computer Aided Diagnosis systems for CT images in Liver cancer detection

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ABSTRACT

Liver tumor identification and classification is a challenging task for radiologists. The Liver parenchyma must be segmented from the abdomen and the least variation found in the Liver cells must be accounted as benign or malignant tumor. CT images still remain one of the best modality of choice due to its better cross sectional view, clear spatial resolution, fast interpretation and high SNR. The other common Liver imaging modalities are MRI, PET and US. The CT images are preferred over the competitor MRI due to its low cost. Computer aided diagnosis (CAD) systems is the area of medical imaging that serves as the second opinion for medical practitioner during image interpretation. The CAD systems are interactive/semi automated and incorporates the findings of the medical practitioner before producing the final result. This is in contradictory with a fully automated system, where all decisions are taken by the computer software. The CAD systems can be either based on a single classifier or ensemble/hybrid model classifier. Ensemble models are preferred over single classifier models. The unavailability of public datasets resulted in classifiers which work alone with a specific dataset. Other CAD systems are also limited to small private datasets collected from hospitals and scanning centers. This means that more datasets should be made public for research and applied for classification. The different Liver cancer detection approaches can't be compared as the performance measure varies across the CAD systems. But we will make use of the final performance measure, accuracy used with the proposed CAD systems to evaluate classifiers. This paper also emphasis the proposed methods to improve the accuracy in the existing works.

Key words: CAD system, Computed tomography, Hepatocellular Carcinoma.

1.INTRODUCTION

The Liver plays an important role as the detoxification unit during metabolism, in which the biomolecules are changed inside the body [1] .It also, has 500 other different functions and is the only organ that can completely regenerate itself. A recent database GLOBOSCAN 2018 estimated the cancer mortality in 185 countries for 36 types of cancer. Liver cancer was found to be the second in mortality rates of men and third in mortality rates of women among the participating countries. There were over 840,000 new Liver cancer cases worldwide in 2018 [2]. Liver cancer rates in India increased by 32.2% since 1990 with about 30000 new cases being reported in 2016 [3]. These surveys show the relevance of Liver cancer detection and treatment at an earlier stage. Liver diseases are found to progress from fatty Liver, Fibrosis to Cirrhosis (Compensated, Decompensated, Cancer) [13]. A malignant Liver tumor (cancerous) can be classified as Liver metastatis, Hemangioma or three histological types of Hepatocellular Carcinoma (HCC) [4]. A Liver cancer will progress from stage 1 to the final stage 4, if left untreated. An early detection of Liver cancer, at a beginning stage using CAD systems is the effective way to treat the patient.

The CT scanner uses X-ray beams for scanning and produces DICOM image slices (CT images) of the scanned area [5]. These CT images are fed to the CAD system for further analysis, where it is converted to .PNG, .JPG or .BMP for CAD analysis [22] .Computer aided diagnosis (CAD) is a [28] semi-automated or interactive system designed to aid faster diagnosis and detect false negatives while physicians are interpreting medical images. [6,14]. CAD systems for any organ are different from fully automated computerized diagnosis systems as they aid physician/radiologists to examine and analyze the results before the final diagnosis [4]. These CAD systems have higher accuracy and are preffered over fully computerized systems. The Liver CAD systems has to overcome the challenges such as

A Fog Based Security Model For Electronic Medical Records In the Cloud Database

Elizabeth M J, Jobin Jose, Dona Jose

Abstract: Nowadays, a lot of emerging trends such as telemedicine, robotics in hospitals, computerized medical diagnosis, cybersecurity, Artificial intelligence, etc. are used to uplift the healthcare sector. Especially telemedicine services get more attention to diagnose and treat patients where health professionals use information and communication technologies for remote patient monitoring. The medical data such as CT scan, MRI reports, X-rays, Heart or Kidney transplantation videos and other health information should be available in digital format and such type of huge multimedia big data needs to be kept in the cloud and needs to be archived. Cloud storage provides better storage capability so that customers no need to worry about their limited resources. This paper proposes a new method for securing various electronic medical records in the cloud database. This proposal mainly concentrates on how we can get data with less latency for patient monitoring and how to secure the patient's private data to overcome data breaches in the cloud server using fog computing technology. A pairing based cryptography technique such as an Elliptic Curve Diffie-Hellman key agreement protocol and a decoy technique are used to access and store data more securely along with the help of some cryptographic algorithms.

Index Terms: Telemedicine, Fog Computing, Healthcare, Cybersecurity, Electronic Medical Records.

I. INTRODUCTION

Highlight Over the past fifteen years, the main focus was on the use of cloud computing service but the steep increase in the number of devices connected over the network will not provide better performance through the centralized server. Therefore, the new computing paradigm emerged is used to provide storage and computation facilities towards the edge of the network closer to end users [1]. The word fog computing (From cOre to edGe) is formulated by Cisco in 2012 and IBM termed it as edge computing [2]. However, these words mainly focus on how to decentralize the computing infrastructure and how to provide all the computing resources in between the data source and the cloud server where the internet ends.

Now we are at the beginning of a very transformative era of fog computing. Fogonomics is an emerging business model of fog computing called fog-as-a-service. The pros and cons of fogonomics are still un-studied but to develop business applications on the edge of the network, a platform is needed. In the field of IT, the tangible and intangible factors of a company always depend on data, is a financial and strategic

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asset of an organization. Therefore the cloud providers must take the responsibility to protect the data at rest and during transmission. In order to gain long-term value, entrepreneurs regularly map their cloud resource requirements closely to their key business goals [4]. The latest cyber-attacks, for example, WannaCry attack and Petya ransomware attack, etc., show that the existing cloud paradigm lacks enough security mechanisms. Therefore, Fog computing with different security mechanisms gets more attention in this era of computing. The market of fog computing is driven by the increasing IOT applications, machine to machine communication, the need for real-time processing, and the increasing demand for a large number of connected devices, etc. According to the MnM report, by 2022, the expected growth-rate of fog computing market is from USD 22.28 Million in 2017 to USD 203.48 Million[15]. Here, we need to pay for resources based on usage that is paying for resources according to use over time.

A lot of emerging trends used to uplift the healthcare sector. Telemedicine services get more attention to diagnose and treat patients where health professionals use ICT for remote patient monitoring. In telemedicine service, the emerging fog computing paradigm plays a major role in providing latency sensitive information as well as data privacy and security. Medical big data refers to a set of electronic health records, includes clinical data, sensor data, insurance, pharmacy, laboratory data, medical images, and other multimedia medical data. Nowadays, these are available in digital format; such records are called electronic medical records (EMR). These EMR records need to be kept in the secure storage and need to be downloaded for the emergency case with very less latency and need to be archived in the healthcare cloud.

A real-time two-way communication takes place between patient and healthcare provider through audiovisual media and integrated medical devices are used for the purpose of consulting. Telemedicine service providers are responsible for the transmission of EMR over the internet to provide better treatment and care of remote patients. Here, a lot of security issues may arise in the health cloud similar to cloud computing such as privacy and protection of data, legal and policy issues, lack of transparency and cybersecurity issues.

The rest of the paper is organized as follows: The background and motivation are explained in section II. The work done so far in this area is presented in section III. Section IV shows the details of the model. The implementation details are explained in part IV and the performance analysis is done in section V. The last section concludes the paper.







Random Bit Extraction for Secret Key Generation in MANETs

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Abstract

Mobile ad hoc networks are a group of random mobile nodes which does not have a preexisting base stations or infrastructure. In order to make communications effective over these networks a security scheme is essential. This can be achieved by establishing some shared random bits generated with fundamental secret key generation techniques. This paper presents a secret key generation scheme suitable for networks adapted to dynamic source routing protocol. Investigations were carried out for the possibility of using a system metadata like routing information for randomness extraction. Using routing tables maintained by the nodes as backbone, we are extracting a set of common secret random data for key generation. The secret key generation starts with random source extraction followed by information reconciliation to reduce errors and privacy amplification to increase the confidentiality. The main advantage of this technique is that it utilizes the sources of randomness inherent in the system itself without increasing the computational complexity. It also helps to identify the presence of an adversary in the network. The results of the system are evaluated to analyze the efficiency of the technique in terms of packet loss and packet overhead.

Keywords MANET · DSR · Routing data · Secret key

1 Introduction

Mobile ad hoc networks (MANETs) comes under the category of wireless communication networks which does not have any specific infrastructure [1]. So these networks are vulnerable to security issues like eavesdropping, data modification and node impersonation. In order to ensure security of the shared data, some cryptographic techniques such as encryption or secret key agreement is to be established at the time of communication. The recent works are concentrating on the generation of secret keys using public key based algorithms [2] or random number generators [3]. The main limitation of these key generation methods is computational overhead and finding a suitable source for the randomness generation. These limitations can be overcome by exploiting the readily available randomness sources

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FRICTION STIR WELDING ON DISSIMILAR ALLOYS - A CRITICAL REVIEW

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ABSTRACT

This paper aims at studying Friction Stir Welding (FSW) which is a new technique in welding invented in 1991 by The Welding Institute (TWI). The process uses a rotating tool, which is non consumable to produce frictional heat as well as plastic deformation at the welding area. This method is used in high strength aluminium alloy aerospace components and high temperature alloy metals which are hard to join by traditional fusion welding method. This paper addresses the current status of friction stir welding. The working principle of this process, microstructure characterization, welding parameters, mechanical properties and application area of FSW for improved welding is discussed.

Key words: Friction Stir welding, Mechanical Properties, Microstructure

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1. INTRODUCTION

Friction stir welding (FSW), recently developed new technique introduced by Thomas and his co-workers at The Welding Institute (TWI) in 1991[1]. In this process two different materials are joined by frictional heat produced by rotating the tool which is non-consumable without melting of tool and work piece. (FSP), Friction Stir Processing, the process developed from FSW used to change the properties of metal. FSP was developed by Mishra and his colleagues [2] based on the principle of FSW. The working principle of FSW is very simple. As shown schematically in figure1, the rotating tool which comprises of a pin and shoulder and it moves along the joint to be weld and stir the material. The results in the formation of sound bond between the materials. The frictional heat generated between the work piece and rotating tool plastically soften the material without melting. The obtained fine micro structured joint gives good mechanical properties.

1406







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Optimization in Turning of 11sMn30 Through Process Capability Index

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Abstract

Organizations focus on the process capacity index (Cpi) to assess the quality of their components for the purpose of improving and assessing quality and reducing operational costs that improve productivity and remain competitive. In this work, the analysis of the capacity of the process is performed for the rotation operation, to analyze the performance of the process within specific limits. Three process inputs were chosen, such as spindle speed, feed and cutting depth for the study of the process capacity in the simple operation of turning the 11SMn30 alloy with carbide tool in dry conditions, using Taguchi's orthogonal L27 matrix. To optimize the process capacity index (Cpi), the output parameters are measured, ie the surface roughness of two types (Ra and Rz). Surface roughness values (Ra and Rz) are optimized separately to optimize input processing parameters to find optimal cutting speed, feed and depth of cut that can maximize the capacity index of the turning process. Unique response optimization was used for the two machining qualities to explore input settings, which would optimize the spinning process. The optimal parameter settings for the average roughness of the Ra &Rz surface were found in a particular combination of spindle speed, feed rate and depth of cut. The results obtained were also verified using utility functions.

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Keywords: Process capability analysis; Surface roughness; Turning;

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MULTI-OBJECTIVE OPTIMIZATION OF MILLING PROCESS PARAMETERS IN GLASS FIBRE REINFORCED POLYMER VIA GREY RELATIONAL ANALYSIS AND DESIRABILITY FUNCTION

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Abstract

Finding the greatest or least value of a function for some constrain, that is correct regardless of the solution, this process is optimization. Inorder to lift up or improve the quality of machining products, to reduce the machining costs and for the raise of production rate, there is an important issue, ie the selection of optimum cutting parameters. In this project there is a performance of different factors of simultaneous optimization as the parameters in milling operation by combining the method of GRA and DFA. The simultaneous optimization is also known as multi-objective optimization. The epoxy glass fibre is the material used for milling operation and the parameters are delamination factor, machining force and surface roughness. On which every parameters have to be in minimized magnitude. The Grey relational analysis (GRA) is based on the grey system theory. GRA is used to study the relation among various attributes in a system and for solving the complicated interrelationships among the multiple responses. DFA is one of the most used methods in the industry for optimizing multiple response features. The analysis of the desirability function is used to convert multiple response characteristics into unique response characteristics.

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Keywords: Grey Relational Analysis GRA, Desirability Function Analysis DFA, Multi criteria decision making (MCDM).

1. Introduction

Milling is the machining operation frequently used in the manufacture of pieces of reinforced fiberplastic, because components made of compounds are commonly produced by network-shaped components that oftenrequires

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Optimization of Glass Fiber Reinforced Polymer (GFRP) using Multi Objective Taguchi function and TOPSIS

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Abstract

Optimization is the process of finding an alternative with the most profitable or highest performance possible within the specified limits, maximizing the desired factors and minimizing the unwanted ones. In this project, the multi-objective optimization, ie the simultaneous optimization of several factors, is performed on the parameters in the drilling operation using the multi-objective function Taguchi and TOPSIS. The material used for the milling operation is the glass fiber reinforced polymer and the parameters are the surface roughness, the rate of material removal and the delamination factor. TOPSIS is a multi-criteria decision-making method developed by Yoon and Wang, which involves determining the shortest distance from the positive solution and the greater distance. of the negative solution. For the maximized parameters, the maximum weighted value is the positive solution, while for the minimized parameters, the minimum weighted value is the positive solution. Dr. Taguchi of Nippon Telephones and Telegraph Company, in Japan, developed an experiment-based method called "ORTHOGONAL ARRAY" which provides a very small "variance" for the experiment with "optimal settings" of the control parameters

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Keywords: TOPSIS, Taguchi, ANOVA, Optimization, GFRP, Response surface analysis

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3.3.2 Number of research papers per teachers in the Journals notified on UGC website during the last five years

2018 - 2019



Carbon Nanotube Reinforced Poly(Trimethylene Terephthalate) Check to Suppose the Nanocomposites: Viscoelastic Properties and Chain Confinement

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Through a very facile route, a new class of nanocomposites involving poly(trimethylene terephthalate; PTT) and multiwalled carbon nanotubes (MWCNTs) was developed which was found to be high performance engineering material showing high modulus. Morphological, mechanical, viscoelastic, and thermal properties of the PTT nanocomposites with varying compositions of MWCNT were systematically studied and the results were analyzed. The dynamic mechanical and tensile properties of all the nanocomposites were seen to be enhanced with the addition of MWCNT and the sample containing 2 wt% MWCNT showing a storage modulus as much as 9.4×10^8 GPa. The results were correlated with the morphological features obtained from scanning electron microscopy and transmission electron microscopy. Coefficient of effectiveness, degree of entanglement density, and reinforcement efficiency factor were estimated from the storage modulus values and, in addition, the degree of chain confinement also could be quantified. Furthermore, theoretical modelling was also done on the elastic properties of the composites. The crystallization temperature, glass transition temperature, and percentage crystallinity were estimated for all the nanocomposites and it was found that the sample with 3 wt% MWCNT content exhibited the highest glass transition temperature of 68.2°C. POLYM. ENG. SCI., 9999:1-11, 2018. © 2018 Society of Plastics Engineers

INTRODUCTION

Polymeric materials reinforced by nanofillers are of special interest in nanotechnology owing to their versatile properties and innumerable applications. The incorporation of nanofillers into the polymers can tune and modify several physical characteristics of the nanocomposites including the strength and modulus of the polymer matrix and can also enhance the thermal and thermo-

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oxidative degradation of the polymers [1-3]. The thermal behavior of nanocomposites can be correlated to the glass transition temperature, T_{g} . Among the nanocomposites, the carbon nanotube (CNTs)-based nanocomposites are known to exhibit good electrical, mechanical, and thermal properties [4,5]. The electrical conductivity shown by the multiwalled carbon nanotubes (MWCNT) is comparable to that of copper (500-10,000 S/cm) and, in addition, the tensile strength (~ 20 GPa) and modulus (in the order of 1 TPa) are still higher [6]. Highly favorable conductivity of MWCNT (100-1,000 W/mK), very high aspect ratio, and good physical properties of CNT are some of the factors which have made the material a very promising and attractive candidate for composite preparations [7]. The conductivity of CNT-based polymer nanocomposite is seen to be dependent on several factors including the concentration of fillers, their aspect ratio, and degree of dispersion. Paszkiewicz et al. [8] investigated the effect of hybrid fillers like single-walled carbon nanotubes (SWCNT) and graphene nanoplatelets (GNP) on PTT-block-poly (tetramethylene oxide) (PTT-PTMO) and reported that the synergic effect of SWCNT and GNP enhances the thermal conductivity of PTT-PTMO significantly. Kumar et al. [9] reported that at a total loading of 0.5 wt% the hybridizing effect of GNP with commercially functionalized MWCNT in polyetherimide (PEI) matrix improve the electrical and thermal conductivity, as well as the dynamic properties considerably. Logakis et al. [10] investigated the thermal, electrical, mechanical, and dielectric properties of poly (methyl methacrylate) (PMMA)/CNT nanocomposites and reported that the electrical percolation threshold was found to be at 0.5 vol%.

PTT which is an aromatic semicrystalline polyester was first synthesized by Whinfield and Dicksen in 1941 (British patent 578 079). Because of the presence of three methylene groups PTT shows good elastic recovery greater than that of other polyesters like poly (butylene terephthalate) (PBT) and poly (ethylene terephthalate) (PET) and it is comparable to that of nylon. PTT also shows good color fastness, uniform dye uptake, stain resistance, and so forth [11]. The properties of PTT are in between that of PBT and PET and hence it can be considered as a promising material for the applications such as fibers, films, and engineering thermoplastics [12]. However, PTT has some limitations

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Multi-performance optimization of micro-drilling using Taguchi technique based on membership function

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Carbon fibre reinforced polymers (CFRP) tends to be employed in the manufacture of aerospace industry, construction and costly sports cars, wherever robust and lightweight materials are needed. The present aims to evaluate and optimize the micro-drilling machining process on carbon fibre reinforced polymer composite material in terms of multiple performance characteristics of circularity and cylindricity errors. Micro-drilling tests based on Taguchi L₂₇ orthogonal array are carried out on CFRP laminates under varying cutting conditions of spindle speed, feed rate and drill diameters. The process outcomes are assessed in-terms of circularity and cylindricity errors. The influence and percentage contribution of process parameters are examined by analysis of variance (ANOVA). Taguchi methodology supported by membership function is used for the optimization of the multiple responses transformed to the output of signal-to-noise (S/N) ratio. The scope of the experimental design is to minimize circularity and cylindricity errors simultaneously. Confirmation tests are performed to verify the effectiveness of the proposed hybrid approach.

Keywords: Micro-drilling, Carbon fibre reinforced polymer, Taguchi technique, Membership function, Circularity error, Cylindricity error

Fibre reinforced polymer (FRP) composite materials by virtue of their high strength-weight ratio, durability and high corrosion resistance, tend to replace the conventional materials as a better alternative in a variety of commercial, domestic and engineering applications. The high strength-to-weight ratio of the material will lead to lighter structural components. The material behaviour depends on the fibre reinforcement content, fibre orientation, and type of resin used. The fastening of components made of FRP composite materials through drilling is extensively done in fabrication of sub-assemblies and assemblies for FRP structures¹. Carbon fibre reinforced polymer, contains carbon fibres as reinforcing element of the matrix. Carbon fibres are factory-made in diameters from 9 to 17 µm like glass fibres. Carbon fibres possess high strength, elastic modulus and enhanced temperature resistance. CFRP composite materials are fabricated from carbon fibre fabric blended with resins like epoxy, polyester and vinyl organic compound resins and find wide spread application in aerospace and automobile industries, civil construction and sports goods².

The orthogonal cutting tests performed on unidirectional carbon fibre reinforced polymer

material by An et al.³ indicate a trend of decreasing cutting force with increasing cutting speeds. The investigations by Xu et al.4 on high strength CFRP with twist and dagger poly-crystalline diamond (PCD) drill tool show that PCD dagger drill generates better hole geometry than the twist drills. The aim of M/s Morioka et al.⁵ was to study the effect of fibre lay-up sequences of the CFRP laminates on the mechanical properties and their fracture behaviour; the test results indicate poor mechanical properties for a fibre orientation of 90° and hence undesirable. Abhishek et al.⁶ studied the effect of process parameters in drilling CFRP with multiple characteristics using fuzzy logic and harmony search (HS) algorithm; they found that the HS algorithm is superior to genetic algorithm (GA) in terms of computational time. Celik *et al.*⁷ investigated the effect of cutting parameters on machining of CFRP with the objective of minimizing the delamination factor; high feed rate give rise to increased delamination factor. The research work of Krishnamoorthy et al.⁸ with CFRP composite on multiple performance characteristics demonstrates undesirable responses found out that the influence of feed rate is more severe towards the responses. Karpat et al.⁹ modelled a mechanistic approach in drilling of CFRP using a PCD tool and observed that the current

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Contact Angle



Effect of MWCNTs on Wetting and Thermal Properties of an Immiscible Polymer Blend

A. R. Ajitha, M. K. Aswathi, Arunima Reghunadhan, Lovley Mathew, Roberto Terzano, and Sabu Thomas*

Poly (trimethylene terephthalate)/Polypropylene blend (PTT/PP) is prepared using melt mixing method and 1 wt% multiwalled carbon nanotubes (MWCNTs) are incorporated to study its effect on the thermal and wetting properties. The droplet morphology reveals the immiscibility of the neat polymers in the blend and there is a reduction in the domain size of the dispersed phase with the addition of MWCNTs due to the compatibilization effect of MWCNTs. With the addition of MWCNTs, there is a slight improvement in the melting temperatures of both PTT and PP while an increase in the crystallization temperature and glass transition temperature (T_g) is observed that may be due to the nucleation effect of MWCNTs. On blending with PP, the thermal stability of PTT matrix is increased and with the addition of MWCNTs there is not much improvement in the thermal stability of the polymer components is observed. With the addition of MWCNTs the contact angle of the blend slightly increased, may be attributed to the hydrophobic nature of MWCNTs.

1. Introduction

Polymer blending is an interesting method to produce novel materials for specific applications since it is very cost efficient and uncomplicated. By blending one can originate new material with the combined attributes of each element. Due to the negligible entropy of mixing most of the polymers are immiscible in nature.^[1,2] In addition to the entropy factor there

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are several other factors which affect the immiscibility of the polymer blends such as difference in polarity, solubility parameters, viscosity, and interfacial tension between the components. The high interfacial tension between the polymer components will lead to poor interfacial adhesion between them and blends become immiscible in nature and hence shows diminished properties than that of individual polymers.^[3] Even though immiscible polymer blends have combined attributes of single parts, due to the phase separation, poor adhesion, and sharp interface, one cannot practice them for potential applications due to inferior mechanical properties. Designing high performance products from immiscible blends are of large significance in the industrial sector. This can only be attained by the compatibilization process, where a third component (compatibilizer) is intro-

duced so as to enhance the interaction between the blend components.^[3] Compatibilizers can stabilize the blend morphology by reducing the interfacial tension thereby improving the interfacial affinity of the polymer components by acting as surfactant or emulsifying agent. There are different types of compatibilizers with specified interactions such as polypropylene-grafted-maleic anhyride (PP-g-MAH), poly(ethylene-co-glycidyl methacrylate) (PEGMA), polypropylene-grafted-acrylic acid (PP-g-AA), polypropylene methyl polyhedral oligomeric silsesquioxanes (PP-POSS), isocyanate group etc.^[4]

Graft or block co-polymers are generally used as compatibilizers since they can reduce the interfacial tension between two or more immiscible polymer components which acts as a stable interface amidst the heterogeneous components of the blends. **Figure 1** shows the schematic representation of the compatibilizing mechanism of a Graft or block co-polymer within an immiscible blend to improve the interfacial adhesion. In Figure 1, violet part has more affinity with first polymer and blue part interacts selectively with the second polymer. Reactive compatibilization is yet another technique for the compatibilization in which the block or graft copolymers forms a stable interface by in situ reaction.^[5]

Nowadays, nanofillers have been studied for the role as effective compatibilizers due to their multi functional nature as nucleating agents, reinforcing agents,etc. For the blends with high processing temperature, unmodified solid nanoparticles Nanocomposites



Selective Localization of MWCNT in Poly (Trimethylene Terephthalate)/Poly Ethylene Blends: Theoretical Analysis, Morphology, and Mechanical Properties

Aswathi M. K., Ajitha A. R., Moothetty Padmanabhan, Lovely P. Mathew, and Sabu Thomas*

Theoretical analysis is carried out to predict the nature of selective localization of multi-walled carbon nanotubes (MWCNTs) in poly-(trimethylene terephthalate/polyethylene (PTT/PE) blends. In agreement with theoretical data experimental results clearly indicate that MWCNT prefers to get associated with PTT phase than with PE. Molecular interactions responsible for such selective localization of MWCNT to PTT component can be attributed to mutual and collective π - π interactions possible between the aromatic moieties present in PTT and MWCNT. In addition, the reinforcing effect of MWCNT in the PTT/PE system was determined using tensile analysis and the morphological features of blends and blend nanocomposites are studied using scanning electron microscope (SEM). Compared to the PTT/PE blend system MWCNT incorporated blend nanocomposites show better mechanical properties. The elongation at break of the blend system is seen to rise with increasing amount of PE content. Among various blend nanocomposites, we have investigated the nanocomposites with higher PTT content show higher tensile strength and Young's modulus. The blend nanocomposite with 90/10/1 composition shows 12% increment in Young's modulus and as much as 80% increment in tensile strength compared to 90/10 blend system which signifies the role MWCNT plays in the blend system.

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1. Introduction

Current environmental pollutions and waste materials in landfills bring in focus the importance of biopolymers and bioplastics. Poly trimethylene terephthalate (PTT) is a bio-based aromatic polyester which can be prepared from the polycondensation of 1,3 propane diol and terephthalic acid.^[1] In PTT about 37% of weight contribution is from its bio based content 1,3 propane diol which are produced from renewable resources.^[2] PTT is endowed with good physical and chemical properties like dimensional stability, heat resistance, good chemical stability, resistant to stretching, low moisture absorption or quick drying, easy processability, and recyclability^[3] which make all PTT-based composites very useful in diverse industrial applications.^[4] However, their low impact strength, low heat distortion temperature, and low viscosity for processing^[5] limit their applications in many ways. Polymer blending is one of the major techniques which can overcome these limitations. Through polymer blending it is possible to develop new and novel materials with attractive proper-

ties.^[6] There are several studies which have reported substantial improvement in mechanical, thermal, and barrier properties in blends compared to their individual polymers. The property improvement and modification brought about by blending have been demonstrated well in polymer blends like poly (trimethylene terephthalate)/poly (ethylene 2,6-naphthalate) (PTT/PEN),^[7,8] polybutylene terephthalate/polyethylene terephthalate glycol (PBT/PETG),^[9] polyethylene/polypropylene (PE/PP),^[10] poly-(trimethylene terephthalate)/poly-butylene terephthalate (PTT/ PBT)^[11] which signify the importance of blending polymers. In addition, Chiu et al. have reported toughening mechanism shown by propylene ethylene block copolymer system when carbon black is incorporated and also by styrene-ethylene butylene-styrene triblock copolymer (SEBS). Significantly improved impact strength was observed for propylene ethylene block copolymer in their study.^[12] Wu et al. reported an improved tensile and impact strength for poly (phenylene oxide)/polyamide-6 (PPO/PA6) blend system with the addition of organo- montmorillonite.^[13] While Li et al. reported improved impact strength and reduced brittleness

Event Detection on Roads Using Perceptual Video Summarization

Sinnu Susan Thomas¹⁰, Sumana Gupta, Member, IEEE, and Venkatesh K. Subramanian

Abstract-Roads are the vital mode of transportation for people and goods around the globe and its use has grown dramatically over the years. There is one death every four minutes due to road accidents in the developing nations. This is of deep concern to the entire humanity. Road accident detection and vehicle behavior analysis is of great interest to the research community in intelligent transportation systems. It is very difficult from the state of the art techniques to provide the abstract form of salient parts of accidents from road surveillance videos. To resolve these issues, we present perceptual video summarization techniques to enrich the speed of visualizing the accident content from a stack of videos. The problem of vehicle analysis is formulated as an optimization problem. To the best of our knowledge, this is the first time we solve an accident detection as an optimization problem and filter the frames to be selected, through a single formulation. With the camera in a surrounding infrastructure and capturing a video, we exploited the properties of sub modularity to provide a relevant and condensed key frame summary. We have studied it for various real world traffic surveillance videos comprising of vehicular accidents and thus making it a promising approach.

Index Terms—Accident detection, optimization framework, perceptual video summarization, surveillance.

I. INTRODUCTION

CCORDING to Annual Global Road Crash Statistics [1], nearly 1.3 million people die in road crashes every year, on average 3,287 deaths a day. Road crashes are one of the leading causes of death globally. The increasing number of vehicles on road will even worsen the problem of road accidents. Surveillance cameras are ubiquitous on the roads and capture videos round the clock. Surveillance videos on roads are captured using surveillance cameras installed on the poles mounted at the side of the roads. These cameras are installed with a perspective to monitor anomalous events occurring on the roads. There are many cameras installed near the roads but the proposed method concentrates on a single camera view that gives a clear picture of the activity occurring on the road. The enormous data collected by cameras may be time consuming and laborious to scrutinize the occurrence of an accident scenario present in the videos. It is highly strenuous to review the entire video to find the accidents recorded. We need to reduce the redundant nature of video so

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Input Video Video Summarization Road Event Analysis

Fig. 1. An overview of the proposed approach.

that its contents become succinct using video summarization techniques.

The road surveillance videos provide enormous details to review the minute details of the events occurring on the roads. Researchers have worked upon various aspects on condition of roads, classification of vehicles, road detection, speed violation detection, traffic flow estimation, traffic management, and collision detection. We intend to work on vehicle analysis and collision detection for road surveillance videos based on perceptual video summarization techniques as shown in Fig. 1.

Video summarization is an economical way of representing video content and is useful for effective and quick browsing of the relevant activity present in the video. It is applied extensively in different applications. It is used in movies [2], sports [3], news [4], remote invigilation [5], medical diagnosis [6], and egocentric [7] videos to summarize its content for quick browsing. In this paper, we select the key frames from the video using the important pictorial video content.

As video summarization is a subjective venture, it is important to make a summary that is in agreement with the general perception of the viewers. An ideal summarization should include all the important semantic content of the video in accordance with human perception. Viewers do not focus on the whole image but only around a small foveation region, that merits higher weightage in the video summary than the peripheral regions [8].

In general, while analyzing road accidents we require to answer the following three questions:

- 1) How do we model road accidents present in surveillance video?
- 2) How do we incorporate video summarization method for analysing road accidents?
- 3) How do we validate the quality of the summarized result?

Considering the requirement of a fast scrutiny of events in surveillance video it is desirable that the overall system is fast and provides a true representation of events in a compact

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Thermodynamic analysis of an integrated gas turbine power plant utilizing cold exergy of LNG

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ABSTRACT

The main concerns in energy from petroleum-based fuels are the scarcity, cost, and pollution the fuels. Now, natural gas is considered as a better alternative. The process of converting natural gas into liquefied natural gas (LNG) is highly energy intensive and consumes about 10-15% of the total energy spent on natural gas production. Novel methods for regasification of LNG (converting back to NG) exist and are being used in various applications; mainly in power generation and refrigeration. One such method in power generation, the cold associated with LNG (cold exergy) can be utilized efficiently for improving the performance of power plants based on the Brayton cycle by precooling the working fluid. The study investigated such a possibility of precooling the inlet working fluid and to bring out the various factors influencing the overall efficiency of the power plant and regasification of LNG. Exergy analysis is the tool used for this study. The combined power plant is modeled using Aspen Hysys process simulation tool, and the results show that there is 35-135% improvement in the exergy efficiency of the power plant. This study also intends to find a suitable working fluid based on the objective functions such as exergy efficiency of the power plant and a regasification parameter (mass flow ratio). The gas turbine cycle gives maximum exergy efficiency when air is used as working fluid and Helium is the best working fluid candidate where regasification is the prime objective. Helium can gasify LNG about ten times more than other three working fluids

Keywords: Liquefied natural gas; regasification; power generation; Brayton cycle, exergy analysis.

INTRODUCTION

Natural gas (NG) is now considered as an alternative to the conventional fuels owing to the latter's issues like limited availability, increased cost and higher pollution. NG is found in deep underground rock formations or associated with other hydrocarbon reservoirs in coal beds and as methane clathrates. However, it is found only in specific areas and most of the reserves are in the Middle East, Russia and the United States [1-3]. Therefore, for distributing it around the globe, it has to be transported over long distances. It can be transported to customer's location in gaseous form (CNG), liquid form (LNG), solid form (Hydrates) and also in the form of electricity. Though there exist different methods for transportation of NG, it is highly economical and easier to convert

RESEARCH ARTICLE



A novel wideband pattern reconfigurable antenna using switchable parasitic stubs

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Abstract

A novel printed wideband pattern reconfigurable antenna using electronically switchable parasitic stubs is presented in this communication. The proposed antenna is compact, made of a low-cost FR-4 substrate and operates from 1.88 to 2.55 GHz with -10 dB impedance bandwidth. This antenna used only two PIN diodes and a simple bias control circuit without any vias or dc lines. It has the feature of improved gain, efficiency and two opposite directional patterns radiated in positive or negative x-axis in the azimuth plane. It has the group delay variations within 2 ns for the wideband operation. The proposed antenna was fabricated and validated for its pattern diversity performance.

KEYWORDS

directional radiation, pattern reconfigurable, radiation efficiency, wideband

1 | INTRODUCTION

The massive growth of wireless communication has laid emphasis on the development of diversity antennas to enrich the performance of wireless networks. To accommodate multiple wireless radio functions in a single antenna, reconfigurability is essential to dynamically change operation according to the specific application.¹ This leads to the necessity of making reconfigurable antenna with diversity properties to diminish the channel interference for a secured communication link.² In general, pattern diversity antennas are more powerful and useful in preserving the signal information in a multipath fading environment. In addition, pattern reconfigurable antennas designed for mobile terminals are needed to be low cost, miniaturized, simple design and have a pattern that is less prone to interference.

Pattern diversity antennas are used in various wireless communication systems such as base station antennas,^{3,4} mobile handset antennas⁵ and MIMO diversity antennas.^{6,7} The reconfiguration mechanism can be realized by using double-pole double-through (DPDT) switch⁸ or varactor diode⁹ or RF switch¹⁰ or pin diode^{6,7} or GaAs FET switch,¹¹ microelectromechanical switches (MEMs)¹² or artificial transmission lines.¹³ A great deal of research has been explored on the design of pattern reconfigurable antenna including tunable impedance surface,¹⁴ shared radiating aperture,⁶ Frequency selective surfaces,^{8,15,16} parasitic layer-based¹⁷, switchable feed networks,¹⁸ switching alternate reflector and radiator,¹⁹ liquid metal reflector²⁰ stacked array²¹ and artificial structures.²² The study shows that the contribution of more RF components and dc lines leads to power loss, disturbs the pattern and deteriorates efficiency. Ferrite beads are used with dc lines to hide the dc line from RF radiation to avoid efficiency degradation.²³ Moreover, the tradeoff between bandwidth and surface thickness as well as losses can be mitigated by adding reconfigurable metasurfaces.²⁴



FIGURE 1 Geometry of the proposed pattern reconfigurable antenna. Ls = 50 mm, Lg = 13.5 mm, Lp = 35, Ws = 50 mm, Wg = 23 mm, Wp = 22 mm, Wa = 26 mm, Wb = 30 mm, Wf = 1.8 mm, G1 = 6 mm, G2 = 1.5 mm, W = 2 mm, S = 1 mm, g0 = 0.6 mm, y0 = 5 mm, h0 = 2 mm

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Survey on analysis of energy optimization in MANET routing

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Abstract

Mobile Adhoc Network (MANET) is becoming a priority in everyday life due to its flexibility and scalability in networking. All mobile applications using networks are ready to share and receive data and so they are capable of supporting infrastructure less networks. This leads to become MANET a prominent networking solution worldwide. So the research eyes are now focused on how to improve the MA-NET performance. There are so many aspects to be analyzed to improve the performance of the MANET. Load balancing is such a critical issue to be addressed seriously to attain maximum throughput from the MANET. Effective Load balancing can be attained by disseminating data traffic among the mobile nodes so that the equilibrium of the MANET is not violated. This ensures the stability of the entire network which will result in maximum throughput and fault tolerance. This paper analyses and compare the effect of energy optimization used in various existing methods and how better load balancing is achieved.

Keywords: Energy Efficiency; Load Balancing; Link Stability; MANET; Node Mobility.

1. Introduction

Mobile adhoc network is an infrastructure-less network of wirelessly connected mobile nodes. The mobile nodes in a MANET is endlessly self-configuring in nature. MANET has various advantages like scalability and flexibility. Any node can join or withdraw from the MANET any time which adds flexibility and scalability in networking. Since the nodes are mobile, huge amount of uncertainty is there in MANET. This also brings overhead in network management process like routing, load balancing [1] [2] etc...

Unless the wired network, MANET has some critical aspects which is to be considered while operating. Energy usage of mobile nodes is such an issue. All operations in a mobile node is powered by battery. So the consumption of power [1], [2] is a precarious factor which defines the life of the mobile nodes [3] [4] [11]. Mobility and data transfer across the nodes in MANET consumes more power [12]. Consumption of energy due to mobility cannot be avoided, but energy optimization can be done in the data transfer phase so that the per node energy consumption can be optimized, which will result in increased life time and stability of the nodes and better load balancing can be attained [5] [10].

This paper makes a survey on energy optimization techniques introduced in the MANET and analyses how better load balancing can be attained by optimizing energy. Various existing protocols proposed in the area of MANET energy is taken to consideration and the working of each protocol is analyzed and comparison is made based on energy consumption and a conclusion is reached in the light of effect of energy optimization in MANET load balancing.

2. Link stability

Link stability is an important aspect to be considered while evaluating MANET performance. Link stability refers to the

regularity of links between nodes. Energy Optimization is a key factor which directly affects the link stability of MANETS. Link Stability and Energy Aware Routing (LAER) Protocol was developed with an objective to maximize the link stability by optimizing the energy utilization based on residual energy and predicting link age. This protocol is particularly used in distributed wireless networks which makes an equilibrium between stability of links and per node minimum energy drain rate. Specifically this routing protocol make use of Link stability and energy aware metric for implementing stable routing in the wireless networks [2].

Considering two nodes a and b with a transmission range T_R , LAER defines the link stability between a and b as

- If the distance between node (a and b) is less that TR, a link will be established between them at the time instant tin.
- If the distance between two nodes (a and b) are greater than TR, the link is considered to be broken at time instant tfin.
- The duration d(a,b) defines the link age[3] between nodes a and b, which is the difference between tfin and tin.

LAER produces an estimation of link age called as link residual life time[3], [4] by observing the link establishment, link breakage and link age for the past time instants. Based on the analysis prediction of stable links are made.

The energy utilization in sending a packet p from node a to node b is defined as

$$E(p,a) = E_{tx}(p,a) + E_{rx}(p,b)$$
(1)

Where $E_{tx}(p,a)$ is the power required to transmit the packet p from node a and $E_{rx}(p,b)$ is the power consumed to receive the packet p in node b.

The power consumed during transmission, reception and overhearing events are being observed by each node. Then it will calculate the drain rate(DR) for every time slot T and making an average by sampling at regular intervals [2] [7].

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Meta-data based secret image sharing application for different sized biomedical images.

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Abstract

Usually in image sharing schemes, shares are generated first for a given secret image and then embedded into cover images to produce stego images. These two steps are done sequentially. There exist some relationship in the first step, the size of the secret image and size of the shares which are derived from them. In the proposed method, these two steps are done concurrently. A cover image is chosen and according to its embedding capacity, share is generated and subsequently embedded into chosen cover to produce the stego image. This process is repeated till all the image portions are embedded. While generating share, meta-data (i.e.) header is created for each shares and appended to shares before being embedded. At the destination end, shares are extracted from each stego images and are reassembled into a single original secret image according to the meta-data present in each share. Methods available in the literature embeds uniform sized secret image into cover images of uniform sizes. Using proposed method different sized secret images have been embedded into cover images of varying sizes.

Keywords: Image sharing, Different sized image, Batch steganography, Least significant bit, Compression.

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Introduction

Shamir et al. designed a Secret Sharing (SS) method to share a secret key where secret key is an integer valued which can be divided into many integer values according to the polynomial equation [1,2]. SS methods are used for many real world application [3,4]. In real life, SS schemes can be applied. Consider this scenario. A country does not want to give the supreme power of giving permission to the use of nuclear weapon in a war. But instead, this power rest on three persons, president, prime minister and the defence minister of that country. At least two out of three must agree to the idea of invocation of nuclear war [5]. SS scheme can be applied to images as well. This is referred as Secret Image Sharing (SIS). This is reported first in [6]. Later SS schemes are applied on the other types of cover as well, i.e., test, audio and video [7]. Many SIS schemes have been proposed so far using different concepts [8,9].

In data communications networks, original data is divided into small chunks called packets by segmentation process when it cannot be transmitted as single packet. Process done at the source end needs to be computed in a reversed order at the destination end to reconstruct the original data from packets [10]. Sometimes, information to be transmitted called payload can be compressed and if need be can be encrypted also [11]. In data communications networks, after original data are segmented into packets. It is encoded as signals and transmitted across the communication medium to reach the destination. This can be modified for steganography. In SIS, after images are divided into shares, it can be embedded into a chosen cover image. So encoding of packets in data communication is correlated with embedding of share in steganography in our proposed method.

Related Works

Thien et al. describes the method for construction of shares from a secret image. Size of the constructed share is smaller than the secret image. This share looks like a random noise image. If shares are sent as such, there will be suspicion. To avoid this, shares are embedded into a cover image to produce a stego image. If t numbers of shares are produced, then size of the share is 1/t of secret image. Size of the cover image which is chosen for embedding these shares must be either 2 times or 4 times the size of share [12]. Wu et al. modifies the paper in such a way the size of the share is 1/t but the size of the stego image is also 1/t [12,13].

Yuan et al. described methods for sharing a binary secret image into multi cover images. For sharing a secret image, four cover images of similar size are chosen. A binary matrix is calculated by XORing LSB planes of all the cover images. To embed secret image into cover, each secret pixel $A_{i, j}$ of secret image is compared with $B_{i, j}$ of binary matrix, if both are same, no operation is done and next secret pixel are examined, otherwise using gradient measure, particular cover image is chosen for embedding this particular secret pixel into $C_{i, j}$ of the chosen

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Brain tumour detection based on FFT, curve analysis, k-space and neural network classifier

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Abstract: Magnetic Resonance Imaging (MRI) has become an efficient instrument for clinical diagnoses in recent years. In this paper, an efficient MRI image segmentation for tumour detection is proposed using FFT, curve analysis and k-space. Input MRI image is pre-processed and segmentation is carried out using EM. Subsequently, features are extracted by using FFT, curve analysis and k-space. Finally, neural network classifier is employed to diagnose brain tumour. The MRI image dataset used to evaluate the proposed image technique is taken from the publicly available sources. The evaluation metrics used to evaluate the proposed technique consists of sensitivity, specificity and accuracy. Overall, the proposed technique could achieve sensitivity, specificity and accuracy values of 0.80, 0.81 and 0.805 respectively. The comparative analysis is also made comparing with other existing techniques. From the results, it can be seen that our proposed technique performed well and obtained better evaluation metrics than the existing methods.

Keywords: MRI image segmentation; tumour detection; classification; FFT; k-space; curve analysis; EM algorithm; neural network.

Reference to this paper should be made as follows: Sheela, V.K. and Babu, S.S. (2016) 'Brain tumour detection based on FFT, curve analysis, k-space and neural network classifier', *Int. J. Signal and Imaging Systems Engineering*, Vol. 9, No. 6, pp.393–402.

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1 Introduction

Medical images build essential portions for distinguishing and investigating dissimilar body structures and the diseases affecting them (Zuo et al., 2004). Arrival of the technology has revolutionised the medical imaging area and has altered the task of analysis of a variety of ailments for medicine practitioners. To produce images of human body for medical purposes it can be very perceptive for the medical process which is trying to analyse the disease. Medical **TECHNICAL PAPER**



Multi-performance Optimization of Drilling Carbon Fiber Reinforced Polymer Using Taguchi: Membership Function

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Abstract The CFRP composite materials are widely used in aircraft, automobiles, infrastructures, 3D printing and many more areas where light weight and high strength is a major factor. This study outlines the implementation of Taguchi technique combined with the membership function to optimize the drilling process parameters using Taguchi L₂₇ array with multiple performance characteristics to minimize the objective. The experiments were performed by using three drill bit types at three levels of cutting speeds and feed rates. The responses namely thrust force and torque were measured by using Kistler multicomponent dynamometer 9257B; circularity and cylindricity were measured by using TESA micro-hite 3D Coordinated Measuring Machine (CMM). The drilling process parameters which directly influenced the performance characteristics were optimized using response surface methodology (RSM). The ANOVA (Analysis of Variance) results clearly indicated that the feed rate was the significant factor which affected the responses. The experimental values of S/N ratio were compared with predicted values of the membership function, and were found to be in good agreement with each other.

Keywords Carbon fiber reinforced polymer (CFRP) · Drilling · Taguchi · Response surface methodology · ANOVA · Membership function

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1 Introduction

Now-a-days, for a variety of applications, the Fiber reinforced Plastics (FRP) composites materials are preferred in almost all the modern engineering industries because of their high strength to weight ratio. Carbon fiber reinforced polymer (CFRP) is said to be an excellent replacement for conventional materials with high strength and modulus. In addition to the strength and modulus, their fatigue properties are also excellent when compared to the well- known metallic structures. The CFRP is said to have extreme corrosion-resistant quality when mixed with proper resins. The CFRP composite materials are widely used in aircraft, automobiles, infrastructures, 3D printing and many more areas where light weight and high strength is a major factor. The CFRPs are very difficult to machining because of the arrangement of the fiber orientation and fiber reinforcement. The most commonly used machining process for all the engineering applications is drilling, which is used to fit the composite materials to the other structures of the system.

Prasanna et al. [1] developed a multi-performance optimization technique in dry drilling of Ti–6Al–4V using Taguchi Grey Relational Analysis (TGRA), which resulted in minimizing the thrust force by means of low feed rate and high spindle speed. Shanmughasundaram et al. [2] analysed the effect of feed rate, spindle speed and step angle in step drilling of Al–Si alloy–Gr composite using Taguchi and ANOVA. Their results revealed that feed rate is the most significant machining parameter which influences the thrust force. Chatterjee et al. [3] have reported the multi-objective optimization algorithm in drilling of AISI steel using NSGA-II (Non-dominated sorting genetic algorithm). The effectiveness of Pareto-optimal solution obtained by NSGA-II enhance the machining conditions.



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Review paper



Feature Extraction Techniques for Leukocyte Classification - A Review

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Abstract

This paper covers an investigation on the various feature extraction techniques employed for the statistical estimation of leukocyte classification from blood sample images since the identification or analysis of these four classes of leukocytes plays a vital role in the early identification of various diseases. The manual estimation of these WBC's by pathologist is error prone and time consuming. This paper mainly concentrates on the study of leukocyte classification methodology and various feature extraction techniques for the classification of four classes of Leukocytes such as Neutrophil, Lymphocyte, Monocyte, and Eosinophil which can be fed to SVM or neural network for further classification.

Keywords: Feature extraction; GLCM; Leukocytes; Preprocessing; Segmentation

1. Introduction

Necessary substances like nutrients and oxygen to the cells are delivered by the body fluid called blood. The blood consist of different components like Plasma, Platelets, Red Blood Cells(RBC's) and White Blood Cells(WBC's). The main component of blood is Plasma which consist of water with ions, nutrients etc. About 55 % of blood volume is plasma. Blood clotting is the responsibility of platelets. Red Blood Cells (RBC's) carry Oxygen and Carbon dioxide. White blood cells are the important part of immune system which is very much important for the persistence of human body. White blood cells ensure the correct working of immune system. White blood cells are also called leukocytes. The WBC's constitute less than 1% of blood volume. The size of the WBC's is bigger than RBC's. WBC's have normal nucleus and mitochondria. There are mainly five types of WBC's which corresponds to two groups like granulocytes and granulocytes. Granulocytes group consist of Neutrophils, Eosinophils and Basophils which contain granules in their cytoplasm when viewed using a microscope after staining. Agranulocytes consist of monocytes and lymphocytes which do not contain cytoplasm. Maintaining the desired count of WBC's is quite important. The low rate of WBC's are due to different type of diseases like Aplastic anemia, HIV/AIDS, Hypersplenism, Kostmann's syndrome, Leukemia, Lumps, Malnutrition and Vitamin deficiencies, Rheumatoid arthritis, Tuberculosis etc[20].

The classification and counting of WBC's are performed manually by pathologists which is a hectic and time consuming process. This paper covers various feature extraction methods for leukocytes classification methods adopted by various researchers based on digital image processing techniques .The image data set is from the dataset provided by Sarrafzadeh et.al [3].

2. Related Work

The work by Muhammad Sajjad et.al [1] have concentrated in the estimation of classification of leukocytes or WBC which are supposed to be the basic building block of immune system of human body. This paper mainly deals with multi-class classification based on features extracted based on textural, wavelet transform and statistical properties. These features are fed to an ensemble multi-class SVM, for the classification of leukocytes to the classes such as Neutrophil, Lymphocyte, Monocyte, Eosinophil and Basophil. The dataset used in this experiment by the researchers are gathered from HMC. This work claims an accuracy of 94.3% for the classification of WBCs. The work carried out by Lin He et.al [6] utilized Discriminative Low-Rank Gabor Filter (DLRGF) method based classification of spectral spatial images. The methodology is based on the classification using DLRGF_SVM and DLRGF-LS.

Lata A. Bhavnani et.al. [5] performed accurate counting of White Blood cells and Red Blood Cells (RBC) using digital image processing and estimating the accurate method for the same through comparison. The research techniques are segmentation using Ostu's hresholding, Erosion, Edge detection, watershed and Hough transform. The objective of the research performed by Margarita Gamarra et.al [7] is to have a detailed study to provide the trends in cell image processing and to have a detailed comparison of various feature extraction and segmentation techniques for cell image processing. This work performed comparison of segmentation techniques like edge-based segmentation, thresholding, clustering and color based feature extraction technique for cell identification. The work conducted by Xi Yin et.al [8] is to provide an approach for prediction of TMB segments using sparse coding algorithm. This work relays on Position Specific Scoring Matrix and Z- coordinate score for feature selection. Another relevant application where image processing techniques plays a vital

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TECHNICAL PAPER



Experimental Investigation on Electro-codeposition Nickel-Weld Slag Composite Coating

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Abstract Electro-codeposition process is considered to be an advanced technique for development of composite coatings. In this study, Ni-weld slag composite coatings are prepared from nickel Watts bath using electrodeposition process. It is a novel approach under the utilization of weld slag particles for the preparation of composite coatings which are composed of ceramic patterns. The weld slag particles are embedded in nickel matrix using electrodeposition by adjusting the process parametic conditions. Taguchi L9 orthogonal array is chosen for experimental design by considering the three primary plating parameters, namely current density, temperature of bath and particle concentrations with three levels of each. In order to confirm the deposition, the deposited coatings are examined using optical microscope, SEM micrographs and EDX investigations. The Microhardness of deposits is evaluated using Vickers microhardness tester with the applied testing load of 100-gram force. The direct effects and significances of plating parameters on the microhardness have been explored using the signal to noise ratio, mean effect studies and analysis of variance. The process parameters are ranked by position through the significance studies. The Ni-weld slag particles produces greater microhardness values than pure nickel coating.

Keywords Electro-codeposition · Nickel-weld slag · Taguchi design · Microhardness · Signal-to-noise ratio

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1 Introduction

The electrodeposition is commonly applied to modify the surface characteristics of a substrate material, to facilitate the enhanced surface characteristics, oxidation resistance, tribological properties, resistance to wear or a combination of above properties. The electrodeposition is technically feasible and cost-effective technology for the formation of metallic and composite depostion with the advantages of uniform deposition rate, ease of control of process parameters for desired properties, simplified equipment setups and low cost preparations [1]. The electrodeposited composite coatings are composed of matrix phase and reinforcing elements. The matrix phase is prepared with metallic or alloy compounds and the reinforcing elements may be a metallic, nonmetallic, ceramic or fiber particles. In the approach of electro-codeposition or electrodeposition of composite coating, the insoluble micron sized particles or reinforcing second phase elements are detained in suspension in a conductive electrolytic bath by agitation. Throughout codeposition, the suspended reinforcing particles are surrounded by the Ni ionic clouds and the same is deposited in the metal matrix compound in the cathode plate through electroplating. The reinforcing materials or insoluble particles are implanted in the metal matrix by the above incessant occurrences and the composite coatings are generated with unique properties [2, 3].

With the assistance of electrodeposition process, metallic particles, Cr [4], Mo, Ti & V [5], Al [6], Cu & Sn [7] and; Ceramic particles, SiC [8], MoS2 [9], TiO2 [10], Al2O3 [11], Si3N4 [1] and cermets [12]; Precise particles; diamond [13], graphite [4], pumice [14], PTFE [15], and fly ash [20] are effectively codeposited in quite a lot of metallic and alloy matrices. Many reports are submitted on the synthesis, characterization and properties of various

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Research Article

Carbon Nanotubes: An Ideal Candidate for Biomedical Applications

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Keywords

• Carbon nanotubes; Nanomaterials; Carbon fibers; Drug delivery

Abstract

Present review tells the importance of carbon nanotubes (CNTs) for biomedical applications. Various nanomaterials have widespread usage in biomedical applications on considering its tremendous superior properties. Silver nano particles, gold nano particles, carbon fibers, carbon nanotubes, nanowires, nanorods, quantum dots, graphene etc., are being widely investigated for various medicinal applications. Due to the multifunctional nature and unique physicochemical properties, carbon nanotubes (carbon nanotubes, fullerenes, graphenes etc) have extensive application in biomedical field. Among these, functionalized carbon nanotubes (f-CNTs) have great importance in biomedical field, since CNTs can interact with various biomacromolecules by physical adsorption. The improved solubility and biocompatibility of f-CNTs along with its unique optical, mechanical and electrical properties makes them as an efficient candidate for biomedical applications. Biomedical applications of CNTs have been progressing rapidly and it can be accepted as a potential biomedical agent for targeting, drug delivery, imaging, sensoring, etc.

INTRODUCTION

Recent developments showed that nanotechnology has great importance in the field of biomedical applications. Major biomedical application of nanomaterials involves targeting of damaged cells, drug delivery, especially for anticancer therapies, discovery of infectious microorganisms, DNA detection assays etc. The usages of nanomaterials in biomedical applications are increasing day by day. Due to their small size and increased surface area, it can interact with biomolecules easily. The commonly used nanomaterials are categorized to three types, like zero-dimensional materials (eg; quantum dots) one dimensional material (nanorods, nanowires, nanotubes etc), and two-dimensional materials (nanobelts, nanodisks, films and nanosheets etc). The major application of nanomaterials is for the drug delivery systems. The nanomaterials can target and deliver the drug specifically. Drug delivery by nanomaterials depends on certain factors such as morphology of the nanomaterials, the interaction between the materials and drug, mechanism of delivery, diffusion coefficient etc.

The nanotechnological application of diagnosis, imaging, curing and controlling of the biological system generally called as "Nanomedicine" or Nanotherapy. For biomedical usage the nanomaterials should be surface modified by chemical, physical and biological methods to improve the solubility of the nanomaterials in aqueous media and to become more compatible with biological systems. Thus nanomedicine involves the usage of modified nanomaterials as drug delivery vehicles, biosensors, imaging agents, scaffold reinforcements labeling agents of cell and tissue, biomaterial reinforcements etc.

The commonly used nanomaterials for biomedical application involves silver nanoparticles, gold nanoparticles, carbon fibers, carbon nanotubes, nanowires, nanorods, quantum dots, graphene etc; and are being widely investigated for various medicinal applications. The main advantages of nanomaterials as biomedical tools involve reduced amount of the drug dose and less toxicity with enhanced stability after the surface functionalization.

Due to the multifunctional nature of carbon-based nanomaterials (CBNs), it acquired great importance for biomedical applications. Recently several works were reported based on the biomedical application of carbon based nanomaterials such as carbon nanotubes, carbon nanofibers, quantum dots, fullerenes, nanodiamonds, carbon, graphene, nanohorns [1-7]. These are broadly used for drug delivery and sensor applications with high selectivity due to its high aspect ratio, high surface to volume ratio, unique electrical and mechanical properties, biocompatibility properties etc; thus these nanomaterials can be used as diagnostic tools against diseases, since both the nanomaterials and most biological systems are in nanometer scale dimensions.

CARBON NANOTUBES (CNTS)

CNTs are allotropes of carbon consist of a hexagonal layer of carbon atoms rolled to form cylindrical tubular structure

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Research Article

Quantum Dots: A Promising Tool for Biomedical application

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Abstract

Quantum dots the colloidal semiconductor nanocrystals showing variety of applications because of its size tuneable optical properties. The bioconjugated colloidal nanoparticles showing similarities with biological macromolecules leads its applications to biological fields such as detecting, imaging and drug delivery. This chapter provides a brief description of QDs in biomedical applications especially in bio imaging, tumour cell targeting and drug delivery. In addition to macro scale in vivo imaging techniques nanoscale QD based probes were well matched for fluorescence imaging in biomedical applications.

INTRODUCTION

Nanotechnology is the study of creation, manipulation, and application of structures in the nanometer size that is between 1 to 100 nm. Metal and semiconductor nanoparticles which are in the 2-6 nm size range shows very good dimensional similarities with biological macromolecules like nucleic acids and proteins. So the integration of nanotechnology and biology leading to open up new endeavour in the field of medical diagnostics, targeted therapeutics, molecular biology and cell biology. Recently several groups has incorporated colloidal nanoparticles to biomolecules and these bioconjugated nanoparticles are then being used for producing homogeneous bioassays and multicolor fluorescent labels for ultrasensitive detection and imaging. Quantum dots (QDs) are colloidal semiconductor nanocrystals having ~1-10 nm diameters. The QDs can be made based on different materials such as inorganic semiconducting materials, carbon, graphene and black phosphorus [1]. Quantum dots shows sizedependent optical and electronic properties and these properties makes quantum dots a good material in the field of biomedical applications such as bio imaging and sensing, drug delivery, diagnostics, cancer therapy etc [2]. Quantum dots have been developed in different shapes, size and configurations and one of the main applications of the QDs in biomedical field. Compared to conventional organic dyes and fluorescent proteins, QDs shows typical features such as size-tunable light emission, improved signal brightness, resistance against photo bleaching and simultaneous excitation of multiple fluorescence colors. These properties are the basic motivation for using QDs in bio medical field compared to individual molecules or bulk semiconductor solids [3].

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All the three dimensions of QDs are in nano metre range and QDs have mainly three parts as shown in Figure 1, one core part made from any semi conductor material such as CdSe, CdTe etc, secondly shell surrounding the core part which helps to improve the optical properties of the core and finally a cap which may be of peptides, antibodies, oligo nucleotides or poly ethylene glycol depending on the required solubility or biological properties [4].

Different sized QDs emit different colour light due to quantum confinement effect. By changing the particle size QD probe give different colours. The biggest quantum dots produce the longest wavelengths or lowest frequencies and shows red light while the smallest dots has bigger band gap make shorter wavelengths or higher frequencies and emits blue light.

The size tuneable optical properties of QDs are shown in Figure 2(A). The fluorescence properties of quantum dots are related to the size of the QD core and the colour of emitted light



Cite this article: Aswathi MK, Ajitha AR, Akhina H, Mathew LP, Thomas S (2018) Quantum Dots: A Promising Tool for Biomedical application. JSM Nanotechnol Nanomed 6(2): 1066. **Research Article**

Energy-efficient fault tolerant technique for deflection routers in two-dimensional mesh Network-on-Chips

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Abstract: New generation multi-processor system-on-chips integrate hundreds of processing elements in a single chip which communicate with each other through on-chip communication networks, commonly known as network-on-chip (NoC). Routers are the most critical NoC components and deflection routing is a technique used in buffer-less routers for better energy efficiency. Massive integration of devices along with fabrication at deep sub-micron level feature sizes increases the possibility of wear out and damage to various components resulting in unreliable operation of the chip. Hence NoC fabric in general and routers, in particular, should be equipped with built-in fault tolerance mechanisms to ensure the reliability of the chip in the presence of faults. The authors propose an energy-efficient routing technique that can tolerate permanent faults in NoC links by introducing a simple logic unit placed next to the output port allocation stage of the deflection router pipeline. This technique incurs minimum wiring overheads and promises a stable network throughput for high fault rates. Evaluation of the proposed method on 8 × 8 mesh NoC for various fault rates reports reduced flit deflection rate and hop power which brings about a significant reduction in dynamic power consumption at the inter-router links compared to state-of-the-art fault tolerance techniques.

1 Introduction

Increasing the integration capacity of transistors in integrated circuits has made it possible to realise multi-core chips which can accommodate thousands of processing elements (Pes) in a single silicon substrate. The high processing capability of these chips demands modular communication architectures like networks-on-chip (NoC), which offers packet-based communication through a set of connected routers and links. Fig. 1*a* shows a two-dimensional (2D) NoC system having 16 routers (interconnected in

a 4×4 mesh topology), each of which is connected to a PE. In a homogeneous multi-processor system-on-chip, each PE consists of an out-of-order superscalar processor and one or two levels of cache memory. Cache misses account for the generation of packets to the NoC framework. TERAFlops [1] and Tile64 [2] are prototype chips with 64 and 80 processor cores, respectively, interconnected using mesh NoCs.

Energy-efficient on-chip communication is achieved by eliminating router buffers [3] and using deflection routing



Fig. 1 (a) $A 4 \times 4$ mesh NoC system, (b) Bufferless deflection router architecture using PDN, (c) Connections between permuters of PDN in FaFNoC Router with faulty north port (R1) and faulty east port (R2), (d) Demonstration of path traversed by flit from source (src) to destination (dst) in a 4×4 mesh NoC using Maze routing and proposed work

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Tuning of Microstructure in Engineered Poly (trimethylene terephthalate) Based Blends with Nano Inclusion as Multifunctional Additive

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Abstract: Immiscible blends and their composites are heterogeneous and have variable morphology due to variation in mesophase regions. Tuning, i.e. controlling the phase dimension is important, thereof we report a "*super-combo*" effect of multiwalled carbon nanotubes (MWCNTs) in poly (trimethylene terephthalate)/polypropylene blends (PTT/PP) blend system. MWCNTs act as a good reinforcing agent and compatibilizer in the otherwise immiscible PTT/PP blend. PTT/PP blends (with varying blend ratio and MWCNT loading) were melt mixed and later compression molded. The fabricated sheets were characterized for mechanical and morphological properties. Information regarding morphology was determined using scanning electron microscope (SEM) and transmission electron microscope (TEM). Dispersion of MWCNT in PTT was confirmed by the TEM images. Better understanding is in sighted by carrying out a correlation between mechanical properties with morphology, in-line with theoretical equations and selective dissolution experiments. Mechanical properties of all blend compositions were enhanced with the addition of 1 wt % MWCNTs, in which the blend having higher composition of PTT shows excellent mechanical properties. The addition of different

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Optimization of Squeeze Casting Process Parameters Using Taguchi in LM13 Matrix B₄C Reinforced Composites

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Abstract. Aluminium metal matrix composite has widely used in aerospace and automobile industry due to its high strength to weight ratio. Aluminium LM13 matrix B₄C reinforced composites are mainly manufactured by Squeeze casting process. The present work optimizes squeeze casting process parameters using Taguchi method. The control factors used for the experiments were Squeeze Pressure. Die Preheat Temperature and weight percentage of Boron Carbide (B₄C) along with multiple performance characteristic of Hardness, Ultimate Tensile Strength (UTS) and Yield Strength (YS). The L27 orthogonal array was used for experimental design. Analysis of variance (ANOVA) is used to determine the significant factor and found out that Squeeze pressure is the most significant factor followed by percentage of B₄C.

1. Introduction

Mechanical properties of aluminium alloy amended by reinforcing with hard ceramic particles like SiC, Al2O3 and B4C etc. This work optimize squeeze casing process parameters using Taguchi method in Aluminium LM13 Matrix B4C reinforced composites. Composite is manufactured using squeeze casting process by varying process parameters Squeeze pressure, Die preheating temperature and percentage of B4C. Biswajit et al. concentrated their study on optimization of stir casting parameters like pouring temperature, stir speed and reaction time for titanium carbide reinforced MMC. They have conducted ANOVA analysis for finding out the percentage contribution of each process parameters. They also formulate regression equation for each output parameters [1]. Prosenjit, et al. conducted study on degree of sphericity optimization of A356 Al casting using cooling slop. Slope angle, pouring temperature and wall temperature of the melt are the input factors selected for the above analysis. They have also conducted ANOVA analysis and finally formulated regression equations for each output parameters [2]. Apparao et al. has studied the effect of porosity on die casting parameters and he optimized die casting parameters of Al-Si8Cu3Fe alloy for minimum porosity [3]. Shailesh, et al. optimized the process parameters of centrifugal casting and found out that pouring time and mechanical properties have converse relationship with die speed [4]. Patel et al. optimized squeeze casing parameters for LM20 alloy and he reported that process parameters Pouring

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Multi-period reverse logistics network design for used refrigerators



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Keywords: Reverse logistics Network design Remanufacturing Repairing Recycling Refrigerator

ABSTRACT

This paper focuses on the design of a multi-stage reverse logistics network for product recovery. Different recovery options such as product remanufacturing, component repairing and material recycling are simultaneously considered. Initially, we propose a mixed integer linear programming model – with a profit maximization objective – for the network design problem. The structure of the product, by way of bill of materials (BOM), is also incorporated into the proposed model in order to analyze the flow at component and material levels. Sensitivity analysis is carried out to study the effects of variations in the values of the input parameters such as product return quantity, unit transportation cost per unit distance, and unit processing cost. The analysis shows that the design decisions of different facilities considerably change even for 5-20% variations in input parameter values. This led to the development of a refined mathematical model which incorporates variations in the different input parameter values over time. The new model provides a unified design for the entire planning horizon and has been validated with the design of a used refrigerator recovery network.

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1. Introduction

Reverse logistics deals with the collection and treatment of used products. Nowadays, apart from economic reasons, organizations across the globe are increasingly focusing on setting up reverse logistics networks owing to the adverse environmental effects caused due to the improper disposal of many used products. However, reverse logistics is still in a state of infancy, particularly in emerging economies (Bouzon et al., [1]). The economic potential associated with used products also makes research in this area quite attractive. According to the Environmental Protection Agency (Dat et al., [2]), there are 20–50 million metric tons of electronic waste (e-waste) alone generated worldwide every year.

Thus, organizations must consider the management of reverse logistics systems in addition to forward logistics (Tahirov et al., [3]; Govindan et al., [4]). Moreover, customers are becoming more knowledgeable about environmental pollution and this affects their purchasing decisions (Kara et al., [5]). So, having a proper mechanism in place for a reverse supply chain not only helps firms reduce the negative environmental impact of its used products but also enhances its green image

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Routing protocol based key management schemes in manet: a survey

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Abstract

Mobile ad-hoc networks (MANETS) are infrastructure less networks and the topology of this network is always changing. The nodes can enter and leave the network at any time. These networks require a high security in communication, as its application demands so. Effective key management is the only technique, which can implement to secure the nodes in communication. In adhocnetworks there is no central controller or router such as in wired network. This will make this network more vulnerable to attack. The intruders can easily enter the net-work and can manipulate the contents easily. Traditional key management schemes will not fit for this type of networks. This article, discuss various key management schemes based on routing protocols in mobile ad-hoc network (MANET). It also analyses them in terms of the security and applicability.

Keywords: Manet; Key Management; CA; Certificate Chaining;

1. Introduction

Mobile ad-hoc networks are temporary networks with no centralized access point, such as base station, access points etc. The only entity in this network is nodes which are free to move randomly. The nodes can communicate each other within the range, also the node themselves act as routers instead of routers in wired networks. This makes network more vulnerable to attacks. So a proper key management scheme is a major requirement, to achieve integrity, security, robustness etc. If a source node wants to send some messages to the destination, then it has to take the help of intermediate nodes to transfer the message. This intermediate nodes help to relaying the message from source to destination. These kinds of networks are useful in various situations such as emergency rescue operations, military battle field. For e.g. during fire attacks, the building as well as the network will collapse, then it is very difficult to recover also it will take time and cost. In such case the application of ad hoc network arises. This will help the people who are engaged in this rescue operation to setup networks temporarily to manage the team activities. There are various other applications also, which are outside the scope of this paper. In order to achieve security in mobile ad-hoc networks different key management schemes are there. The evaluation of this key management is based on different parameters. One of the important parameter among them is complexity. This paper evaluates three key management schemes with three different routing protocols and their complexity levels.

A description on key management schemes based on three different protocols is discussed in the paper. In section, II elaborates on Diffie-Hellman key exchange, which is the base for all key management schemes [1]. In sections III, IV and V, an effort has been taken to study three different routing based key management schemes, their merits and demerits. Section VI concludes the paper.

2. Diffiehellman key exchange

Diffie Hellman is one of the oldest and basic key management schemes. It is a symmetric key management scheme[1]. If a source node wants to communicate with a destination node, they should share some secret key to ensure the data security. It will assure that an eavesdropper (Eve) can't overhear the communicated message.

In this algorithm eve is considered as a passive attacker, who can only see the message and can't modify it. In this method source and destination can exchange a secret key without Eve can learn it and this key is then used for further communication. The algorithm is as follows

Algorithm 1. Diffie Hellman	
1) Randomly select two large numbers, one prime 'S', and 'G' a prim-	
itive root of P	
2) Users pick private values 'a' and 'b'	
3) Compute values	
$X = G^a \mod S$	
$Y = G^b \mod S$	
4) Values 'X' and 'Y' are exchanged	
5) Compute shared, private key	
$K_a = Y^a \mod S$	
$K_b = X^b \mod S$	
6) Algebraically it can be shown that $Ka = Kb$	

By the above method a secret key agreement is developed between the source and the receiver nodes. The main advantage of this scheme is the fact that the key is not transmitted over the network, it is generated by the nodes themselves. So if an intruder wants the key he has to generate it using the values exchanges by the two nodes. And the probability of finding the key by a third node is very small. This algorithm will work fine for communication be-

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ORIGINAL ARTICLE



Reverse logistics network design: a case of mobile phones and digital cameras

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Abstract The world is producing electrical and electronic waste (e-waste) more than ever before. According to a UN study, between 2009 and 2014, the global annual production of electronic waste has been approximately fixed at 42 million tonnes. The improper and unscientific disposal of e-waste is a big threat to the environment. The purpose of this paper is to develop a mathematical model for the network design of a multi-product, multi-echelon reverse logistics system. Different recovery options such as remanufacturing, repairing and recycling are considered in this study. Based on the residual value of the used product, the returns are graded into two categories-low product residual value (PRV) and high PRV returns. Although the process of grading results in additional grading costs, it assists the decision maker in choosing appropriate recovery option. An integer linear programming formulation is used to model and solve the problem. Two commonly used consumer electronic goods, mobile phones and digital cameras, are considered for validation. The proposed model determines the optimal number and location of different facilities to be established. By way of explicit consideration of the product structure, the analysis is carried out down to the level of components across the different stages of the supply chain. Further, detailed analysis is performed to determine minimum quantities of high PRV returns for a remanufacturing facility to

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be economically viable. The results provide interesting information about the relevance of quantum of products with high PRV on the network design decisions. Also, the results underscore the importance of transportation costs on the overall profitability of the reverse supply chain.

Keywords Reverse logistics · Network design · Product structure · Multi-product · Product residual value · Remanufacturing

1 Introduction

The world is producing electrical and electronic waste (ewaste) more than ever before. According to a UN study, between 2009 and 2014, the global annual production of electronic waste has been approximately fixed at 42 million tonnes with USA producing the largest total amount of e-waste per year at 7.1 million tonnes [1, 2]. The e-waste primarily comprises of used computers, televisions, refrigerators, washing machines, mobile phones, digital cameras and other household appliances. The improper and unscientific disposal of e-waste is a big threat to the environment. Studies conducted in Europe show that every year, one European discards about 15 kg of electrical and electronic equipment with Norway generating the most e-waste per person at 28.3 kg [3]. It is estimated that the average life span of domestic electric equipment is about 7-8 years for television sets, 8-10 years for refrigerators and washing machines and 10-11 years for air conditioners [4]. After their life span, all these products enter into the environment and cause serious environmental hazards, if not handled properly. Most of the developed economies have strict regulations governing the disposal of e-waste. For example, USA follows 'take-back' systems while the European Union has two comprehensive directives:

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3.3.2 Number of research papers per teachers in the Journals notified on UGC website during the last five years

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To Study the Cooling Rate and Influence of Boron Carbide on Mechanical Properties of Aluminium LM13 Matrix B₄C Reinforced Composites

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Abstract

Aluminium Metal Matrix Composites are one of the advanced engineering materials that have been widely used in aerospace and automotive industries due to their excellent mechanical properties. In Aluminium Metal Matrix Composite, aluminium matrix is strengthened by reinforcing it with hard ceramic particles like Sic, Al_2O_3 , and B_4C etc. Aluminium Metal Matrix Composite was manufactured by sand casting process with Aluminium-LM13 grade as base metal and boron carbide as reinforcement. This study investigates the cooling rate and influence of boron carbide on mechanical properties of Aluminium Metal Matrix Composites. Experiments were performed by casting of Aluminium Metal Matrix Composites with varying the weight Percentage of boron carbide from 3% to 9% and cooling rate is measured using k type thermocouple at point 1mm away from the mold cavity.In order to investigate the influence of boron carbide on mechanical properties microstructure analysis, tensile tests, hardness tests were conducted. Results showed that mechanical properties of Aluminium Metal Matrix Composite were improved with Percentage of boron carbide.

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Keywords: Aluminium Metal Matrix Composites, Influence of boron carbide, Mechanical properties, Aluminium-LM13

1. Introduction

Aluminium Metal Matrix Composites are widely used in automotive and aircraft industries because of their excellent mechanical properties [1, 2-3]. Increased use of Aluminium Metal Matrix Composite create a need for

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Investigation on the effects of low-temperature anodic bonding and its reliability for MEMS packaging using destructive and non-destructive techniques

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Abstract Excellence in the performance of MEMS-based devices such as RF switches, microfluidics, and pressure sensors are well known and by now reported. Operations of these devices are very sensitive to the environmental factors such as contamination, humidity, vibrations etc. Thus, the integration of these micro-devices with the real-life systems could be challenging without a hermetic sealing. A very common practice for these sealing is to bond a recessed cap onto a micromachined wafer using low-temperature wafer bonding mechanism known as anodic bonding or hightemperature sealing techniques such as fusion bonding for vacuum packages. Considering the limit of high-temperature bonding due to thin-film metals like nickel and gold present on the wafer and the induced bow associated with this high-temperature, this paper reveals a devising electrode designed that successfully bonded the samples at a reduced temperature well below at 250 °C. The reliability and effects of this low-temperature bonding between the silicon and Pyrex glass using destructive and non-destructive mechanisms have been investigated in this paper. The tensile strength measurements indicated a superior bonding strength of 14.12 MPa for the sample bonded at 250 °C. The induced bow height reduced from 30.3 µm (at 450 °C) to 0.3 µm (at 250 °C) meaning a significant reduction of bow up to 80.2%. Elemental composition was studied at the interface using

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energy dispersive X-ray spectroscopy (EDAX). To evaluate the bond quality, infra-red (IR) imaging was performed on the bonded sample pair. The interfaces were examined and analysed by scanning electron microscopy (SEM). Finally, we implemented this technique for a MEMS based pressure sensor application to prove the feasibility of low-temperature anodic bonding.

1 Introduction

Adhesion between two materials without an intermediate layer (may be a thin film, resin or glue) has always fascinated the research community and the packaging industry. People wondered the magical process that happens during bonding and went running for this quest of knowledge. History articulates that, Galileo Galilei (1564-1642) was one such person who was in this hunt and postulated that two plane polished surfaces would adhere to each other whereas two rough surfaces would not. He believed that the vacuum between the surfaces was the driving force for this adhesion [1]. From the past to present, the power of knowledge, wisdom, visualization and practice, made public to bring best amoung these processes. The advancement in technology tools like elastic recoil detection analysis (ERDA), nuclear magnetic resonance (NMR), X-Ray diffraction (XRD), glass techniques, scanning electron microscopy (SEM), atomic force microscopy (AFM), energy dispersive spectroscopy (EDS), Transmission electron microscopy (TEM), ultrasonic testing system (UTS), Secondary ion mass spectroscopy (SIMS), optical microscopy (OM), tensile stress measurement techniques and finite element simulation have accelerated the study of bonding interface to its pinnacle [2-15].

Now, wafer bonding has become an integral part of optoelectronics, micro/nano-electronics, and micro-electro







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Influence of heat Treatment and aging process on LM13 Aluminium Alloy Cast Sections: An Experimental Study

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Abstract

LM13 Aluminium alloy of variable section sizes have been extensively used in the automotive and aerospace industry. This paper reports the influence of heat Treatment and aging process on the microstructure, mechanical properties of LM13 aluminium alloy sections. Experiment is performed by melting of Aluminium ingot using heat treatment furnace and poured into sand mould cavity of varying section sizes. Microstructure, mechanical properties like hardness, tensile strength and impact strength were measured during as-cast, heat treated and aged condition. ASTM standard B917-01 was followed for heat treatment of LM13 Aluminium Alloy. Cast section was kept at 537^oC for 12 hrs for heat treatment, followed by aging at a temperature of 155^oC for 5 hrs. The result obtained indicates that at as-cast condition, microstructure changes from coarse to fine with decrease in section size. It was also observed that, mechanical properties also improve with decrease in section size. At heat treated and aged condition, it was observed that almost similar microstructure was observed. Further, the mechanical properties were improved when compared to as-cast condition and variation is irrespective to section size.

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Keywords: heat treatment, Mechanical properties, Aluminium-LM13, Cast section

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Optimization of Drilling Characteristics using Grey-Fuzzy logic in Glass Fiber Reinforced Polymer (GFRP)

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Abstract

Now-a-days drilling became one of the most important machining processes used for joining of Glass Fiber Reinforced Polymer (GFRP) composite. Machining of composite need great attention due to phenomena like delamination and cutting edge failure. In present work, optimization of process parameters in drilling of GFRP was conducted by using grey relational analysis linked with fuzzy logic system. Drilling experiment designed on the basis of $L27(3^{13})$ orthogonal array with cutting speed, feed rate and drill diameter as input parameters with multiple characteristic of Delamination factor(DF) and Surface Roughness (Ra and Rz) as response. Grey-fuzzy logic combination is used to determine the grey –fuzzy reasoning grade to find out the optimum combination of process parameters. ANOVA results indicate that feed rate is the most significant parameter which affect the multiple performance of Delamination Factor (DF) and surface Roughness (Ra and Rz). The optimum process parameter combinations are evaluated by conducting conformation test.

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Keywords: Glass Fiber Reinforced Polymers (GFRPs), Grey-fuzzy logic, Delamination Factor, surface Roughness

1. Introduction

Glass Fiber Reinforced Polymers (GFRPs) find application in the construction of Automobile and aircraft body parts and components because of its strength, durability and resistance to corrosion. The main parameters which are influencing the drilling of the Glass Fiber Reinforced Polymers (GFRPs) are identified as Delamination Factor and

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A novel image processing approach for finding the bubble count in neutron dosimeter

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Abstract

The bubble detector is used to detect the amount of neutron and hence used to measure the neutron dose under intense gamma field. It can be used to monitor radioactive exposure. The number of nucleated bubbles yields the neutron dose. Hence the accuracy of the measurement depends on the counting of bubbles. This work proposes an image processing based technique to increase the accuracy in finding the number of bubbles in the bubble detector.

It is carried out by using watershed and region growing based segmentation. The image processing segmentation techniques shade the digital image of bubble detector into various segments from which the number of bubbles in the bubble detector is detected.

Keywords: Region growing segmentation, Watershed segmentation, Neutron dosimeter, Bubble detector, Neutron dose.

Introduction

In this nuclear era, various technologies that apply nuclear science have popped up for different applications. These range from power production to radiotherapy. In these applications, there is a natural urge for controlled or minimal exposure of neutrons. The modern world is prone to radio hazards. Hence the calibration of neutron dose which is exposed is very much essential. By calibration we can check whether the radioactive exposure is in safe levels and if not, it is possible to take immediate steps to prevent unforeseen impacts⁸. For this, various appliances have been developed to give the neutron level².

A bubble detector is considered as one of the most preferred neutron detector for measuring neutron dose rate amidst high-intense gamma fields^{3, 4}. From the count of the bubbles in this dosimeter the neutron dose can be detected¹³. The bubbles in this detector are of uniform size and are distributed uniformly throughout the dosimeter. As the visualization of all the generated bubbles in the bubble detectors is not practically feasible, they can be found out by employing various techniques. Image processing is one such field on whose application we can find the bubble count. Image segmentation plays a crucial role in evaluating the image for essential information^{5, 6, 9}. It is used in analysis of an image and deriving a conclusion.

The segmentation techniques are categorized into two groups¹⁰. One group is grounded on discontinuity property of intensities also referred as region based segmentation. And another one is grounded on similarity property of intensities. On the whole, there are many segmentation techniques suitable for various applications; this paper employs watershed based segmentation and region growing segmentation.

Moghaddamzadeh et al¹¹ used a fuzzy based approach on region growing segmentation. Two methods were proposed: one for compression and other for object recognition by using finer and coarse segmentation techniques respectively. Information about edges was used to segment in coarse segmentation process. Fuzzy based criteria have been used to grow the segments and merging pixels with a segment. Each image segment is taken as a fuzzy set and fuzzy operators have been used to handle boundaries.

Tremeau et al¹⁶ proposed usage of region growing and merging for segmentation. Color similarity and spatial proximity were taken as criteria for region growing process. After the region growing process, region merging process has been carried out to merge regions having color similarity. This work portrays region growing as more appropriate when compared to clustering and thresholding approaches. To measure color homogeneity, they use three criteria: local homogeneity, average homogeneity and second average homogeneity criteria. This approach combines local parameters as well as global parameters to get a non-partitioned segmentation for processing regions that have similar colors.

The work of Senthilkumar et al¹⁴ proposes a methodology for detecting breast cancer by using region growing segmentation of mammograms. The methodology uses a cloud model to recognize automatic segmentation. Preprocessing has been carried out using selective median filter and the enhancement of image has been done by CLAHE (Contrast Limited Adaptive Histogram Equalization) methods. The region growing method have provided with good segmentation results and when combined with the above said techniques, identification of cancer area has been achieved with 93% accuracy.

The study by Ng et al¹² used K-Means clustering algorithm and improved watershed algorithm for image segmentation. The watershed algorithm provides complete division of images. An unsupervised learning has been carried out by www.czasopisma.pan.pl

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OPTIMIZATION OF DRILLING PROCESS PARAMETERS VIA TAGUCHI, TOPSIS AND RSA TECHNIQUES

Carbon Fiber Reinforced Polymer (CFRP) is the most preferred composite material due to its high strength, high modulus, corrosion resistance and rigidity and which has wide applications in aerospace engineering, automobile sector, sports instrumentation, light trucks, airframes. This paper is an attempt to carry out drilling experiments as per Taguchi's L_{27} (3¹³) orthogonal array on CFRP under dry condition with three different drill bit type (HSS, TiAlN and TiN). In this research work Response Surface Analysis (RSA) is used to correlate the effect of process parameters (cutting speed and feed rate) on thrust force, torque, vibration and surface roughness. This paper also focuses on determining the optimum combination of input process parameter and the drill bit type that produces quality holes in CFRP composite laminate using Multi-objective Taguchi technique and TOPSIS. The percentage of contribution, influence of process parameters and adequacy of the second order regression model is carried out by analysis of variance (ANOVA). The results of experimental investigation demonstrates that feed rate is the pre-dominate factor which affects the response variables.

Keywords: CFRP, Taguchi, TOPSIS, RSA, Vibration, Optimization

1. Introduction

Carbon Fiber Reinforced Polymer (CFRP) is well-known for their extraordinarily high strength, high modulus, corrosion resistance and rigidity. Carbon fibers reinforced with epoxy resin usually find very good application because of their strength and stiffness combination. The CFRPs are superior to steel and glass fiber reinforced polymer (GFRP) with respect to specific tensile strength and specific elastic modulus. CFRPs with their positive characteristics are mostly used in applications like aerospace engineering, automobile sector, sports instrumentation, industrial sector, shafts etc. Joining of composite structures is an unavoidable process in many applications; hence the quality of the machined hole plays a vital role on it. During drilling of CFRPs several problems like fuzzing, fiber-pullout, fiber breakage, delamination, debonding of fiber/matrix etc., occurs due to its anisotropic and non-homogeneity nature of structures. Conventional method of drilling remains at top priority in lieu of its mechanical/thermal properties and also the cost and quality of the manufactured goods.

Arul et al. [1] proposed a new technique by inducing vibration in the direction of feed, there by reduces thrust force and improves the quality of drilled holes. Ramesh et al. [2] have worked on multiple performance characteristics of drilling process parameters using Grey Relational Analysis (GRA), TOPSIS and Response Surface Methodology (RSM). The adequacy of the developed model is validated by means of ANOVA. Quality holes can be drilled on bi-directional CFRP composites using TiN-SC tool. Since TiN-SC exhibits lower thrust force, surface roughness of the drilled holes improves considerably [3]. Kurt et al. [4] performed an experimental investigation with three different drilling tools on hole quality and surface roughness in drilling of Al 2024 in dry condition. Taguchi technique is successfully used to optimize the machining process parameters. Grilo et al. [5] studied the influence of drill geometry and optimize the process parameters in drilling of CFRP using three different drill bits with the aim of reducing the delamination and increasing the production rate. Tsao and Hocheng [6] conducted an experimental survey of thrust force and surface roughness models in drilling of CFRP. Correlation between the machining process parameter and the responses are obtained by neural network and regression analysis. Sheth and George [7] investigated the effect of machining process parameters during drilling of Wrought Cast Steel Grade B (WCB) on cylindricity and perpendicularity. Taguchi L_{27} (3¹³) orthogonal array is used for the experimental design and the significance of process parameters is evaluated by ANOVA. Nouari et al. [8] analyzed the influence of input process parameters in drilling aluminium alloy on tool life and hole quality. They have recommended using reduced web thickness, increasing the helix and point angle to optimal drill geometry. Feed rate and drill type are the significant factors which affect thrust force while feed rate and cutting speed contributes more to the total variation of torque [9]. Neseli [10] investigated the effect of

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Multi-Objective Optimization of Machining Parameters during Dry Turning of 11SMn30 Free Cutting Steel Using Grey Relational Analysis

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Abstract

This study aims at investigating the influence of the machining parameters, such as cutting speed, feed and depth of cut on the output parameters (surface roughness and material removal rate) during dry turning operation of 11SMn30, free cutting steel. The tool used was WIDIA CNMG 120408-49-TN 2000 tool. L_{27} orthogonal array design of experiments was adopted to carry out the experimental study at three different cutting speeds (80,160 and 240 m/min), feed rates (0.1, 0.2 and 0.4 mm/rev) and depth of cut (0.5, 1 and 1.5mm). Grey relational analysis was conducted to quantify the influence of the machining parameters on the output responses, and the optimum combination of these parameters was found out. The confirmation tests are conducted at optimum cutting conditions. The predicted results are found to be closer to experimental results.

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Keywords: 11SMn30 Free cutting steel, dry turning, surface roughness, material removal rate, Grey relational analysis

1. Introduction

Machining is an essential finishing process by which jobs of desired dimensions and required surface finish are produced by the removal of excess material from a blank in the form of chips. This is done with the help of cutting tools moved past the work piece.

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Experiments in LEENA facility with modified wire type leak detector layout in large sodium pipelines



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ABSTRACT

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Keywords: Fast Breeder Reactors Sodium leak Leak detectors Conductivity Test section Modified leak detector layout Simulator hole Leak rate Detection time Sodium cooled Fast Breeder Reactors (SFRs) are envisaged in the second phase of Indian nuclear power programme. Liquid sodium is used as the coolant in the SFRs due to its favourable nuclear properties and excellent heat transfer properties. Leaks in sodium systems have the potential of being exceptionally hazardous due to the reaction of liquid sodium with oxygen and water vapour in the air. When a sodium leak occurs, the sodium leak rate, the total quantity of sodium leaked and leak detector layout governs the detection time. Other factors to be considered are insulation material packing condition, distance between the leak point and detector, heater layout, pipe geometry, temperature etc. Potential regions of leakage in Fast Breeder Reactor (FBR) sodium circuits are near welds, high stress areas and regions subjected to thermal striping. Early detection of leak is needed for minimizing the quantity of sodium leaked to outside and consequent damages. Three wire type leak detectors (WLDs positioned at 90°, 180° and 270°) working on conductivity principle are used for detecting sodium leak in the large horizontal secondary sodium pipelines of Prototype Fast Breeder Reactor (PFBR). It was found from the upper boundary curve based on LEENA (LEak Experiments in NAtrium) facility experimental results with present PFBR leak detector layout, that a leak rate of 200 g/h and above can be detected within 6 h. To improve the detection capability, modified leak detector layout was proposed for FBR 800 NB size horizontal secondary circuit pipelines of FBR with seven WLDs positioned at 45°, 90°, 135°, 180°, 225°, 270° and 315° by taking top of pipeline as 0°. It is required to assess the performance of wire type leak detectors along with its layout on large horizontal sodium pipelines and confirm that they are meeting the requirements. LEENA facility was re-commissioned and five sodium leak experiments with modified leak detector layout on large horizontal pipeline were conducted with different sodium leak rates. From the experimental data it was observed that there was considerable reduction in detection time with modified WLD layout. This is due to the reduction in distance between leak point and leak detector (Reduced from 0.63 m to 0.31 m). From the experiments it was found that a leak rate of 200 g/h can be detected in one hour.

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1. Introduction

Sodium cooled Fast Breeder Reactors (SFRs) are envisaged in the second phase of Indian nuclear power programme. Liquid sodium is used as the coolant in the SFRs due to its favourable nuclear properties and excellent heat transfer properties. Leaks in sodium systems have the potential of being exceptionally hazardous due to the reaction of liquid sodium with oxygen and water vapour in the air. It also reacts with concrete releasing hydrogen and leading to damage and loss of strength of concrete structures. In advanced Gen IV SFRs, for public acceptance, main objective is to

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http://dx.doi.org/10.1016/j.anucene.2017.01.033 0306-4549/© 2017 Elsevier Ltd. All rights reserved. ensure the safety of the reactor. Wire type leak detectors (WLD) working on conductivity principle, are used for detecting sodium leak in the secondary sodium circuits of Prototype Fast Breeder Reactor (PFBR). Early detection of leak is needed for minimizing the quantity of sodium leaked to outside and consequent damages. Potential regions of leakage in Fast Breeder Reactor (FBR) sodium circuits are near welds, high stress areas and regions subjected to thermal striping. Leaking sodium catches fire depending on its temperature. Even though all measures are taken to prevent sodium leak during design, fabrication, quality assurance, operation and maintenance, the possibility of a sodium leak cannot be completely ruled out. Different types of leak detectors are used for detecting sodium leak in single wall pipelines, double wall pipelines, tanks and components in FBR. Wire type leak detectors

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Hydraulic characteristics of a fast reactor fuel subassembly: An experimental investigation



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ABSTRACT

Fuel subassemblies of a fast reactor consist of fuel pin bundle with helically wound spacer wires, arranged in a triangular pitch within a hexagonal wrapper. The fuel pins are located within the subassembly. Further the subassembly comprises of a diffuser where the cross section changes from cylindrical to hexagonal, mixing plenum before the exit of pin bundle and a specially designed blockage adapter. Accurate assessment of the pressure drop in the fuel subassembly is essential to ensure adequate core cooling and design of sodium pump. Experimental determination of pressure drop characteristics in the subassembly by simulating the hydraulic condition in the subassemblies of the reactor core is considered essential as a better choice as correlations reported in the literature cannot be directly used for all the complex regions present in the subassembly. This is due to the fact that flows in the interconnecting sections are highly under developed. Further, the flow regime in a fuel subassembly varies from laminar (during shutdown heat removal under natural convection) to completely turbulent under full power condition.

To understand the hydraulic characteristics of the 500 MWe Proto type Fast Breeder Reactor (PFBR) fuel subassembly, an experimental facility has been commissioned. Experiments on full scale subassembly with dummy fuel pins have been performed using water as simulant. Experiments have been conducted covering a wide range of Reynolds number encompassing laminar, transition and turbulent regimes. In the rod bundle, no abrupt changes in friction factor were observed when the flow changes from laminar to turbulent. The experimental results have been transposed using Euler number similarity, to determine the pressure drop for sodium flow in the reactor. Possible uncertainties in the experimental data have been quantified. Useful pressure drop correlations have been proposed for various section of the sub-assembly of a fast breeder reactor. Finally the results for fuel pin bundle region are compared with the data reported in the literature and a satisfactory agreement has been observed.

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1. Introduction

The Prototype Fast Breeder Reactor (PFBR) is a 500 MWe pool type sodium cooled reactor which is in its advanced phase of commissioning at Kalpakkam, India. It is designed to have two secondary loops with each loop having one Secondary Sodium Pump (SSP) and two Intermediate Heat Exchangers (IHX). Reactor core comprises of various types of subassemblies resting inside the grid plate sleeves through which primary sodium coolant is fed to all the individual subassemblies by two Primary Sodium Pumps (PSP) operating in parallel. The heat generated in core is transported by primary sodium to the secondary sodium in the Intermediate Heat

http://dx.doi.org/10.1016/j.anucene.2016.12.025 0306-4549/© 2016 Elsevier Ltd. All rights reserved. Exchangers. Finally, the secondary sodium transfers heat to water in the steam generator leading to production of superheated steam to generate power (Chetal et al., 2006). The schematic flow sheet of PFBR is depicted in Fig. 1. The primary circuit of PFBR consists of inner vessel surrounded by main vessel housing grid plate, reactor core, control plug, IHX and pump assembly apart from other components as depicted in Fig. 2. The core consists of various types of subassemblies, viz., fuel, blanket, reflector, storage, shielding etc. A core plan showing all these subassemblies is depicted in Fig. 3. About 90% of the thermal power is generated in fuel region which consists of 181 subassemblies grouped into seven zones based on the flux pattern and the associated flow requirements to get a nearly uniform sodium outlet temperature. The geometrical details of the fuel subassembly are listed in Table 1. The subassembly is complex in geometry having radial entry, axial exit and pin bundle

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An inventory position-based policy for better supply chain performance

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ABSTRACT

This paper proposes an inventory position-based policy, and its performance is assessed in terms of supply chain fill rate, bullwhip effect and total cost of supply chain under different scenarios. The scenarios are developed considering the different levels of supply chain structures, demand patterns, and information sharing strategies. Under each scenario, the performance of the proposed policy is compared with the other inventory position-based policies such as Order-Up-To, Order-Up-To smoothing, (*s*, *S*) and (*s*, *Q*) using spreadsheet-based simulation methodology. The multi-attribute performance comparison, grey relational analysis, shows that the proposed policy is the best compared to other policies tested because of the better performance in supply chain fill rate and order smoothing. The simulation study provides sufficient insights to managers in selecting a suitable inventory policy based on the operating conditions of a supply chain and multiple performance measures.

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Inventory policy; information sharing; simulation; supply chain performance; grey relational analysis

1. Introduction

A Supply Chain (SC) consists of geographically dispersed facilities where raw materials, intermediate products, or finished products are acquired, transformed, stored, or sold as well as transportation links that connect facilities along which products flow. Organizations in a supply chain use inventory policies to manage the flow of goods in the supply chain. Inventory policy details the rules to be followed by the members of a supply chain while taking decisions on "when" and "how much" to order.[1] One of the challenging roles of a manager in an organization within a supply chain is choosing an appropriate inventory policy that provides better performance for the supply chain.[2] The customer order fill rate, bullwhip effect, and inventory cost in a supply chain depend on the inventory policy followed by the members of the supply chain.[3] Order fill rate depends on the availability of inventory for meeting the orders. When the order quantity variability increases, as we move from downstream stage to upstream stage in a supply chain, bullwhip effect can be noticed. The inventory cost is proportional to the inventory carried and shortage quantity.

There are mainly two independent-demand inventory systems viz., periodic review system and continuous review system. In the periodic review system, the inventory position is reviewed at regular intervals (at review periods), and an appropriate quantity is ordered. However, in the continuous review system, reviews are often carried out continuously (after each transaction), and a fixed quantity of the item is ordered when the inventory position reaches the reorder level.[4] Inventory position at a time point shows the net of on-hand, on-order and backorder inventories. That is, Inventory position = (On-hand inventory) + (On-order inventory) -Backorders. On-hand inventory is the quantity immediately available to meet the demand. On-order inventory is the quantity ordered but not yet received and backorders show the demand that is not yet met.[5] Inventory position-based policies consider inventory position for placing the orders (either for order decision or order size determination). The proposed policy is an inventory position-based periodic review type policy. The other inventory position-based policies considered for comparison along with the proposed policy are Order-Up-To (OUT), OUT smoothing (OUTS), (s, S) and (s, Q) where s, S and Q are the reorder level, order-up-to level, and fixed order size, respectively. OUT policy is a "standard periodic review type" [6] and "industrially popular" [7] policy. The ordering procedure of OUT policy causes a large bullwhip effect, and the consequences of this effect on fill rate and cost of the supply chain are detrimental.[8] OUT smoothing policies are suitable for mitigating the bullwhip effect.[9] However, the order smoothing policies have poor customer fill rate in a supply chain.[8,10] The fill rate of the supply chain is an important performance measure, and the proposed policy takes into account this

Transport phenomena in electrodeionization of cesium from AMP-PAN

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Abstract

Electrodeionization of cesium from cesium sorbed Ammonium molybdophosphate Polyacrylonitrile (AMP-PAN) was investigated by passing eluant through the packed bed of ion exchange resin in an electrodialysis cell. The deionized cesium from the packed bed was recovered in catholyte by migration and in the eluant by convection. Recovery percentage of Cs by migration increased while the recovery by convection decreased with increase in current density from 20 mA/cm² to 40mA/cm². Increased eluant concentration resulted in low migration percentage of cesium. Increased catholyte concentration had negligible effect on total recovery. Apparent diffusion coefficients evaluated using Nernst-Plank relation increased with increase in current density and catholyte concentration while a decreasing trend was observed with increase in eluant concentration.

Keywords; Cesium; AMP-PAN; migration; convection; recovery

1. Introduction

Electrodeionization (EDI) process is a combined technique of electrodialysis and ion exchange used for the treatment of dilute heavy/transition metals. It has proven to be a successful method for the production of ultrapure water [1, 2] since its first application for the treatment of dilute radioactive waste by Glueckauf [3].

In conventional EDI, dilute metal solutions are treated by injecting continuously through a packed-bed of ion exchange resins inserted between two electrode compartments, separated by ion-selective membranes. Metal cations are sorbed by the resins, and are transported to the



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5th International Conference of Materials Processing and Characterization (ICMPC 2016) Oxidation and Corrosion resistance of AlCoCrFeTiHigh Entropy Alloy

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Abstract

Ability to form simple solid solution contrary to complex phase makes multi-component High Entropy Alloys (HEAs) promising new generation alloys. The present study deals with the oxidation and corrosion resistance of AlCoCrFeTi high entropy alloy synthesized by Mechanical alloying (MA) and consolidated using Spark plasma sintering (SPS). Elements in the alloy system were selected with small size factor to avoid the formation of amorphous phase. Powder diffraction study confirms dissolution of elemental addition into a single phase body centered cubic system. Milled powders were sintered at 900 °C, 45 MPa and with a holding time of 15 min. Spark plasma sintering results in minor traces of face centered cubic phase along with body centered cubic system. Relative density of sintered sample is 98.5%. Thermal stability of the milled powder is analyzed using Differential Scanning Calorimetry. Vickers microhardness test on sintered sample reveals a hardness value of 1074.5 HV. Synthesized alloy exhibits excellent corrosion resistance and linear oxidation kinetics with a very low weight gain.

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Keywords: High entropy alloys, Mechanical alloying, Spark plasma sintering, Micro-hardness, Oxidation resistance, Corrosion resistance;

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The Effect of Fiber Loading on the Mechanical Behaviour of Carbonaramid Hybrid Composites

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SUMMARY

In this emerging world the importance of the research on the material science is increasing because of its wide application in the field of aerospace industry, automotive industry, medical fields, military applications etc.. The hybrid composites give a balanced mechanical properties when compared to conventional composites. Epoxy composites having a different percentage composition of carbon-aramid hybrid fibers are fabricated by vacuum assisted resin transfer molding. The improvements in the mechanical properties at different composition of carbon-aramid hybrid fibers are studied. 30, 35, and 45 are the percentage composition of carbon-aramid hybrid fibers which are used in order to study the variation in the mechanical properties such as tensile strength and hardness.

Keywords: Carbon-aramid hybrid fiber, Tensile testing, Hardness

1. INTRODUCTION

Demand for high strength to weight ratio resulting in the development of composite materials. Fiber reinforced hybrid composite material consists of two or more fibers and they are bound by using a matrix like epoxy resin. Compared to conventional fiber composites the hybrid fiber reinforced composites give better mechanical properties such as high specific modulus, strength, corrosion resistance and in many cases excellent thermal stability. Due to this excellent mechanical properties the composite materials find applications in the aerospace industry, automobile industry, ballistic industry, medical fields etc.

Sathishkumar *et al.*¹ studied the different types of manufacturing process, mechanical properties of hybrid fibers and also about its application in various fields. The main application areas are building and construction field,

storage devices like post boxes, bio gas containers, etc., electric devices, pipes, transportation fields like automobile, railway coach interior, boat, gears etc. Kalaprasad *et al.* have studied the developments in the hybrid fiber reinforced polymeric composites. They concluded that the mechanical properties of hybrid composites rely on the fiber composition, fiber length, fiber orientation, hybrid design etc.

Kretsis² have investigated the fatigue behavior of hybrid composite material in flexural loading. He uses ACA type sandwich arrangement for the manufacturing of hybrid composites. The results prove that the high flexural strength of the hybrid fiber shows higher fatigue stress.

Jang *et al.*³ have studied the response of the hybrid composites on the low velocity impact loading. The results show that polyethylene, PET and Nylon fibers absorb large amount of energy when combined with epoxy resin and it also found that interlaminated hybridization improve the delamination which is a factor for energy absorption.

Aronhime⁴ reported the influence of factors that determining flexuralfatigue behavior of aramid fiber/carbon fiber sandwich hybrid composites and its dependence on strain rate. The results show that the degradation rate for aramid-carbon-aramid type hybrid composites are lower than that of carbon-aramid-carbon type hybrid composites.

Rodriguez *et al.*⁵ studied, the effect of the strain rate on the mechanical properties of aramid and polyethylene woven fabric composites from tensile measurements. Hopkinson bar is used to determine the strain rate. The dynamic Stress strain curve is more linear than static strain curve, which is a function of strain rate. The results show that the tensile strength is increased with the increase in strain rate, whereas failure strength decreases with increase in strain rate.

Bandaru *et al.*⁶ Reported influence of hybridization on the hybrid composite

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The Effect of Fibers Loading on the Mechanical Properties of Carbon Epoxy Composite

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SUMMARY

Carbon fiber reinforced epoxy composites are having greater acceptance in industries as well as for researches and engineers due to the inherent properties. In this paper the change in mechanical properties like tensile strength and hardness are studied by changing the percentage composition of carbon by 30%, 35% and 45% in the carbon epoxy composite. Composite is manufactured by vacuum suction method.

Keywords: Carbon fiber, Tensile strength, Hardness, Flexural strength

1. INTRODUCTION

Recently, the application of carbon fibers composites has been increased in the aerospace industries and automobile industries due to its minimal weight and high strength. These materials are finally fulfilling the promise of providing manufacturers with a costcompetitive alternative to traditional materials while offering higher properties at lower weight, as well as some other unique characteristics. Automobili Lamborghini has been a pioneer in the development of novel carbon fiber technologies, and the only car maker to date that has employed carbon fiber for continuous production vehicles.

G. Agrawall *et al.* reported on increasing the fiber loading from 10 wt.% to 50 wt% the mechanical properties such as tensile strength, flexural strength, inter laminar shear strength, impact strength and hardness increases. Bidirectional carbon fiber reinforced epoxy composites have good tensile strength, inter laminar shear strength, flexural strength and strength at strength and strength at strength and strength at strength

impact strength. Hardness value for short carbon fiber reinforced epoxy composites are higher.

Mayer *et al.* reported that the type of matrix has greater influence on mechanical properties like tensile strength and shear strength rather than the type of carbon fiber arrangement. From the mechanical test conducted it was concluded that carbon fiber epoxy laminates are adequate materials for application in aeronautical industries.

Rahmani *et al.* reported that the tensile and flexural strength was found to be increasing on increasing the ply from three to five. They also reported that the fiber orientation has greater influence in the mechanical properties.

Coronado *et al.* found that stiffness decreases with high and low temperatures. However the materials showed considerable good mechanical properties at 9 degree celcius. During the initiation of fatigue delamination, it was observed that the maximum delamination energy required to

initiate the crack (GIC max) increased with increasing test temperature and decreased significantly after initiation of the crack.

The reported studies on short fiber reinforced composites by different investigators are found to have focused mostly on the strength properties of the composites. Beyerlein et al. have described the influence of fiber shape in short fiber composites. Kari et al. have evaluated numerically the effective material properties of composites with randomly distributed short fibers. Hine et al. have presented a numerical simulation of the effects of fiber length distribution on the elastic and thermoelastic properties of short fiber composites. Fu S.Y et al. have studied the flexural properties of misaligned short fiber reinforced polymers by taking into account the effects of fiber length and fiber orientation.

Mechanical properties of fibrereinforced composites are depending on the properties of the constituent materials (type, quantity, fibre distribution and orientation, void content). Beside those properties, the nature of the interfacial bonds and the mechanisms of load transfer at the interphase also play an important role. This paper studies the effect of

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Evaluation of hydraulic characteristics of core flow monitoring mechanism for PFBR



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ABSTRACT

Sodium flow through the fuel, blanket and storage subassemblies will be measured in Prototype Fast Breeder Reactor (PFBR) by the Core Flow Monitoring Mechanism (CFMM) during its commissioning. CFMM is planned to be placed on the top of the subassembly for the sodium flow measurement. This will monitor the flow allocation through different sub-assemblies and will infer flow blockage in subassembly if any. A portion of the sodium flowing through the subassembly will flow through the CFMM and the rest will flow through the lateral safety flow path provided at the subassembly top. The sodium flow through the subassembly top The sodium flow through the subassembly top option and CFMM was established by experiments in water medium. It is estimated that 58.5% of the coolant flow passes through the CFMM for measuring sodium flow through fuel subassemblies and the rest passes through the lateral holes in the subassembly head. In case of measurement of flow through the blanket and storage subassemblies, 52% of the coolant passes through CFMM and the rest passes through the lateral holes. The data obtained from the water experiments were used to validate the numerical model of the same. This paper gives the details of the experimental and numerical studies carried out to characterize the core flow monitoring device for PFBR.

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1. Introduction

Prototype Fast Breeder Reactor is a liquid sodium cooled, pool type fast breeder reactor with 500 MWe nominal capacity (Chetal et al., 2006). The reactor is in advanced stage of construction at

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http://dx.doi.org/10.1016/j.anucene.2016.11.018 0306-4549/© 2016 Elsevier Ltd. All rights reserved. Kalpakkam, India. Compact size of reactor core and high linear power rating of the fuel pins are the main characteristics of the Fast Breeder Reactor core. This demands very effective core cooling system to remove the heat from the core. Liquid sodium is selected as the coolant for PFBR due to its lower moderating properties and preferable heat transport properties. The heat produced in the reactor core is transferred to the pool of sodium in the reactor vessel i.e., to primary sodium. The heat from the primary sodium is





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Optimization of Micro-Drilling Parameters by Taguchi Grey Relational Analysis

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Abstract

The study behind this paper is in finding out optimization on drilling the Carbon Fiber Reinforced Polymer (CFRP), using various drill bits of diameter 0.7 mm, 0.8 mm and 0.9 mm by the Taguchi Grey Relational analysis (TGRA). For the Microdrilling experiment, the input process parameters selected are spindle speed, feed rate and drill diameter. The experiments are carried out by the Taguchi's L₂₇ orthogonal array design. The experiments are conducted to optimize the machining condition and simultaneously minimize the Delamination factor and maximize the Material Removal Rate (MRR). The values which are obtained from the experiment are optimized by the Taguchi Grey Relational Analysis (TGRA). The influence of process parameter on the response is identified using ANOVA. The Grey Relational Analysis coupled with Taguchi simplifies the optimization of machining process with multiple performance characteristics for improving the quality of the drilled holes.

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Keywords: Drilling, Optimization; CFRP composites; Grey relational analysis; Delamination factor; Taguchi method.

1. Introduction

Machining is used in the manufacturing of many metal products, it can also be used on materials such as wood, plastic, ceramic and composites. Machining is any of various processes in which a piece of raw material is cut into a desired final shape and size by a controlled material-removal process. It is used directly or indirectly in the manufacture of almost all the goods manufactured in the world.

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Necessary and sufficient condition for modified Nevanlinna-Pick interpolation for closed-loop pole placement

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 Department of Electrical and Electronics Engineering, Hindustan Institute of Technology and Science, Chennai, TN, 603103 India Received 17 January 2016; revised 31 August 2016; accepted 2 September 2016

Abstract

Nevanlinna-Pick interpolation theory has sevaral applications, in particular in robust control. In this paper, we derive necessary and sufficient condition so that a modification of the Nevanlinna-Pick theory can place the closed-loop poles inside a circular region in the left half of the complex plane in addition to the control system design being robust and internally stable. Numerical examples illustrate the theory.

Keywords: Interpolation, pole assignment, robustness, sensitivity, uncertainty

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1 Introduction

The Nevanlinna-Pick interpolation problem was originally proposed by Pick in 1916 [1] and independently by Nevanlinna in 1919 [2]. The classical Nevanlinna-Pick interpolation problem is to find (if one exists) an analytic function $f : D \rightarrow \overline{D}$ such that $f(a_i) = b_i, a_i \in$ $D, b_i \in \overline{D}, i = 1, 2, ..., q$, where D and \overline{D} correspond to open and closed unit disks in the complex plane respectively. An interpolating function $f(\cdot)$ exists if and only if the matrix, $N = \left\lceil \frac{1 - b_i \overline{b}_j}{1 - a_i \overline{a}_i} \right\rceil_{i,j=1,2,...,q}$ is positive semidefinite. The bar above the symbol stands for its complex conjugate. The Nevanlinna-Pick problem has found numerous applications in model approximation, robust stabilization [3, 4], model matching problem [5], circuit theory [6], etc.

Khargonekar and Tannenbaum [3] proposed a modification of the classical Nevanlinna-Pick interpolation problem to find an analytic function $f(a_i) = \alpha b_i$, $a_i \in D$, $b_i \in \mathbb{C}$, i = 1, 2, ..., q and $\alpha > 0$ in \mathbb{R} and \mathbb{C} is the complex plane. The function $f(\cdot)$ exists if and only if $\alpha \leq \alpha_{\max}$, where $\alpha_{\max} = \frac{1}{\sqrt{\lambda_{\max}}}$ and λ_{\max} is the largest

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Multi-period reverse logistics network design with emission cost

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Abstract

Purpose – The purpose of this paper is to develop a mathematical model for the network design of a reverse supply chain in a multi-product, multi-period environment. The emission cost due to transportation activities is incorporated into the model to reduce the total cost of emission and study the significance of inclusion of emission cost on the network design decisions.

Design/methodology/approach – Mixed integer linear programming formulation is used to model the network. The developed model is solved and analysed using the commercial solver LINGO.

Findings – The mathematical model provides a unified design of the network for the entire planning horizon comprising of different periods. A reduction in the total cost of emission is achieved. The analysis of the problem environment shows that the network design decisions significantly vary with the consideration of emission cost.

Research limitations/implications – A single mode of transportation is considered in this study. Also, a single type of vehicle is considered for the transportation purpose.

Practical implications – The developed model can aid the decision makers in making better decisions while reducing the total emission cost. The quantification of the emission cost due to transportation activities is presented in an Indian context and can be used for future studies.

Originality/value – An all-encompassing approach for the design of reverse logistics networks with explicit consideration of product structure and emission cost.

Keywords Transportation decisions, Supply chain management, Reverse logistics

Paper type Research paper

1. Introduction

In recent years, the concept of reverse logistics has gained significant attention in both academia and practice, due to a variety of reasons, especially, those pertaining to environmental concerns. Another motive is the economic potential associated with the used products and the resulting business options. There are many firms such as Dell, GM, HP. Kodak, Xerox (Üster et al., 2007), ReCellular Inc. (Guide and Wassenhove, 2001) and third party logistics providers such as FedEx, ASTRA and GENCO (Krumwiede and Sheu, 2002). which recognize the importance of reverse logistics activities. Activities in a typical reverse supply chain include collection, testing or inspection, separation, reprocessing and redistribution (Hanafi et al., 2008). Around the world, the sales of many electronic items are growing at a fast pace. For example, Euromonitor International's estimate in 2010 shows that between 2004 and 2009, portable computers sold in Australia rose from about 2.53 million to 3.88 million units, an increase of about 35 per cent (Rahman and Subramanian, 2012). After its useful life, these products require a proper disposal, without which it may pose a serious threat to the environment. This is not only the case for computer industry, but also for other products such as refrigerators, mobile phones, automobiles, etc. The management of returned products is an arduous task as it requires special logistics



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Multi-period reverse logistics network design

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Process Capability Analysis and Optimization in Turning of 11sMn30 Alloy

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Abstract

This article depicts the optimization of the three prominent turning process parameters, cutting speed, fede rate and depth of cut respectively for obtaining better process capability index(Cpk) of turning operation performed on the 11SMn30 alloy using carbide tool in dry condition.Surface roughness (Ra and Rz) is the output parameter identified in the study to optimize the process capability index(Cpk). The influence of various input parameters of the turning process and their impact on determining the process capability were studied by adopting Taguchi approach. The surface roughness values (Ra and Rz) are optimised individually for optimizing the input machining parameters with the objective of identifying the optimum cutting speed, feed rate and depth of cut which can maximize the turning process capability. The ANOVA result reveals that the feed rate and cutting speed have equal significance in determining the surface roughness (Ra and Rz).

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Keywords: Turning, Surface Roughness, Taguchi Method, Process Capability, Optimization

1. Introduction

Many researchers are in the process of identifying the various methods for optimising the input machining parameters which indicates the significance of the machining process optimization in different industrial sectors involved in manufacturing of goods and services.

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Optimization of Drilling Characteristics using Grey Relational Analysis (GRA) in Glass Fiber Reinforced Polymer (GFRP)

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Abstract

Glass Fiber Reinforced Polymers (GFRP) are widely used composite in the arena of automobile and aircraft body fabrication. Aim of this paper is to optimizedrilling parameters for GFRP with multi-objective of Delamination Factor (DF) and Surface Roughness (Ra and Rz) using Grey Relational Analysis (GRA) and Taguchi method. The drilling experiment is designed using Taguchi L $_{27}$ (3¹³) orthogonal array with cutting speed, feed rate and drill diameter as the input factors at three different levels. The ANOVA result reveals that the cutting speed is the most significant process parameter which influences the Delamination Factor (DF) and Surface Roughness (Ra and Rz) respectively.

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Keywords:GFRP, Grey Relations, Drilling Parameter Optimization, Surface Finish, Delamination Factor;

1. Introduction

Glass Fiber Reinforced Polymers (GFRPs) is widely used in automotive and aircraft industries because of their excellent properties like lightweight, strength and corrosion resistance. Increased use of Glass Fiber Reinforced Polymers in various applications demands a need for deep understanding of their machining parameters. Machining of composite is difficult due to phenomena like delamination and cutting edge failure. Henceoptimization of machining parameters have great importance in machining of composites. Drilling is the process of countersinking a hole on the surface of a work material, and it is one of the most important cutting process and unavoidable process in composite joining. Tool geometry and cutting parameters are the most important factors which determine the quality of machining process [1].Nowadays machining of composite mainly focused on drilling process[2].

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An enhanced model for reliable deflection routing in mesh network on chip

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Abstract: Massive integration of processing cores into a finite chip area increases the possibility of damage and failure of various chip components. Issues and solutions related to reliable on chip communication is of great importance in this context. On chip routers play a vital role in routing packets through the NoC. In this paper, we propose a new fault tolerant routing model for NoCs using deflection routing mechanism. This model intelligently utilises fault-free unidirectional links between the routers to forward flits to their destinations in a few number of hops. These links are activated at regular time intervals so that they serve as alternate productive paths for flits which are delayed due to faults in their computed routes. We also present a routing algorithm that exploits the path diversity in the network generated by the enhanced model. From experimental analysis, we obtain significant improvement in the network performance parameters like flit latency, deflection rate and dynamic energy dissipation across router links for the proposed model compared to the state-of-the-art fault tolerant routing methods in NoC.

Keywords: network on chip; fault tolerant routing; deflection routing; average latency; dynamic link energy; enhanced model; reliability; fault rate; output port allocation; buffer-less router; link fault; active input/ouput ports

Reference to this paper should be made as follows: Sleeba, S.Z. and Mini, M.G. (2017) 'An enhanced model for reliable deflection routing in mesh network on chip', *Int. J. High Performance Systems Architecture*, Vol. 7, No. 2, pp.87–97.

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M.G. Mini received her BTech in Electronics and Communication Engineering from the Kerala University, MTech in Digital Electronics and PhD in Image Processing from the Cochin University of Science and Technology, India. She is presently working as the Principal of College of Engineering, Cherthala, Kerala, South India. Her research interests include low power MPSoC design, network on chip architectures and digital image processing.

1 Introduction

With the advancements in semiconductor process technology, more numbers of processing cores are being integrated onto a single chip. Multiprocessor system on chips (MPSoC) with enormous computing power are packed with 100s and 1,000s of computing cores (Bell et al., 2008; Taylor et al., 2004). The highly parallel and distributed computation power of these chips demand efficient inter-processor communication fabric. Integrated circuits with few number of processors use bus based on chip communication. Global wire delay is a major issue with bus based systems when used in large multicore systems; hence, they are replaced by packet switched network on chips (NoC) (Nychis et al., 2010). Features of NoCs such as scalability and modularity make them the most suitable communication medium inside chips that demand high performance and bandwidth (Dally and Towles, 2001).



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3.3.2 Number of research papers per teachers in the Journals notified on UGC website during the last five years

2016 - 2017



Numerical Simulation of Miniature Mutual Inductance Type Leak Detector for FBTR

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ABSTRACT

Early detection of water or steam leaks into sodium in the steam generator units of liquid-metalcooled fast breeder reactors is an important requirement from safety and economic considerations. Among the various methods used worldwide, one widely accepted technique is monitoring the increase in the hydrogen concentration in sodium. The increase in hydrogen concentration is due to the dissolution of the hydrogen produced during the process of sodium-water reaction. Thus any increase of H₂ from the stabilised background value indicates a leak in the steam generator. A nickel-diffuser-based instrumentation has been installed in Fast Breeder Test Reactor (FBTR) at Kalpakkam, India, to detect the hydrogen concentration in liquid sodium. Any failure of nickel diffuser can make the whole system unavailable and hence it is required to be detected. This paper details the optimisation of design parameters for the development of a miniature mutual inductance type leak detector for the detection of sodium leak resulting from failure/rupture of nickel diffuser tubes.

KEYWORDS

Eddy currents; FBTR; mutual inductance type leak detector; Nickel diffuser hydrogen monitoring; SG leak; Sodium leak; Steam generator

1. INTRODUCTION

The Fast Breeder Test Reactor (FBTR) is a fast breeder reactor located at Kalpakkam, India, designed to produce 40 MW of thermal power. The reactor uses a plutoniumuranium mixed carbide fuel and liquid sodium as coolant. Two parallel hydraulically coupled primary sodium loops transfer the heat generated in the reactor core to the corresponding secondary sodium loops through intermediate heat exchangeras as shown in Figure 1. Each secondary sodium loop is provided with two once-through steam generator (SG) modules. High-pressure water/ steam flows on tube side at 14 MPa at a temperature of up to 500 °C, whereas the sodium flows on the shell side at 0.3 MPa. Water will leak into sodium in case of any leak in the SG tube due to any defect resulting in sodium-water reaction. [1] For safe and reliable operation, detection of leak at initial stage is highly required.

2. FBTR STEAM GENERATOR

SG is a liquid metal heated, once through counterflow heat exchanger in which sodium flows through shell side and water/steam through tube side. There are two SG modules connected in parallel in each loop [2]. Each module consists of a shell of ϕ 177.7/193.7 mm and seven tubes of ϕ 25.7/33.7 mm as shown in Figure 2. The length of each module is around 90 m and is in the form of \circ 2016 IETE

three S shapes. The once-through type SG is selected to limit the water inventory available for reaction, if any, in case of a tube failure. Depending on the leak size, extensive damage can occur in case of a leak of water to the sodium side in SG. Any water/steam leak into sodium has to be detected at the incipient stage and corrective action taken immediately [3]. The water leak into sodium in SG is detected by a very sensitive sputter ionpump-based Steam Generator Leak Detection System (SGLDS) by measuring hydrogen in sodium.

3. METHODOLOGY OF SG LEAK DETECTION

The hydrogen concentration in sodium measured in a sampling line taken at the outlet of SG represents the hydrogen dissolved in the sodium stream. Sodium drawn from the sampling line is heated to a temperature of 723 K and allowed to pass through a set of thin-walled nickel tubes. These nickel tubes act as the diffuser and permeate hydrogen into a vacuum chamber [4]. Nickel tube assembly is called diffuser and it allows diffusion of hydrogen from sodium to vacuum side. Because of the partial pressure gradient formed, the hydrogen in sodium diffuses through the nickel diffuser and enters the vacuum side of the meter. The sputter ion pump kept connected in the vacuum side of nickel diffuser monitors the ingress of hydrogen from the sodium and

Defluoridation of water by chemical impregnated Artocarpus hirsutus sawdust

P. Dhanasekaran, P. M. Satya Sai, C. Anandbabu and K. K. Rajan

ABSTRACT

Sawdust of *Artocarpus hirsutus* impregnated with ferric hydroxide and activated alumina (SFAA) has been studied for defluoridation of water. This paper presents a detailed surface characterization of the adsorbent by studying pore size distribution and surface morphology. By combining the constituents in the right proportion, an adsorbent with a well-developed pore size distribution could be synthesized. The effects of various parameters on fluoride adsorption by SFAA are investigated. The adsorption capacity of SFAA is considerably higher than that of many adsorbents including activated alumina. More importantly, the adsorption capacity remains unchanged for the pH range of 1 to 9, which also makes it attractive for wastewater treatment. Besides a higher efficiency supported by the results of column studies, this adsorbent is economic as the sawdust constitutes 40% by weight of the total adsorbent. Kinetic studies indicate that fluoride adsorption on SFAA follows pseudo second-order model. Breakthrough adsorption capacity of SFAA is 1.21 mg/g, as compared with 0.41 mg/g for activated alumina.

Key words | adsorption, biosorbent, fluoride, fluorosis, sawdust

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INTRODUCTION

Fluorine occurs in nature in the form of fluorides in a number of minerals and accounts for about 0.3 g/kg of the Earth's crust. Weathering events along with volcanic and fumarolic processes, contribute to the rise in fluoride levels of groundwater. High fluoride concentrations in groundwater occur in large parts of Africa, China, Sri Lanka and India (Meenakshi & Maheshwari 2006). In India, Andhra Pradesh, Tamil Nadu, Karnataka, Kerala, Rajasthan, Gujarat, Uttar Pradesh, Punjab, Orissa and Jammu Kashmir have been reported to contain high fluoride levels in groundwater (Alagumuthu & Rajan 2010a). As prescribed by the World Health Organization (WHO), the maximum permissible limit for fluoride level in drinking water is 1.5 mg/L. Consumption of water with higher fluoride concentrations causes fluorosis, dental fluorosis in particular. Fluoride levels above 10 mg/L in drinking water cause skeletal fluorosis (WHO 2011).

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Chemically fluoride ion is a hard base, exhibiting strong affinity towards metal ions, including Al^{3+} and Fe^{3+} (Wu *et al.* 2007; Chen *et al.* 2011). Consequently chemical additive methods, contact precipitation techniques and adsorption/ ion exchange methods are reported to remove fluorides in water. Among these, adsorption is considered to be a fast, efficient and inexpensive method of defluoridation. Numerous adsorbents have been reported for the defluoridation of aqueous solutions (Bhatnagar *et al.* 2011). Of these, activated alumina based compounds have been extensively studied for the adsorption of fluoride from aqueous solutions (Shimelis *et al.* 2006; Goswami & Purkait 2012). Use of amorphous Fe/Al mixed hydroxides for fluoride adsorption from aqueous solutions was studied by Sujana *et al.* (2009).

Many researchers have investigated the use of natural and low-cost materials such as pure chitosan, chitosan with iron (Viswanathan & Meenakshi 2008; Viswanathan

Ultrasonic Technique for Vibration Measurements on PFBR Fuel Subassemblies

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Abstract

Prototype Fast Breeder Reactor (PFBR) is a 500 MWe liquid metal cooled fast breeder reactor under construction at Kalpakkam, India. The core of PFBR consists of 1758 subassemblies supported at the bottom on the grid plate sleeves. Liquid sodium is used as the coolant and it flows axially from bottom of the subassembly to top and it is in highly turbulent regime. This turbulent flow can excite flow-induced vibration of fuel subassembly which can cause failure of the fuel pin clad tubes from fatigue, wear and vibration induced fretting. Excessive vibration of fuel subassembly can also results in reactivity noise, fatigue or rattling.

Flow induced vibration studies of dummy fuel subassemblies in water were conducted in subassembly test facility and the design was qualified for PFBR. However it is planned to measure the amplitude and frequency of vibration during pre-commissioning tests of PFBR. Measurements are planned during the isothermal run of PFBR at 200°C with dummy subassemblies loaded in the core. Since measurement has to be carried out in high temperature sodium environment, non-contact measurement technique using ultrasound waves was developed and a device named SONAR was manufactured for PFBR. Extensive testing was carried out to assess the performance of the device for reactor application. This paper discusses the details of the FIV measurements on PFBR fuel subassemblies, details of ultrasonic technique and SONAR device, its testing and results and conclusion.

Keywords: PFBR, Subassembly, Vibration, Sonar, Ultrasonic technique

1 Introduction

Prototype Fast Breeder Reactor (PFBR) is a 500 MWe sodium cooled fast breeder reactor under construction at Kalpakkam, India. It is a techno-commercial demonstrator and the fore-runner of a series of FBRs planned in India. The core of PFBR consists of 1758 subassemblies vertically supported on the grid plate. Out of the core subassemblies, 181 are fuel subassemblies which hold the fuel material in position^[1]. Coolant sodium flows axially from the bottom of the subassembly to top and is in turbulent regime, in order to increase the heat transfer performance. As the subassemblies are free standing and supported only at the bottom, it is prone to Flow Induced Vibrations (FIV), which can result in the failure of the fuel clad tubes from fatigue, wear and vibration induced fretting^[2]. Excessive vibration of fuel subassemblies may also lead to reactivity fluctuations.

FIV studies were carried out on PFBR fuel subassembly in a water test rig to determine the amplitude and frequency of vibration. It is also planned to measure subassembly vibrations in PFBR during commissioning. Since it is very difficult to carry out such measurement under sodium at high temperature, using conventional contact type vibration sensors such as accelerometers, strain gages etc non-contact type measurement techniques were investigated. It is planned to measure the subassembly vibration under sodium using ultrasonic technique. Extensive experiments were carried out in various test facilities and a device (SONAR) is designed and manufactured. The prototype device was tested in water and in sodium for assessing its performance. This paper discusses the FIV measurements carried out on PFBR fuel subassemblies, details of ultrasonic technique used and SONAR device, its testing and results and conclusion.

2 Flow Induced Vibration Studies on PFBR Fuel Subassembly

Flow induced vibration studies were carried out on PFBR subassemblies as part of its design qualification for the reactor application^[2]. The entire core subassemblies are supported in the sleeves of grid plate, which acts as the main coolant header. Details of a typical fuel subassembly are shown in Fig. 1. The total height of the subassembly is 4.5 m out of which 3.9 m is above the grid plate. The total coolant flow from the two pumps in the reactor vessel is 7020 kg/s. The flow through the maximum rated fuel subassembly is 36 kg/s. The coolant flow path in PFBR is shown in Fig. 2.

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Experimental studies on acoustic leak detection in steam generators of Fast Breeder Reactor

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In Fast Breeder Reactors, Steam generator (SG) is an important com-Abstract ponent in which water in the tube side exchanges heat with sodium in the shell side producing superheated steam, to generate electricity in turbine. Any defect/crack in the tubes will result in the sodium water reaction, producing hydrogen and other corrosive products and leads to tube damage by corrosion and erosion. The detection of steam/water leaks at the incipient stage is therefore highly important. The detection of the hydrogen in sodium at the steam generator outlet is the method adapted presently in fast reactors which has of slow response because of the transportation delay involved in detection of hydrogen. Steam/water leaks detection based on acoustic technique has gained importance due to its fast response and the capability to locate leaks. Typically, a leak of 1g/s leak rate could be detected in less than 3 sec time. Acoustic leak detection studies were carried out in a test section of Sodium Water Reaction Test Facility (SOWART). Modified 9Cr 1 Mo/nickel tubes (17.2 dia., 2.3 mm thick) leak simulators, having a pinhole were used for injecting steam into sodium. A target tube of Mod 9Cr 1Mo (17.2mm dia and 2.3 mm thick) is fixed into the test section from top in such a way that the reaction jet from the leaking tube hits on the target tube and produces wastage on its surface. Steam at 172 bar was injected into sodium through leak simulator at different leak rates and different sodium and steam temperatures. Experiments were also carried out in Steam Generator test Facility (SGTF). Argon gas at 20bar to 100bar was injected into shell side sodium of model steam generator at different mass flow rates through an orifice of 0.5mm to simulate steam/water leaks. Acoustic noise generated during the experiment was picked up by accelerometers mounted on waveguides welded to the test section. These signals were analyzed in time domain and frequency domain. Studies on signal enhancement by Wavelet transform based signal processing techniques were carried out on the test signals. The results were compared and reported in this paper.

Key words Steam/Water leaks, Steam Generator, Fast Reactor, and Wavelet transforms.

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Design and performance evaluation of Core Flow Monitoring Mechanisms for PFBR



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ABSTRACT

In this paper, the scheme adopted for off-line monitoring of fuel/blanket sub-assemblies, by measuring the coolant flow rate at sub-assembly exit, in a typical sodium cooled fast breeder reactor is presented. In Prototype Fast Breeder Reactor (PFBR), the temperature of sodium exiting from all the fuel sub-assemblies is monitored by core temperature monitoring system for detecting any flow blockage during reactor operation. However, such online monitoring of blanket sub-assembly outlet temperature was not envisaged. Instead, offline monitoring is proposed, which involves measuring the flow rate of sodium exiting from blanket sub-assemblies during re-fuelling of reactor. A flow measuring system is proposed for measuring sodium flow from blanket sub-assemblies. In addition, the sodium flow from Fuel and storage sub-assemblies is also measured during commissioning stage in order to identify any blockage in the hydraulic paths of respective sub-assemblies.

The flow measuring system employs Core Flow Monitoring Mechanism (CFMM) equipped with Eddy Current Flow Sensor (ECFS) for sodium flow measurement. The system needs two CFMMs, one for fuel sub-assemblies and another for blanket and storage sub-assemblies. The necessary experimental studies were carried out for generating data needed for sodium flow estimation and to resolve uncertainties in the design of CFMM. Experimental studies include hydraulic studies and sodium calibration of ECFS. Subsequently, integrated assembly testing of CFMM was carried out to demonstrate the safe operation of the mechanisms before clearing for erection on pile. After successful completion of all the tests, both the CFMM were erected on pile. This paper discusses the detailed design features of CFMM and the developmental activities carried out to qualify the mechanism for reactor use.

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1. Introduction

Prototype Fast Breeder Reactor (PFBR) is a 500 MWe sodium cooled pool type fast reactor with state-of-art safety features. It consists of both inherent safety and engineered safety features to counter any abnormal condition. Core monitoring is one of the important engineered safety features with the objective of detecting any fault and ensuring safety of core. Core monitoring system of PFBR consists of neutron flux monitoring system, failed fuel detection and location system, core temperature monitoring system and core flow monitoring system. These systems ensure at least two diverse scram parameters for almost all events affecting the core.

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As part of core temperature monitoring system, 211 nos. of thermocouples are used to monitor temperatures at outlets of 181 Fuel Sub-assemblies (FSAs) and 30 Blanket Sub-assemblies (BSAs). The requirement for monitoring the temperature at the outlets of these many numbers of sub-assemblies arises from the concern of sub-assembly blockage and consequent fuel melting. Monitoring the temperature at the outlet of all BSAs is not envisaged. Instead, it is planned to measure the coolant flow in BSAs in reactor shutdown state during re-fuelling to identify blockage of sub-assemblies, if any. Since the operating conditions of BSA pins are benign compared to fuel pins and reactivity effects due to blanket slumping and sodium voiding are negative, off-line monitoring is sufficient. After completion of each fuel handling campaign, flow through all freshly loaded BSAs will be measured. In addition, random sampling of some of the BSAs that are in the last campaign of their life will also be done.

Optimisation of thermal baffle for liquid metal injection nozzle

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Abstract: SADHANA is a test facility dedicated for the experimental demonstration of passive safety grade decay heat removal in the prototype fast breeder reactor. Experiments are planned in SADHANA to characterise the behaviour of this system followed by various reactor transients. For simulating the reactor transients of hot pool, cold sodium at 310°C has to be injected to the test vessel of SADHANA at 550°C temperature. Thermal baffle provided in the nozzle of test vessel was optimised to limit the peak local stress. This paper gives the thermo-mechanical studies conducted to optimise the nozzle geometry with thermal baffles.

Keywords: thermal stress; thermal baffle; creep fatigue interaction in nozzle joints; vessel to nozzle junction; sodium heat transfer.

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temperatures of sodium and air. The focus of the study has been to identify conditions that can pose the risk of sodium freezing. [DOI: 10.1115/1.4030730] Keywords: finned tubes, sodium to air heat exchanger, decay heat removal, porous body model, prototype fast breeder reactor

Fast Reactors

Porous Body Model Based

Parametric Study for Sodium

to Air Heat Exchanger Used in

Sodium to air heat exchangers (AHX) with finned tubes is used in fast breeder reactors

for decay heat removal. The aim of decay heat removal is to maintain the fuel, clad, coolant, and structural temperatures within safety limits. To investigate the thermal hydraulic

features of AHX, a robust porous body based computational fluid dynamics (CFD) model

has been developed and validated against the experimental data obtained from a model

AHX of 2 MW capacity in Steam Generator Test Facility at the Indira Gandhi Centre for

Atomic Research, Kalpakkam. In the present paper, the developed porous body model is used to study the sodium and air temperature distribution and the influence of various

parameters that affect the heat removal rate and sodium outlet temperature in full-size

AHX used in the fast breeder reactors. The parameters include mass flow rates and inlet

1 Introduction

Nuclear reactors produce electricity much the same way as a conventional thermal power plant, but differ in the source of heat. The heat produced in the nuclear reactor is mainly by fission of heavy fissile isotopes such as U-235 and Pu-239. The fission of fissile isotopes results in the formation of radioactive fission products. Heat continues to be produced by radioactive decay of fission products even after the reactor shut down and this heat is known as decay heat. When the reactor is shutdown, power drops drastically to about 7% of full power in 1s. Power does not drop to zero because of the radioactive decay of fission products. The decay heat reduces very slowly after about one day when the decay power is already below 1% of the operating power. The decay heat must be removed at the same rate as it is produced to limit the core, coolant, and structural temperatures within design safety limits. The prototype fast breeder reactor (PFBR) is a 1250 MW thermal pool type sodium cooled reactor in an advanced stage of construction at Kalpakkam, India. It has been provided with two diverse and independent paths for decay heat removal. The first one is termed as the operation grade decay heat removal (OGDHR) system which is used when at least one secondary sodium system, steam water system, and off-site power supply are available. The second one is termed as the safety grade decay heat removal (SGDHR) system which is used when the OGDHR system is not available. Each SGDHR circuit consists of a sodium to sodium decay heat exchanger (DHX) dipped in a hot sodium pool and an AHX kept at a higher elevation at the bottom of a tall stack and associated sodium piping (refer to Fig. 1). The DHX picks up heat from the hot sodium pool and transfers the heat to atmospheric air through AHX. Thus, the SGDHR system consists of three coupled natural convection loops. For a realistic understanding of dynamic behavior of these loops, a coupled transient thermal hydraulic model is required. From the limitations of computational time, such a model is usually single dimensional. Development of such a model requires basic understanding of multidimensional behavior of individual systems. In this direction, the present paper is focused toward development of a multidimensional model to understand the steady-state behavior of AHX for a range of intermediate sodium parameters. The decay heat removal capacity of SGDHR system is governed by the performance of AHX. In spite of all the favorable heat transfer properties of sodium, the main drawback of sodium is its high freezing point, viz., 98 °C. With a margin of 50 °C, the sodium temperature into SGDHR system has to be maintained greater than or equal to 150 °C. This margin is required to account for higher freezing point due to the presence of impurities in sodium and local temperature reduction [1]. Hence, it is essential to understand the effect of varying the operating parameters on the heat exchanger performance from the point of view, heat removal capacity, risk of sodium freezing, etc.

A complete numerical simulation of full-size sodium to air finned heat exchanger is formidable due to multiphysics conjugate heat transfer mechanisms, small-scale geometrical features, and large size of the AHX. On the other hand, a porous media based transport equations to a bundle with finned tubes can greatly reduce the computational time [2]. The porous matrix is represented by appropriate porosity, permeability, and form drag coefficient. It is concluded from this study that as long as the macroscopic properties (porosity, permeability, and form drag coefficient) are determined accurately, the results are not very sensitive to the internal structure of the porous matrix. It is also seen that the governing equations are accurate enough to be used instead of pore-scale simulations. A thermal hydraulics evaluation of peripheral fin heat exchanger has been performed by Pussoli et al. [3]. The heat exchanger is modeled based on the theory of

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A Survey on Last level Cache Partitioning **Techniques in Chip Multi-Processors**

Jobin Jose* and N. Ramasubramanian**

ABSTRACT

Chip Multi Processors (CMPs), a new generation of multicore architecture emerged as the base of System on Chip(SoC) paradigm. Multiple processing cores are packed into a single chip here. Each core is capable of executing simple and complex applications in parallel. Memory is being considered as a scarce resource for the application. The multilevel memory hierarchy that involves various levels of caches are being accommodated into the chip in shared/private mode for faster access of data. Of these, the Last Level Cache (LLC) is being shared amongst various processing cores. Multiple applications are accessing the same L2 cache, and thus increases the conflicts in Cache entries and this acts as a source of contention. These applications may produce the destructive interference between cores and at the same time occurs cache misses. This will cause a serious effect on the performance and efficiency in terms of energy of the system. In order to mitigate these problems, the shared LLC is being partitioned amongst the applications. Depending on the cache organization, different schemes are used for partitioning that includes an initial placement and replacement policies that helps to develop a good system which will improve the utilization of cache space. This paper presents a study on various cache partitioning schemes used for the LLC in terms of replacement policy, simulating tools and cache design and analyze in term of performance and found that dynamic way based partitioning techniques performs better in terms of energy.

Keywords: Chip Multi Processors; Multi level memory; Last level cache; LLC; Cache partitioning; Replacement

1. INTRODUCTION

The revolution of multi-core processors has turned into a new direction after the introduction of Chip multiprocessors (CMPs)[1] that solve many disadvantages of uni-processor systems such as scalability, energy and area efficiency. The CMPs improves the throughput and the degree of parallelism at various levels. With the introduction of CMPs, the multi core architecture has moved from desktop computers to embedded systems. Multiple small cores are accommodated in the small die area that makes the CMP more area efficient. The power consumption and the resource sharing via wires are still appears as performance hindrance factors for it. The basic element in the CMP architecture consists of homogeneous or heterogeneous processing element(PE), that includes cores and the on- chip cache memory together. The cores use caches to reduce both the latency in memory accees and traffic. The cache in the system , are shared via properly designed interconnection networks that has organized as shared or private, of which the shared cache provides better performance, as this was accessed by multiple cores. As the number of cores in the multiprocessor system increased, the shared cache has become a source of contention which has increased the memory pressure and thus affects the utilization efficiency. The sharing also causes interference due to multiple accesses by different cores. This often produces a large amount of misses in the system. The private cache is often small in capacity, that can be accommodated as on chip caches which reduces the access latency and provides high utilization. Although the private caches provides good access efficiency, it cannot be used in the environments where high memory is demanded. Due to the wire delays in the inter

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