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Seed Grant-Approval Letters



Academic Year (2021-22)

3.1.2 The institution provides seed money to its teachers for research
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Rheological and thermal properties of honey produced in Algeria and Ethiopia: a review

Kenenisa Dekeba Tafa ^{a*}, Venkatesa Prabhu Sundramurthy^b, and **N. Subramanian^c**

^aDepartment of Food Process Engineering, College of Engineering and Technology, Wolkite University, Wolkite, Ethiopia; ^bDepartment of Chemical Engineering, Addis Ababa Science and Technology University, Addis Ababa, Ethiopia; ^cDepartment of Chemical Engineering, Nandha Engineering College, Erode, Tamil Nadu, India

ABSTRACT

Honey has medicinal benefits due to its substantial nutritional profile, wholesome, sweet, and active ingredient that is used for interdisciplinary purposes in the food industry. Honey quality can be characterized by its engineering properties besides potential functional features, such as antioxidant, antibacterial, and antimicrobial properties. However, there are many problems associated with the design of processes, product, equipment, and process control. Therefore, food engineers, scientists, processors, and beekeepers have a duty to understand the concept of engineering properties and to fix the problems occurred during harvesting, storage, transport, mixing, heating, cooling, refining and pumping honey and honey products. In the case of the future-line work, there are few compressive reviews concerning with engineering properties of honey. However, in the present review, an emphasis has been given to explore the knowledge of some engineering properties of Algerian and Ethiopian honeys, such as viscosity, moisture content, minerals, specific gravity, hydroxymethylfurfural, glass transition, color, degree brix and sugar components.

ARTICLE HISTORY

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KEYWORDS

Honey; physiochemical properties; rheological properties; thermal properties; viscosity

Introduction

Honey is a very nutritious, sweet and viscous food. The nectar of flowers is turned into honey by honeybees. It can be stored for a long time and used as a primary food source and as an ingredient in the preparation of honey-based products.^[1,2] The key components of honey are carbohydrates such as monosaccharaides (glucose and fructose) and oligosaccharides such as sucrose, maltose, melezitose, and raffinose. Pure honey also contains proteins, fat, water, vitamins and minerals. Honey is used as an antioxidant, anti-inflammatory, anti-proliferative, pro-apoptotic, anti-bacterial agent, immune-modulatory and anti-metastatic properties.^[3–6] It is highly nutritious and has prophylactic medicinal benefit. Honey quality can be measured by assessing its engineering properties such as its physiochemical, rheological and thermal properties. Some selected physical properties of honeys are presented in Table 1.

Knowledge of the engineering properties of food materials is essential for the proper design of equipment and processes for handling, storing, processing and distributing food products and transforming them into finished products.^[5,7] In the same way, basic information should be accessible to food engineers, scientists, processors and beekeepers who are urgently in need of it for modeling, equipment and process design, and manufacturers. Engineering properties of food materials are critical to addressing the problems associated with the design of equipment or study of the actions of food products and agricultural processes. The engineering properties of honey can be categorized in rheological, physiochemical, thermal and electrical properties.

CONTACT Kenenisa Dekeba Tafa  barikene21@gmail.com  Corresponding Author: Kenenisa Dekeba Tafa Department of Food Process Engineering, College of Engineering and Technology, Wolkite University, Wolkite, Ethiopia

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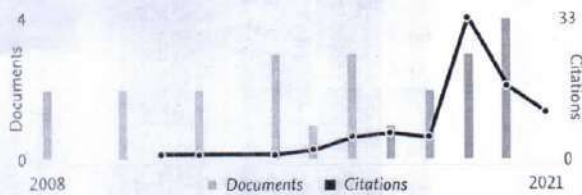
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VLSI Design of a Squaring Architecture based on Yavadunam Sutra of Vedic Mathematics

Deepa, A., Marimuthu, C.N.

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PAPER • OPEN ACCESS

An efficient high speed squaring and multiplier architecture using yavadunam sutra and bit reduction technique

A Deepa¹, C N Marimuthu² and C Murugesan³

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Journal of Physics: Conference Series, Volume 1432, First International Conference on Emerging Electrical Energy, Electronics and Computing Technologies 2019 30–31 October 2019, Melaka, Malaysia

Citation A Deepa *et al* 2020 *J. Phys.: Conf. Ser.* **1432** 012080

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¹ Department of ECE, Assistant Professor, J.K.K.Munirajah College of Technology, Gobi, Erode, Tamil Nadu, India² Department of ECE, Professor and Dean, Nandha Engineering College, Erode, Tamil Nadu, India³ Department of ECE, J.K.K.Munirajah College of Technology, Gobi, Erode, Tamil Nadu, India<https://doi.org/10.1088/1742-6596/1432/1/012080>

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Abstract

Vedic Mathematics, an ancient Indian technique can be used to solve any arithmetic problems in an easy and simple way. A novel high speed Vedic squaring and multiplier unit is designed using the principles of Yavadunam sutra and the bit reduction technique is projected in this paper. The complexity of the multiplier is reduced as the bit reduction technique is employed and later the

This article was prepared using the Yavadunam sutra and the bit reduction technique for the calculation of the efficiency. The size of the proposed N bit multiplier is reduced as the bit reduction technique is employed and later the complexity of the multiplier is reduced as the bit reduction technique is employed and later the

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- 3 Related Work
- 4 Vedic Sutras
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In this digital epoch, the thirst for high speed is fulfilled by the accomplishment of digital multipliers. Multipliers play a fundamental role in many high-speed applications where the complex multiplications are carried out by squaring operations. Vedic Mathematics is a part of Atharva Veda which deals with the easiest methodology for all types of arithmetic calculations. Yavadunam is one of the squaring algorithms of Vedic Mathematics. But currently, there is a lack of implementation hardware for Yavadunam for squaring binary numbers. In this paper, a squaring architecture is designed by implementing Yavadunam

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Mobile Networks and Applications

Cuckoo Search and its Application in Mobile Towers



Authors: C. Murugesan, **C. N. Marimuthu** [Authors Info & Claims](#)

Mobile Networks and Applications, Volume 24, Issue 2 • April 2019 • pp 340–349 • <https://doi.org/10.1007/s11036-018-1046-7>

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Abstract

Nano-grids are a replication of large electricity grids resembling their model but only on a smaller scale to locations that are not accessible easily and the connectivity of grid is not possible. Generally, these are used in remote hilly regions where there can be a renewable source

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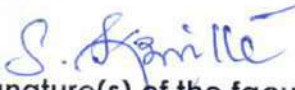
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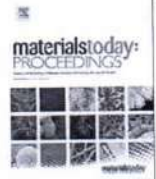

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Ring monopole antenna for Tera-Hertz application

S. Prasad Jones Christydass^{a,*}, J. Suganthi^b, S. Kavitha^c, R. Yuvaraj^d^a Department of Electronics and Communication Engineering, K. Ramakrishnan College of Technology, Trichy, India^b Department of Electronics and Communication Engineering, PES University, Bangalore, India^c Department of Electronics and Communication Engineering, Nandha Engineering College, (Autonomous), Erode, Tamilnadu, India^d Department of Electronics and Communication Engineering, Saveetha School of Engineering, Chennai, India

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ABSTRACT

In this paper, a circular slot microstrip patch antenna is proposed for Tera-Hertz application. The entire structure is developed on a substrate having 4.4 and 0.02 as relative permittivity ϵ_r and loss tangent 0.2 on FR4 substrate. The total size of the proposed antenna is $40 \times 40 \mu\text{m}^2$. The height of the substrate is $1.6 \mu\text{m}$. The proposed antenna has four resonating bands from 2.36 THz to 3.20 THz with the bandwidth of 2.69 THz, 3.92 THz to 5.38 THz with the bandwidth of 4.79, 7.36 THz to 8.70 THz with the bandwidth of 7.95 THz, 12.86 THz to 14.35 THz with the bandwidth of 13.70 THz. The Computer simulation tool an electromagnetic software is used for simulating the entire projected antenna. The simulated results such as return loss, VSWR, surface current, radiation pattern, gain, and directivity are presented. The simulated results show that the presented antenna is the right choice for Tera-Hertz application. © 2020 Elsevier Ltd. All rights reserved.

Selection and peer-review under responsibility of the scientific committee of the International Conference on Advances in Materials Research – 2019.

1. Introduction

In recent times, wireless data traffic is occurring at a higher rate due to changes in the creation, sharing, and consumption of data. By this change, there is a need for the highspeed wireless data transmission anywhere at any time. To overcome this, wireless terabit-per second (Tbps) are used to come within five years for which they could solve the wireless data traffic problems as they could transmit for higher speed. For the short-distance wireless communication, the (0.1 – 10 THz) Tera-Hertz range and sub-THz (0.1 – 0.3 THz) are widely used. THz communication links play a significant role in which very high data rates are transmitted over a short distance. The major disadvantage is small distance and but the transmission data rate will be higher when compared to long range data transmission. One of the significant challenges faced at THz communication frequencies is that very high path loss will be imposed for the more considerable distance. The most important advantage of the THz frequencies is that the antenna size, where they are made to reduce to micrometers (mm). The recogni-

tion of the photonic and semiconductor devices which operate in terahertz made it possible to implement communication devices that operate in the THz band.

Due to the shorter wavelengths of Tera-hertz, it suffers higher free-space loss and attenuation. This can be overcome with the help of antennas with higher gain and directivity. The microstrip patch antenna meets the above requirements because of its low cost, easy fabrication, and installation. In the literature, various types of patch antennas are proposed for the Tera-hertz application. Various types of nanoantenna [1–4] are studied in literature, and most have a complex structure. Metamaterials [5] such as SRR [6] CSRR [7,8], S-shaped, 8 shaped, and omega-shaped resonator [9–11] are the artificial man-made structures that can ably enhance the EM properties of the antenna. The metamaterial has negative permittivity and permeability because of its structure and not based on its constituents.

The microstrip patch antenna is widely used in the THz application in the recent past because of its ease of fabrication and less cost. But the major disadvantage of the microstrip patch antenna is a surface wave, which causes a reduction in bandwidth and gain. Defect ground structures and slotted grounds [12] are widely used in the literature to cover come to the effects of the surface wave. To improve the bandwidth [13], the multilayer substrate is also used,

* Corresponding author.

E-mail address: prasadjones.ece@ktct.ac.in (S. Prasad Jones Christydass).<https://doi.org/10.1016/j.matpr.2020.09.003>

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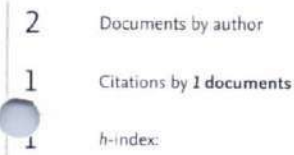
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Computer aided innovation method for detection and classification of cervical cancer using ANFISclassifier

Ponnusamy, S., Samikannu, R., Venkatachary, S.K., Sukumar, S., Ravi, R.

Journal of Ambient Intelligence and Humanized Computing, 2021, 12(6), pp. 6231-6240

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Computer aided innovation method for detection and classification of cervical cancer using ANFIS classifier

Sukumar Ponnusamy¹ · Ravi Samikannu² · Sampath Kumar Venkatachary³ · Sharmila Sukumar⁴ · Rohini Ravi⁵

Received: 18 February 2020 / Accepted: 6 June 2020
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Abstract

Early detection of cervical tumour is very important to minimise deaths due to cervical cancer. Further it provides a deep insight into the anatomical information of the normal and abnormal cervix and helps in planning for a good treatment well in advance. Numerous techniques are used to detect malignancy through image segmentation. One such segmentation technique is discussed here. The proposed technique uses Artificial Neural Network Fuzzy Inference system (ANFIS) and watershed segmentation techniques for image classification and processing and compares the results with known techniques. A comprehensive set of fuzzy rules was used in the experiment to classify abnormal images to the corresponding malignancy. The experiment shows that the proposed technique is feasible and provides greater accuracy in detection of tumour types.

Keywords Cervical cancer · Image classification · Tumour · Fuzzy rules · Neural network

1 Introduction

Cervical malignancy is the abnormal growth of cells in the cervix and can invade other tissues and organs in the body. It is one of the main causes of death in middle-aged ladies across the globe especially in the developing countries which stands at about 80%. However, it is important to understand that, as cervical cancer is slow-progressing, its precancerous sores due to slow progression, provide a great opportunity for prevention and is totally preventable provided the sores are detected early and treated in early stages. As per the World Health Organisation (WHO) 2002 report on cervical cancer, cervical malignancy is the most dangerous disease which affects most middle aged women. Approximating 12% of all cancers in women which affects middle aged women. Accordingly, WHO reports a detection rate of 471,000 new cases in 2001 and an estimated 288,000 die from it every year and was noticed especially between ages 15–44 predominantly.

Cervical cancer is predominant 4th place in all forms of genital cancer in among all the forms of female cancers. Cervical cancer is the 6th leading reason of deaths for middle aged women in the United States. Of the total number is reported or diagnosed cancer cases in developing countries, 75% account for cervical malignancy (Jang 1993). This is primarily due to the fact that most developing countries have no effective detective or screening and preventive

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Performance analysis of clock pulse generators and design of low power area efficient shift register using multiplexer based clock pulse generator

R. Murugasami^a , U.S. Ragupathy^b

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Abstract

Shift registers are the essential elements that are capable of storing and transmitting the data in sequential mode in digital circuits. It consists of D flip-flops, which are connected in a successive manner and share the common clock pulse applied to each Flip-flop. However, the clock distribution network consumes the major portion among the whole power consumption. In this paper a novel clock pulse generation scheme, called as Multiplexer based Clock Pulse Generator (MCPG) is proposed to minimize the power consumption and reduce the silicon area occupation of the shift register by reconstructing the clock distribution network using MCPG. It generates multiple non overlapped clock pulses with minimum power utilization, less area and also resolves the inequality between arrival of clock pulse and data to the consecutive Flip-flops at different time. The proposed clock distribution method reduce area and overall power consumption up to 22% and 31% respectively, compared with shift registers implemented using

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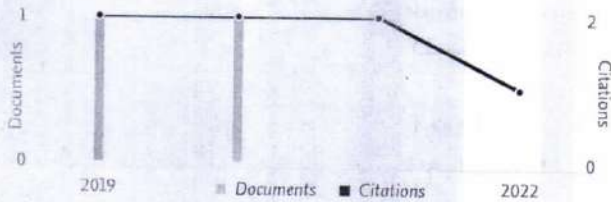
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DACASN: Dynamic ant routing-based channel accessing cognitive sensor network in Internet of Things

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Summary

The Internet of Things (IoT) is a structure with sensors, base station, gateway, and network servers. Users can access the information contained in it and use it as they need. These sensors are embedded in several data collection locations in a uniform or random manner to collect data. The users in many parts of the world obtain such data that fit their requirements. For example, sensors are used in remote areas to monitor various areas such as forests, wildlife sanctuaries, fields, industrial needs, human condition, and changes in the ocean. The changes like these that take place in the open spaces require the selection of the best routing method and seamless delay reduction in data collection helps to immediately reach those involved in it. In the proposed protocol, dynamic ant routing-based channel accessing cognitive sensor network (DACASN) in the IoT, cognitive sensors are used. It is made with the knowledge of choosing a channel for communication as well as selecting the parameters for path selection and setting the most accurate path with the channel knowledge and communicating with the internet server. The sensors set the paths for this route selection using the centrifugal method and the anticolonial method. As a result, it can be seen in the results and discussion section that the quality of the routing information is high because it is delivered to the destination in the shortest possible time.

KEYWORDS

ant IoT routing, centroid IoT path selection, channel selection, cognitive knowledge, sensor networks

1 | INTRODUCTION

Over the last decade, the growth of sensors has been unimaginably high, among which, cognitive sensors establish intelligent communication between the products and the users through the sharing of environmental information globally. The aim of the sensor is to monitor the environment and collect the latest context to notify and alert the users. The sensor is also widely used in smartphones, laptops, and medical applications. Further, its use in many electrical devices and many remote locations is expanding. It can also be used in several applications like Wi-Fi devices, increasing domains, smart technologies, healthcare products, home safety products, and automation equipment. The sensor network is now connected to the internet server and its information is stored in the server's storage area of the server. Figure 1 explains the connection methodology of the sensor network and users through the internet servers.



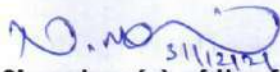
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Certain Investigation on Palm Vein based Authenticating System

Brindha Samarasam¹ and Manikandaprabu Nallasivam²

^{1,2}Nandha Engineering College, Erode, Tamil Nadu, India

ABSTRACT

In recent days, efforts taken on securing data or information is been major field of research. Biometrics doesn't limit in securing data, it also supports in authenticating individuals in financial, banking sectors. Palm vein pattern-based authentication system is one among such securing method. Reliability on biometric security is very much accepted than any other method of guarding data. In this paper, a three-stage process is proposed, which includes, palm vein image enhancement, segmentation and classification. For image enhancement Contrast Limited Adaptive Histogram Equalization was used with Gabor filter. The next level involves mathematical morphological segmentation followed by Support Vector Machine with Radial Basis Function classifier for categorization which supports in authentication. This SVM-RBF classifier achieves 0.0139% of Equal Error Rate which demonstrates as outperforming percentage of result comparatively.

KEY WORDS: VEIN RECOGNITION, SUPPORT VECTOR MACHINE - RADIAL BASIS FUNCTION, GABOR FILTER, GRAY LEVEL CO-OCCURRENCE MATRIX, CONTRAST LIMITED ADAPTIVE HISTOGRAM EQUALIZATION, MATHEMATICAL MORPHOLOGY.

INTRODUCTION

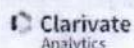
The growing demand for securing and authenticating with finger vein or palm vein supports in various aspects of developing field. Various methods had been proposed for securing the palm vein image patterns obtained as there are issues of spoofing, which leads vulnerable effects. These drawbacks don't limit in depending on the palm vein pattern of authentication. This majorly depends on the principle of Infrared absorption. The IR light passed through Palm penetrates through the vein

and are captured as images by the sensors placed on the opposite side of the palm. These palm vein pattern obtained are unique in nature and thus supports for authenticating and identifying individuals. These images obtained are considered for the process of enhancement as these patterns cannot be counterfeited and duplication of patterns can be avoided. The texture features involving contrast correlation, energy and homogeneity are considered for authenticating the palm vein of human with Support Vector Machine classifier (G. Lalli, et al (2014)).

ARTICLE INFORMATION

*Corresponding Author: brindha.bliss@gmail.com
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2. Literature Survey: Mi Pan et al proposed a comprehensive comparison of three algorithms which includes Scale Invariant Feature Transform, Speeded-Up Robust Features and Affine- Scale Invariant Feature Transform. By histogram equalization the images obtained are preprocessed and the local features are extracted by the

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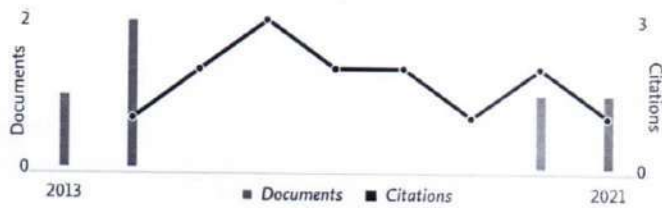
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Moving Human Target Detection and Tracking in Video Frames

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Abstract: The conventional method for moving human target detection and tracking has come across a major setback due to various hindering factors such as environmental lighting conditions, temperature, etc. Similarly, it has been noticed that the manual selection of moving human targets in a video sequence does not provide convincing results either. In this paper, a new method for moving human target detection and tracking is proposed. It involves two stages. The first stage consists in the detection of moving human targets and the second one in target tracking based on the Continuously Adaptive Mean-Shift (CAMShift) algorithm. In the first stage, in order to select the moving target, the background subtraction method and frame subtraction method are combined. The Region Of Interest (ROI), which is usually the moving target is identified. In the second stage, target tracking is performed by choosing a centroid pixel point over the ROI, which is then used by the CAMShift algorithm. The proposed method has shown outperforming results for various performance parameters such as precision, accuracy, recall, and the F1-score under three different lighting conditions. The results obtained also show a reduction in time complexity in comparison with the state-of-the-art algorithms.

Keywords: Background subtraction, Frame subtraction, CAMShift algorithm, Target detection, Target tracking.

1. Introduction

Surveillance video systems are being increasingly used for everyday security. Surveillance cameras are available with various resolutions. The frame rate of each camera differs based on the resolution. Usually, the frame rate for a camera of average quality (1280 x 720) is around 30 fps. In an automated video surveillance system, moving target detection and tracking of dynamic circumstances remains a challenging task. For the detection of a moving target, a fixed background model is necessary, from which the foreground moving target can be extracted.

On the other hand, the foreground moving target may be extracted based on various features such as color, shape, edges, texture, etc. Trainable classifiers play a major part in automated systems and have proved to work efficiently in target detection with recorded video databases (Rahmaniar, Wang & Chen, 2019). The major drawback of the trainable classifiers is that the computational time for processing each frame exceeds the average frame rate of a camera (Guerrero-Ibáñez, Zeadally & Contreras-Castillo, 2018). Similarly, the application of a deep learning algorithm for this type of problem has become too expensive due to the need for a dedicated Graphical Processing Unit (GPU), and the database framing time and training time are also high when compared with the proposed algorithm (Algabri & Choi, 2020; Dou, Qin, & Tu, 2019).

These drawbacks are avoided by designing a simple, efficient algorithm for live monitoring in the automated surveillance system.

This paper is organized as follows. Section 2 presents the related works. Section 3 sets forth, the target detection process using background subtraction and frame subtraction methods. Section 4 describes the target tracking process using the CAMShift algorithm. Section 5 includes the experimental analysis and the related results. Finally, the conclusion is presented in Section 6.

2. Related work

Akli et al. (2021) proposed an active contour-based moving object detection and Kalman filter-based tracking with camera motion compensation. The active contour algorithm detects the exact boundary of the moving object and the detected object was tracked by Kalman filter. The implementation of Smooth Variable Structure Filter (SVSF) improved the robustness in motion estimation. Video stabilization achieved by using a homography matrix, reduces the unwanted camera vibrations, shakes, and motion blur. Similarly, another approach based on the Kalman filter and fusion of multi-resolution features was proposed by (Zhou & Zhang, 2019), it provides a solution for overcoming the shortcomings in the Siamese network. The Kalman filter was used




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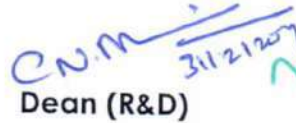
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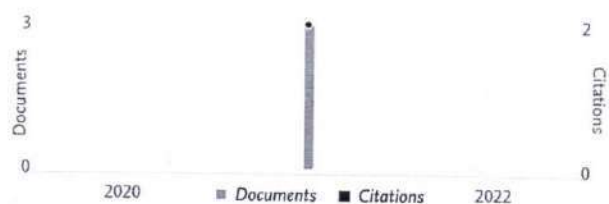
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An Energy Efficient Path Selection Using Swarm Intelligence in IoT SN

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Abstract. IoT is regarded as one of future technology's most important fields and is receiving significant interest from a wide variety of applications. Nowadays, with the emergence of smart objects, the quantity of things that are associated with the web is expanding dramatically. In IoT, there are many critical problems such as scalability, load balancing, tolerance for faults, energy utilization, etc. A few steering conventions have been created to meet the Internet of Things details for various models, for example, energy utilization, load adjusting, multicasting, network life expectancy, unwavering quality, and versatility. Another directing calculation dependent on the insect settlement calculation is proposed to locate the ideal course of information transmission in the IOT. In Swarm Intelligence, Ant-Colony Optimization algorithm is a procedure used to address computational issues that can be utilized to locate an ideal way and subsequently devour less energy. Results of simulation show that the new ant-colony algorithm can successfully saves node energy and broaden the life of the system.

Keywords: Internet of Things, Routing algorithm, Ant-Colony Optimization, energy consumption.

1. Introduction

In a world overwhelmed by computerized advancements, IoT assumes an indispensable part in our lives. It has made an environment that joins numerous frameworks to offer keen exhibitions in each function. The multiplication of the IoT has made a substitution advancement of phones, home and other inserted applications that are totally associated with the web. Presently a-days, the quantity of items being associated with the web is developing quickly, with the appearance of the keen things. For instance, savvy things, for example, sensors are utilized broadly in climate checking and gauging; air contamination observing; environment control of vehicle, mechanical and home cooling; fire checking in smart homes; dampness and water level observing inside the farming; transportation and leaving inside the shrewd urban communities. It's the most fundamental advancement of the 21st century. These systems use a channel to send information





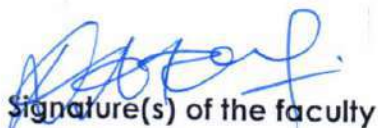
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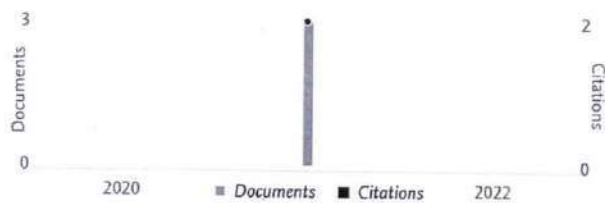
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Trusted cognitive sensor based dual routing network on Internet of things

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Summary

To protect wireless sensor based Internet of things (IoT) networks from internal non-cooperative nodes, developing a reliable method between sensors has proven to be an excellent way in the present investigation. Losses and vulnerabilities in the network can be resolved by examining the activities of the network and then selecting the sensor to which the information is sent, rather than just the communication of the sensor. Most of the existing reliable models consider only the contact nature is this when calculating one-hop reliability. However, this is not enough with different types of attacks. So, the proposed design focuses on developing a communication with a reliable model between sources to destination based on the TCSRN—trusted cognitive sensor based dual routing network on the IoT. Based on this the highest packet delivery ratio and minimum delay are achieved at the end of the communication because of the reliable path selection with dual-path selection method according to one-hop report, endorsement report based reliability and global cumulative reliability based on relations between sensors.

KEYWORDS

cognitive sensor, delay, IoT network, packet delivery ratio, reliable communication

1 | INTRODUCTION

In wireless sensor networks the sensors will track all the areas around them from the network. It can be the temperature of the area, the humidity, the water required for farmland, the information related to the fertilizer, or the noise, pollution in the same place, the details of a patient's health. Informing an end user somewhere far away from such details can help them take immediate action. This network system allows to instantly inform the user of information concerned that is somewhere. This system has the highest number of users and the largest network components. It causes more security problems and then creates a need to explore the authenticity of the construction and to make connections among sensor nodes.

The sensor allows to get instant access to skin-to-skin information of network nodes, as well as information about the location of the most difficult environments in general. The sensors used in the power of phase monitor the amount of power generation and inform the distributors of the details that control them. Similarly, human body monitoring sensors are currently widely used in the medical field. These sensors help to monitor the changes in the human body and send them to the doctor immediately. They detect the properties of water and separate the levels of toxins and minerals from it. This allows the water level to be felt. Pollution in environment, gas leakages and water leakages are communicated to the vendor through an internet service connection. By providing such a wide range of information from a




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Design and implementation of ANN-based SAPF approach for current harmonics mitigation in industrial power systems

M. Karthikeyan^a, **K. Sharmilee^{b, g}**, P.M. Balasubramaniam^c, N.B. Prakash^d, M. Rajesh Babu^e, V. Subramaniaswamy^f, S. Sudhakar^{g, h, i}

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Abstract

This article describes with Shunt Active Power Filter (SAPF) for compensation of reactive Power (P), current harmonics. An ADALINE based neural network current estimator can control the SAPF to maintain sinusoidal source currents and unity Power Factor (PF). The three-phase (III-Phase) load currents are sensed and measured by Least Mean Square(LMS) algorithm based on ADALINE, the weights obtained with the help of online calculation, and then these weights are multiplied with the help of unit vector, which gives the fundamental frequency of Load Currents (LC). The DC link voltage (V) of the V Source Converter, maintained at a constant value, and it can work as the SAPF, and various simulation results are presented under the steady-state conditions using the PI controller. The switching action of VSC is performed using Hysteresis Current Control based on pulse width modulation, which makes the source currents should follow the reference source currents. The MATLAB based simulation results and implementation results are obtained to determine the efficacy of the SAPF with ADALINE based neural network control for load compensation. SAPF system meets

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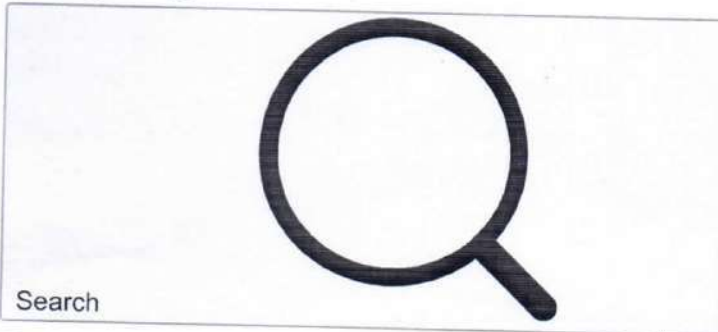
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Abstract

The present research work focused on fabricating Biodegradable Plate (BD plate) composed of rice husk ash, bagasse and corn starch which is harmless to the environment. Mechanical properties such as compressive strength, moisture absorption, solubility and infiltration time were examined in fabricated BD plate. Box–


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Behnken Design (BBD) and ANOVA analysis are employed to optimize the operating parameters includes raw material mix ratio, temperature on the die, pressure during the mixing process and time. Input factors such as temperature varies (80–100 °C), pressure (1–3 bar), time (4–6 min) and Mix ratio (M1, M2 and M3) are coded into the BBD design. Lack of fit test, p and F value of the independent variables are calculated to confirm the significance of the regression model. Maximum compressive strength of 31 kgf is obtained at the optimal process parameters like temperature of 90 °C, pressure of 2 bar, holding time of 6 min and Mix ratio of 2. The developed biodegradable plate serves as the alternative solution for plastic plates such that the developed plate withstands for 30 days free from fungus.

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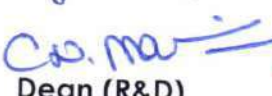
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Journal of Testing and Evaluation

P. Jamuna,¹ G. Ramani,² and K. P. Suresh³

DOI: 10.1520/JTE20200005

Performance Validation of PV
System Incorporated ZSI-
Dynamic Voltage Restorer for
Long-Lasting Power Quality
Improvement


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P. Jamuna,¹ G. Ramani,² and K. P. Suresh³

Performance Validation of PV System Incorporated ZSI-Dynamic Voltage Restorer for Long-Lasting Power Quality Improvement

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P. Jamuna, G. Ramani, and K. P. Suresh, "Performance Validation of PV System Incorporated ZSI-Dynamic Voltage Restorer for Long-Lasting Power Quality Improvement," *Journal of Testing and Evaluation* <https://doi.org/10.1520/JTE20200005>

ABSTRACT

A power distribution system's main challenge is to provide consistent, reliable electricity to fulfill high demand. The incorporation of renewable energy sources into the utility grid system can be accomplished. However, renewable sources are intermittent in nature, and the loads work dynamically and cause imbalances to the system voltage within an immediate time frame. Intermittent renewable sources affect the voltage of the power grid system. Photovoltaic (PV) power generation with Z-source inverter (ZSI)-based dynamic voltage restorer (DVR) is used to avoid negative effects on the voltage. For step-up low direct current (dc) voltage to require alternating current voltage for the compensation of the voltage disturbance, ZSI with an energy storage impedance network is used. dc-dc converters connect the PV cell and the battery storage to the impedance source network. This article also incorporates an improved second-order generalized integrator (I-SOGI) control system for the generation of reference voltage signals. The I-SOGI control reference voltage generation approach greatly improves system performance and decreases the harmonic voltage. The voltage-related problems in the system connected to the utility grid are mitigated with DVR. In different load and source conditions, the PV generation with DVR performance is verified by the experimental prototype.

Keywords

photovoltaic system, Z-source inverter, dynamic voltage restorer, power quality, harmonic distortion

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Implementation of solar PV system unified ZSI-based dynamic voltage restorer with U-SOGI control scheme for power quality improvement

T. Jayakumar^a and Albert Alexander Stonier^b

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ABSTRACT

The main challenge in today's power system is to supply continuous, reliable power and satisfy the high demand. The incorporation of renewable energy sources into the utility grid system can be accomplished. However, the renewable sources are intermittent in nature and the loads work dynamically and cause imbalances to the system voltage within an immediate time. Intermittent renewable sources affect the voltage of the power grid system. Photovoltaic (PV) power generation with Z-source inverter (ZSI)-based dynamic voltage restorer (DVR) is used to avoid that. For step-up low DC voltage to required AC voltage for the compensation of the voltage disturbance, ZSI with the energy storage impedance network is used. DC-DC converters connect the PV cell and the battery storage to the impedance source network. This article also incorporates an upgraded second-order generalized integrator (U-SOGI) control system for the generation of reference voltage signals. The U-SOGI control reference voltage generation approach greatly improves system performance and decreases the harmonic voltage. The voltage-related problems in the system connected to the utility grid are mitigated with DVR. In different load and source conditions, the PV generation with DVR performance is verified by the digital simulation and experimental prototype.

ARTICLE HISTORY

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KEYWORDS

Dynamic voltage restorer; second-order generalized integrator; solar photovoltaic; Z-source inverter; Total harmonic distortion

Nomenclature

PV	photovoltaic
ZSI	Z-source inverter
DVR	dynamic voltage restorer
U-SOGI	upgraded second-order generalized integrator
I_{sc}	short circuit current
V_{oc}	open-circuit voltage
I_{ph}	photocurrent (A)
I_{PV}	PV current (A)
V_{PV}	solar PV voltage (V)
K	Boltzmann constant
I_D	diode saturation current (A)
T_n	PV cell reference temperature (°C)
n	ideality factor of the diode
N_s	number of series-connected PV cells
q	electron charge (coulombs)
R_s	series resistance (Ω)
$V_{Cd}^*, V_{Cq}^*, V_{Co}^*$	reference compensation voltage in $dq0$ reference frame
$V_{Ca}^*, V_{Cb}^*, V_{Cc}^*$	reference compensation voltage in abc reference frame
PCC	point of Common Coupling
FPGA	field-programmable-gate-array

R-L	resistive-inductive
K_p, K_i, K_d	proportional, integral and derivative gains

1. Introduction

The electricity demand for loads has increased every day in India, due to technological advancement, population growth, and industry growth. The incorporation of renewable sources into the existing electrical energy system will meet demand. With the introduction of renewable sources incorporated into the present energy system, the deficit in demand is decreasing every year. Both isolated and grid-connected electrical networks, wind and solar power sources play a significant role. In contrast to other sources of renewable energy, PV incorporation plays a vital role in the electrical distribution system. Nevertheless, solar energy has an intermittent nature and affects both the grid and the reactive load [1]. Due to its intermittent existence, PV power does not provide a continuous power supply [2]. With the introduction of battery storage systems, the intermediation issue is avoided. The combination of these energy sources provides versatile energy and satisfies the necessary long-term peak demand. In the

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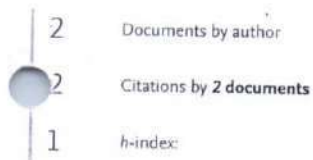
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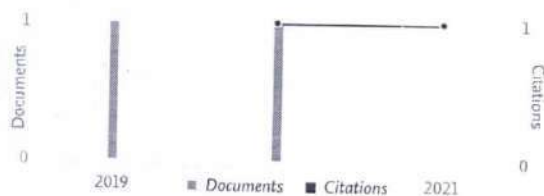
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SMART FARMING FIELD OBSERVATION USING EMBEDDED SYSTEMS

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Associate Professor, Department of Electronics and Communication Engineering,
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Associate Professor, Department of Electronics and Communication Engineering,
Holy Mary Institute of Technology & Science, Hyderabad, India.

ABSTRACT

Farming gives as one of the monetary strong establishment to most of the provincial India. Dominant part of the individuals in rustic spots set up their own homesteads for their job. The ordinary strategies that they use require a great deal of human work and devour vitality. There is no perfect water system strategy for every single climate condition, soil structures and assortment of yield societies. In view of absence of information in the progression of innovation, numerous multiple times they endure an incredible misfortune because of abrupt change in climate conditions, absence of gracefully of water or abundance flexibly of water just as the utilization of composts and deficient funding to purchase apparatus.

This research work proposes an embedded framework based farming field observing plan that create and execute the utilization of various sensors embedded to an AVR microcontroller. The sensors joined are temperature, soil moisture and rain detector sensors. In light of the state of the soil detected by the soil moisture sensor and the state of rain, it turns ON/OFF the siphon for flexibly of water to the field. LCD is utilized to show the state of field gave by the different sensors. This framework is relied upon to permit the ranchers in assessing the soil conditions through which it can lessen the undesirable use of water and permitting appropriate yield of harvests just as decreasing human work.



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IoT Based Moisture Control and Temperature Monitoring In Smart Farming

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Elango Sengottaiyan⁴, Prabu Mani⁴, D T Kalavathi⁵, and V Gowrishankar⁶

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Abstract. The Internet of Things (IoT) has made a revolution in all the fields of human life by making the work be smart and effective. The IoT devices like sensors, controller, Wi-Fi module and the cloud play a significant part in smart farming which acquires yield in the field of farming and lessens the wastage. The goal of this paper is to propose the IoT based framework for the farmers by analyzing the live information like (moisture, temperature) in the cloud. The agrarian device is equipped with Arduino innovation and can be received through web servers with different sensors and live information transmissions through Thingspeak.com. The smart agriculture stick is proposed through this paper which is integrated with controller, sensor and live data that can be monitored through the cloud.

Keywords: IoT; Wi-Fi Module; Microcontroller; Agriculture; Sensors; Moisture; Temperatur.

1. Introduction

A greenhouse is a building or a house for plant growth. The dimensions of this structure range from small sheds to industrial buildings, depending on the unit requirements. The heat sink is a miniature house or a mini greenhouse. The greenhouses offer better control over the growing climate of the plants due to their smaller size. They allow the user to change or use them for small research purposes. Adjustable key factors, depending on the technical specifications of the greenhouse, include temperature, sun, shade, intensity, drainage, fertilizer and soil, and humidity. Greenhouses are valuable for solving scarcity or low productivity due to crop characteristics which include limited growing seasons and poor light, thereby increasing peripheral food production and saving time. Cash management technology is rapidly demanding precise, accurate and reliably quantifiable details outlined with the advancement of greenhouse gardening. In some nations, cable contact was used in most of the current cash management schemes, and the management states were also in the process of replacing other cables. This included high costs as well as problems with installation and maintenance,



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Microstructural, Mechanical and Wear Properties of Friction Stir Welded AA6061/AlN_p Composite Joints

B. Ashok Kumar¹, I. Dinaharan, and N. Murugan

Submitted: 28 October 2020 / Revised: 25 July 2021 / Accepted: 12 August 2021

Friction stir welding (FSW) process is an appropriate welding process to successfully join the aluminum matrix composites (AMCs) reinforced with ceramic particles. In this study, AA6061 AMCs reinforced with 10 and 20 weight percentages of aluminum nitride particles (AlN_p) were welded by FSW process. The effect of FSW on microstructure, microhardness and tensile strength of AA6061/AlN_p composite joints as well as wear behavior of the weld zone (WZ) was analyzed. It was found that reinforcement particles were broken and fragmented in the weld zone of FS-welded composite joints. Microhardness of the weld zone was higher compared to other metallurgical zones. Average microhardness at the WZ of AA6061/20 wt.% AlN_p composite was 134 HV which is 36% higher than that of its base composite. It was observed that grain size of the AA6061 matrix was refined at the WZ. Average grain size of AA6061 alloy was 138 μm which was reduced to 3.8 μm at the WZ of AA6061/20 wt.% of AlN_p composite joint. Around 90% of the particles size in the WZ was reduced to less than 5 μm from the relatively large size existed in the base composite. Ultimate tensile strength of FS-welded AA6061 alloy was 151 MPa which increased to 231 MPa in FS-welded AA6061/20 wt.% AlN_p composite joint. Wear rate of FS-welded composite joints was less than that of its corresponding base composites under the same wear testing conditions. Average coefficient of friction at the WZ of FS-welded AA6061 alloy and AA6061/10 and 20 wt.% AlN_p was found to be 0.41, 0.33 and 0.22, respectively. Wear mechanism of FS-welded joint was characterized to be abrasive.

Keywords aluminum matrix composite, AlN particle, friction stir welding, tensile strength

1. Introduction

Aluminum matrix composites (AMCs) reinforced with particulate form of ceramic reinforcements are extensively employed in various engineering applications because AMCs exhibit superior mechanical and tribological properties at room and elevated temperature. However, it is necessary to develop a welding procedure for AMCs to achieve widespread industrial applications because fabrication of virtually any complex structure requires joining of its components. Both conventional and modern fusion welding processes were applied to join AMCs by several researchers (Ref 1-4). Unfortunately, joints made by fusion welding processes possess many defects and were not suitable to serve its purposes (Ref 5-7). The problems are attributed to heating of aluminum matrix above its melting point during fusion welding process. Thus, it is essential to develop a procedure to weld AMCs without affecting its superior properties so that AMCs can be efficiently employed in various critical engineering applications.

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Solid state welding process is an appropriate process for joining AMCs to avoid the above said problems. Among various solid state welding processes, friction stir welding (FSW) is a low energy, autogenous, hot shear, green technology that is most suitable for joining AMCs (Ref 8). As the quality of joints made by FSW process under optimized process condition is almost compatible with base composite (Ref 9, 10), it is currently employed in ship building industries, aerospace applications and so on where there is no compromise in weld quality (Ref 11, 12).

Dinaharan and Murugan (Ref 13) studied the influence of tool rotational speed, welding speed and axial force on tensile strength on AA6061/10 wt.% ZrB₂ composite joints. The maximum tensile strength was obtained with tool rotational speed of 1155 rpm, welding speed of 48.8 mm/min and axial force of 5.9 kN. Defects were found in the joints produced on either side of these parameter values. These patterns were further confirmed by few other researchers (Ref 14-16). In addition to tool rotational speed, welding speed and axial force, FSW tool geometry is another significant process parameter to influence the material flow and joint properties (Ref 17).

Faradonbeh et al. (Ref 18) investigated the effect of different tool pin profiles (viz., cylindrical, triangular, square and hexagonal), tool transverse and rotational speed on the microstructure and mechanical properties of FS-welded Al-2 vol.% B₄C composite which was fabricated by accumulative roll bonding process. The joint made with square profile pin revealed better microhardness and tensile strength as B₄C particle dispersion in the weld zone was homogeneous and finest in size. Elangovan and Balasubramanian (Ref 19) studied the influence of tool pin profile and tool shoulder diameter on joint strength of FS-welded AA6061 alloy of thickness 6 mm. They reported that the 18 mm shoulder diameter made defect free welds regardless of pin profiles. Similarly, the joints made

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Experimental studies on viscosity, thermal and tribological properties of vegetable oil (kapok oil) with boric acid as an additive

Shankar, S., Manikandan, M., Raja, G., Priyadarashini, G.S., Pramanik, A.

Micro and Nano Letters, 2021, 16(5), pp. 290–298

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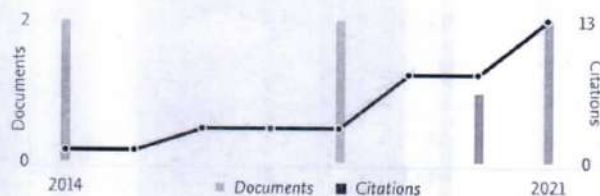
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Experimental investigations of vibration and acoustics signals in milling process using kapok oil as cutting fluid

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Received: 30 September 2019 / Accepted: 27 July 2020

Abstract. Vegetable oils are found as the feasible alternative for conventional minerals oils. There has been many environmental and health issues which are spotted with the use of conventional cutting fluids. There has been a great demand for developing new environmentally friendly vegetable based cutting fluids to reduce these harmful effects. In this present study, vegetable based kapok oil is used as a cutting fluid during milling to study its consequences over other conventional oils. The process parameters such as spindle speed, depth of cut and feed rate were optimized with respect to the flank wear (V_b) and surface roughness (R_a) respectively with the use of central composite design in response surface methodology (RSM). Further an attempt has been made to monitor the tool condition by measuring the cutting force, vibration and sound pressure simultaneously. Three different tool conditions such as dull, fresh and working were analyzed and their consequences were also reported. Also, the performance of the kapok oil is compared with the palm oil and mineral oil (SAE 20W 40). The feed rate has the major contribution for surface roughness and flank wear. It is found that the cutting force (F), sound pressure (p) and vibration (V) increases with the tool wear.

Keywords: Cutting fluids / kapok oil / surface roughness / flank wear / tool condition monitoring / RSM

1 Introduction

Milling is the basic machining process which tends to have high metal removal rate and mostly used for complex machining shapes. Cutting fluids have been used in the machining process to improve the tribological characteristics of the work piece and tool involved [1]. Cutting fluids assists in carrying away the heat produced and debris ejected during machining [2]. These aspects will help to diminish the tool wear and energy consumption during machining [3]. Cutting fluids improves the efficiency of machining process by enhancing tool life, surface finish of the workpiece, reducing cutting force and vibrations. Conventional mineral, synthetic and semi-synthetic cutting fluids involved in the ecological cycle with air, soil and water and their toxicity leads to environmental pollution [4]. Many research works have been undertaken on the application of vegetable based cutting fluids for machining applications and most of them were used as a straight cutting oils [5,6]. It is reported that 320 000 ton per year of metal working fluids were consumed by European Union

alone of which at least two-third need to be disposed as wastage into the environment [7]. The disposal of waste is expensive and also it affects the environment. Cutting fluid processing involves waste treatment as well as pre-treatment. The cost for the treatment of fluid is higher than purchasing of new cutting fluids in most cases [8]. Thus, to reduce the mass usage of conventional mineral oil cutting fluids and also to minimize their effects on environment and operators, several alternatives are being extremely explored such as solid lubricants, dry machining, cryogenic cooling, minimum quantity lubrication (MQL) [9] technique and also by the application of vegetable oils [10–12]. Vegetable based cutting fluids minimizes the health and environmental effects as compared to the petroleum based oils which are biodegradable [13]. They possess good lubrication capability as compared to other conventional oils.

The effect of vegetable based cutting oil on cutting forces and power shows that they were equal or dominant than conventional mineral oil [14]. Vegetable based oils are considered as environmentally friendly because they are renewable, less toxic and holds high biodegradability. The vegetable based cutting fluids have been used for various mechanical processes such as drilling, turning,

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Experimental studies on viscosity, thermal and tribological properties of vegetable oil (kapok oil) with boric acid as an additive

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Abstract

Non-renewability and damage caused to the environment while using mineral based and synthetic based lubricants become the greatest concern of this century. Disposal issues initiated a global trend to utilize vegetable based lubricants in industries. Vegetable oils are environmental friendly, have low toxicity and highly biodegradable in nature. The main objective of this work is to improve the viscosity and reduce the friction and wear rate of Kapok oil using boric acid as an additive. The tribological properties of kapok oil with three different concentrations (1, 3 and 5 wt%) of boric acid is evaluated and compared with pure kapok oil using pin on disc tribometer. The worn out surface of the pin are analyzed using the optical microscope after the wear test. The viscosity and thermal properties of kapok oil with 5 wt% of boric acid possess the better performance compared to other samples. Boric acid particles suspension exhibits reduction in friction and wear when compared with pure kapok oil. Overall, the kapok oil combined with 5 wt% of boric acid acts as the better bio lubricant oil which would help to reduce the global demand of petroleum-based lubricant sustainability.

1 | INTRODUCTION

Generally, lubricant plays a vital role in industrial and as well as in the machine components which are used to reduce the friction between the two contacts surfaces and also used to minimize the heat between the two surfaces [1]. The viscosity of the lubricant has a great influence on the quality of the lubrication of the machine components [2]. The liquid lubricants are classified into three types that is, synthetic, mineral and vegetable oil. The synthetic oil is the chemical composition of the artificial made, is manufactured using the chemical reformation from the petroleum component rather than the complete crude oil. Mineral oils are mostly used in the motor and engine applications, which are also obtained from the petroleum-based crude oil. The mineral oil is harmful to the environment which causes more toxicity and non-biodegradable [3]. The mineral oil lubricants have hydrocarbons which cause those effects and the natural lubricants are obtained from esters [4]. Vegetable oil is mostly an environmental friendly lubricant, easily biodegradable

and non-toxic [5, 6]. Vegetable oil has good lubricant properties but limited in thermal stability and oxidation stability properties [7, 8]. While comparing with the mineral oil, vegetable oil has a high pour point, enhanced better viscosity index, and low evaporation loss [9]. In this work, one such vegetable oil (kapok oil) is considered and its change in properties are studied using boric acid as an additive. The friction and wear rate characteristics of kapok oil possess minimum when compared with mineral oil (SAE 20W 40) and Palm oil [10].


Lot of works were carried out using Nanoparticles and Nanomaterials as an additive with lubricant oil [11, 12]. Depending upon the characteristics of nanoparticles such as size, shape and concentration, the friction and wear between the two contacting surfaces were reduced [13]. The lubricating properties of boric acid (H_3BO_3) were studied which was commercial available in the market and environmentally safe [14]. The environmental protection agency act established that boric acid does not cause any harm or pollution. In order to reduce friction and wear, various additives were added in the lubricating oil [15].

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Investigations on the tribological behaviour, toxicity, and biodegradability of kapok oil bio-lubricant blended with (SAE20W40) mineral oil

S. Shankar , M. Manikandan, D. K. Karupannasamy, C. Jagadeesh, Alokesh Pramanik & Animesh Kumar Basak

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Abstract

Vegetable oil becomes a viable alternative to mineral or synthetic oils due to its biodegradable nature. In this work, one such vegetable-based non-edible oil (kapok oil) is blended with a mineral-based oil (SAE20W40) at 15 and 30% ratio (by volume), and its changes in thermal, tribological, and corrosive properties were evaluated. Four-ball tribometer is utilized to assess its dynamic friction coefficient and the wear scar diameter of the worn out area on the ball. Biodegradability and toxicity test of kapok oil were examined and compared with the palm and mineral oil through bacterial growth and brine shrimp assay methods, respectively. The results showed that the dynamic friction coefficient and specific wear rate of the blended oil were lesser than the mineral oil. The mineral oil produced a higher roughness average (R_a) value than that of the blended oil. Kapok oil shows an adequate tribological properties (anti-friction and anti-wear) in contrast to the other vegetable oils. Overall, kapok oil had a high biodegradability nature and lower toxicity than the mineral oil.


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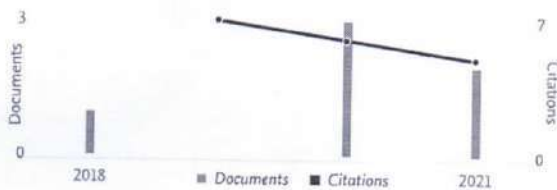
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IOP Conference Series: Materials Science and Engineering, 2021, 1059(1), 012033

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Effects of Temperature and Particles Concentration on the Dynamic Viscosity of Graphene-NiO/Coconut Oil Hybrid Nanofluid: Experimental Study

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International Journal of Nanoscience, 2020, 19(3), 1950016

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Materials Today: Proceedings, 2020, 46, pp. 3845-3847

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Journal of Advanced Research in Dynamical and Control Systems, 2018, 10(12), pp. 533-541

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A Study of Added SiC Powder in Kerosene for the Blind Square Hole Machining of CFRP Using Electrical Discharge Machining

PV Arul Kumar¹ · J. Vivek² · N. Senniangiri³ · S. Nagarajan⁴ · K. Chandrasekaran⁵

Received: 26 March 2021 / Accepted: 28 June 2021
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Abstract

Carbon Fiber Reinforced Polymers (CFRPs) have been applied potentially for various application components owing to their lightweight and better mechanical properties. However, the machining of CFRP has been observed to be poor machinability due to the properties of the CFRP composites. Micro-feature fabricating on CFRP macro-component is a challenging task due to the selection of inadequate process parameters and machines. However, micron-level blind square holes are required in CFRPs for proposing the applications of micro-robotics, micro-vibration measurements, and micro-detection of cracking. These square holes produced on CFRP have the difficult task of being machined using the Electrical Discharge Machining (EDM) process. In this research, the effects of concentration of silicon carbide, pulse duration, duty cycle, and current on squareness, hole depth, and surface roughness of CFRPs are analyzed using Electrical Discharge Machining (EDM) with the square copper electrode. The input parameters, the various percentage of concentration of silicon carbide, pulse duration, duty cycle, and current for EDM are selected. The responses, squareness, hole depth, and surface roughness are considered. Also, an electrode wear length and surface defects have been analyzed. The modeling has been performed for selected responses. Additive Ratio Assessment (ARAS) is used for obtaining optimum parameters. The overall analysis found that the silicon carbide concentration and pulse duration are greatly affected all the responses. Also, the square electrodes produced unstable spark phenomena in the EDM process.

Keywords CFRP · EDM · Silicon carbide · Squareness · Depth

1 Introduction

Carbon Fiber Reinforced Polymers (CFRPs) are used in aerospace, satellite, electronic field, and commercial parts. The reasons for using these CFRPs are low density, high strength, low friction coefficient, high toughness, and good wear resistance. Square holes are required in CFRPs for proposing the applications of micro-robotics, micro-vibration measurements, micro-detection of cracks, micron-level

relative humidity measurements, micron-level - thermal strain measurements, micro - level -temperature measurements, detection of micro - delamination, and micro-fiber optics. Thereby, the square holes were fabricated on CFRP by using EDM [1–3], laser machining [4], mechanical drilling [5, 6], and micro-EDM [7]. Also, the square hole is mostly used in the precision manufacturing sector for manufacturing the micron-level square in the 3D micro-components for microfluid transportation purposes and

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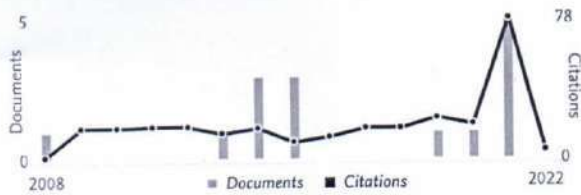
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 Muthukumar, M., Senthil Kumar, A.P., Sasikumar, C., Yuvaraj, S., Singh, T.S.

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Lecture Notes in Mechanical Engineering, 2021, pp. 113-125

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Karthikeyan, M., Karthikeyan, P., Muthukumar, M., ...Jothi, V.R., Sung-ChulYi,

International Journal of Hydrogen Energy, 2020, 45(13), pp. 7863-7872

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Experimental investigation on uniform and zigzag positioned porous inserts on the rib surface of cathode flow channel for performance enhancement in PEMFC

Karthikeyan, P., Vasanth, R.J., Muthukumar, M.

International Journal of Hydrogen Energy, 2015, 40(13), pp. 4641-4648

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Performance improvement of PEM fuel cell with multi-pass serpentine flow channel designs

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Effect of nanoparticles on the droplet combustion of rice bran oil biodiesel

Muthukumar M¹ · Senthil Kumar A P² · Sasikumar C³ · Yuvaraj S⁴ · Thokchom Subhaschandra Singh⁵

Received: 28 September 2020 / Revised: 2 December 2020 / Accepted: 11 December 2020
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Abstract

The present study is dealt with the phenomenon of combustion for rice bran oil (RBO) methyl ester blends with diesel along with nanoparticles of magnesium. Nanoparticles composition of 25 ppm, 50 ppm, and 75 ppm are added to blends of B20, B40, and B60 in the study. A conversion rate of $89.64 \pm 2.8\%$ is observed during the transesterification reaction performed at 5 wt% of potassium hydroxide (KOH) catalyst, 10:1 alcohol to oil ratio (methanol), 75 °C reaction temperature, and 60 min reaction time. During the combustion study, few samples displayed the puffing characteristics, which are caused by popping of bubbles at lower pressure. The summary of the present study suggested that blend B20 with 25 ppm nanoparticles has the potential to be used as fuel and further proposed that the fuel will be more economical if the injection droplet diameter is 0.77 mm. Other blends like B20 with 75 ppm are also likely to be used as fuel due to its exhibition of lesser threat towards combustion. Bubble formation followed by micro-explosion is observed in B60 with 25 ppm blend. The present study hoped to enrich future researchers working in similar area for signifying the importance of understanding droplet combustion of biofuels.

Keywords Droplet combustion · Biodiesel · Rice bran oil · Magnesium · Nanoparticles

Abbreviations

RBO	Rice bran oil	ppm	Parts per million
B20	20% methyl ester with 80% diesel	Al ₂ O ₃	Aluminum oxide
B40	40% methyl ester with 60% diesel	SiO ₂	Silicon dioxide
B60	60% methyl ester with 40% diesel	TiO ₂	Titanium dioxide
KOH	Potassium hydroxide	K	Kelvin
		B	Boron

Highlights

- Rice bran oil (RBO) is transesterified using KOH to produce methyl esters and the conversion rate is achieved to be $89.64 \pm 2.8\%$
- Rice bran oil methyl ester is blended with mineral diesel to produce B20, B40, and B60 blend.
- Magnesium nanoparticles are added to the blend at 25 ppm, 50 ppm, and 75 ppm.
- Droplet combustion study of the fuel mixtures are conducted, and the summary of results are obtained.
- The characteristics of puffing, which are caused by the popping of bubbles at lower pressure are observed in few samples.

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Performance and ecological parameters of a diesel engine fueled with diesel and plastic pyrolyzed oil (PPO) at variable working parameters

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ABSTRACT

Plastics are one of the major pollutants to the environment. An investigation is carried out in converting low density polyethylene (LDPE) to oil by pyrolysis method with the aid of catalyst for the use in internal combustion engines. Experiments were conducted at different speeds (1200, 1500 and 1800 rpm) and variable loads (low, medium and full) with constant compression ratio engine to evaluate the performance and ecological parameters. Plastic pyrolyzed oil (PPO) is blended with diesel fuel in 20:80 volume proportion to get D80P020 blended mixture which is employed in engine in order to assess its characteristics. Encouraging outcomes have been obtained as cylinder pressure in combustion is of same order as that of diesel fueled engine. The results showed that increasing engine speeds resulted in higher cylinder pressure and brake thermal efficiency. Also, high nitrogen oxide (NO_x) and low brake specific energy consumption (BSFC) has been identified. Lower smoke (BSN) and NO_x emissions are noticed from engine tail pipe with D80P020 blended mixture.

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1. Introduction

Diminishing of plastic pollution has been consistently one of the major strategies for many central bodies and climate authorities since last two decades. In the modern society, lack of awareness about the increasing pollution caused by plastics, the general population continues to practise irresponsible dumping to the environment. Although there are various policies adopted for controlling waste, a popular method includes solid waste management through rigorous collection from respective households and correspondingly landfill. This eventually cause pollution of land and contamination to the water and environment. From the various methods of plastic waste handling, pyrolysis technique has been found to be a potential one as this method is able to perform with and without the aid of catalysts. This method transforms left-over plastic to oil (liquid), gases and char (solid residue) with the aid of high temperatures (300–900 °C).

An investigation is carried out to pyrolyze empty fruit bunch (EFB) with activated carbon by utilizing microwave heating. The outcome of this investigation has enhanced bio-oil portion by 36.37 wt. % at 500 °C (Idris et al., 2021).

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The development of fuel cell electric vehicles – A review

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ABSTRACT

The natural petroleum by-product will come into in-existence and unavailable in future. The emission from IC engine vehicles is also a critical problem. So the new technologies depending on electrical powered conveyance are developing. In that way, a fuel cell concept has been introduced for various applications along with electric vehicles. The various efforts are being taken to implement the fuel cell systems in automobiles. Still there is a technological gap in success of such fuel cell electric vehicles due to the problem in handling hydrogen, high cost of battery and fuel cell components, water management etc. In this paper, the type of fuel cell used in automobile, various supporting components and flow diagram of fuel cell systems, the implementation of fuel cell systems in automobiles, the design and development of Fuel Cell Electric Vehicles (FCEV) by various automobile companies are discussed. Further the related issues in FCEV and the methods to improve performance of FCEV are discussed.

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1. Introduction

The fuel cell is producing the electricity. It consists of anode and cathode where the chemical reaction takes place. The basic fuels mainly hydrogen and oxygen are required that produce electric energy with very less amount of pollution. The current produced from the fuel cell is Direct Current (DC). If we require Alternate Current (AC), a conversion device called inverter is required. The fuel cell electric vehicles are having fuel cell system, DC-DC converter, charging system, energy storage device, motor, drive systems and control systems. The battery is used to manage the dynamic response of the vehicle under varying load conditions.

Abbreviations: 4WDEV, four wheel drive electric vehicle; AC, alternate current; APFCT, Asia Pacific fuel cell technology; BEV, battery electric vehicles; cc, cubic centimeter; DC, direct current; SVM-DTC, space vector modulation-direct torque control; EMS, energy management strategy; FC, fuel cell; FCHEV, fuel cell hybrid electric vehicles; FCE, fuel cell engine; FCEV, fuel cell electric vehicles; FCS, fuel cell systems; FES, flywheel energy systems; FCV, fuel cell vehicles; IC, internal combustion; ICE, internal combustion engine; ICEV, internal combustion engine vehicles; PEM, proton exchange membrane; PEMFC, proton exchange membrane fuel cell; PFCEV, plug-in fuel cell electric vehicles; MDIBC, multi-device interleaved boost converter; MHV, Mingdao hydrogen vehicle; UC, ultracapacitor.

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The DC/DC converter is used to convert the output of fuel cell into required voltage and current to supply to battery/motor. Brushless DC motor is used to run the vehicles. As there is no moving part in fuel cells, the noise and heat generations are very less compared to internal combustion engine vehicles (ICEV). A Ragone chart (Fig. 1) is comparing the performance of various energy devices such as fuel cell, battery, SC etc. The fuel cell is having much higher energy density than other types of energy storing devices. As the Energy density of fuel cell is higher than other type energy-storage devices, the fuel cell can be used for long time applications. Due to many advantages, the fuel cell electric vehicles are under developments by various automobile companies and are successfully tested. Even though many advantages are in the fuel cells, due to some practical issues, there is a gap in the implementation of the fuel cells in on-road vehicles.

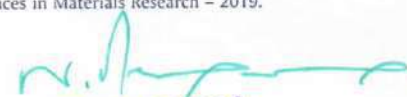
In this paper, the development of the fuel cell electric systems and their supporting components for two wheeler and four wheeler applications by various automobile companies and educational institutions are reviewed. Further the advantages, issues and applications of FCEV are discussed.

Working principle of the fuel cells the working principle of the fuel cell is following electrolysis technique. The fuel cells have two electrodes where the electrolyte process takes place between

<https://doi.org/10.1016/j.matpr.2020.03.679>

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Effects of Different Membranes on the Performance of PEM Fuel Cell



M. Muthukumar, A. Ragul Aadhitya, N. Rengarajan, K. Sharan, and P. Karthikeyan

Abstract Nowadays, air pollution prevails as one of the major problems all over the world. Fuel cell is the recently developed technology to counteract air pollution. Fuel cells are electrochemical devices that produce electricity by the reaction of two gases such as hydrogen and oxygen. Proton exchange membrane (PEM) fuel cell is the most economical one. The advantage of using PEM fuel cell is that they can operate at low temperature of about 50 °C to 80 °C, and there is no emission of harmful gases to the atmosphere, thereby maintaining eco-friendly environment. The performance of the fuel cell is mainly influenced by various factors like material properties of components (like gas diffusion layer, membrane, catalyst layer), flow channel designs, operating conditions and water management. The main function of membrane which is made of polytetrafluoroethylene is to allow only the protons from anode to cathode and not allows electrons. So the membrane is called as PEM. The performance of the fuel cell is affected by different types of membranes. In this paper, the performance of PEM fuel cell with two different membranes such as Nafion 117 and Nafion 212 is analyzed. The serpentine flow field is chosen on both cathode and anode sides. The PEM fuel cell having active area of 11.6 cm² is designed and analyzed with best-operating conditions. The results show that the PEM fuel cell with Nafion 212 membrane generates more power.

Keywords Emission · Eco-friendly · Membrane · Nafion · Power

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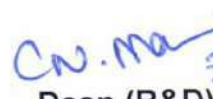
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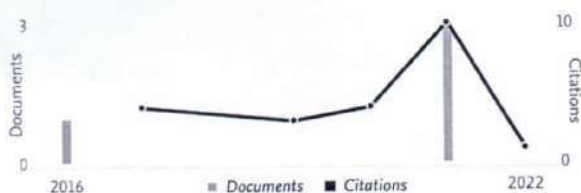
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Performance Studies of Proton Exchange Membrane Fuel Cells with Different Flow Field Designs – Review

Muthukumar Marappan,^[a] Karthikeyan Palaniswamy,^[b] Thiagarajan Velumani,^[b] Kim Byung Chul,^[c] Rajavel Velayutham,^[c] Praveenkumar Shivakumar,^[d] and Senthilarasu Sundaram^{*[e]}

Abstract: Proton Exchange Membrane Fuel Cell (PEMFC) is majorly used for power generation without producing any emission. In PEMFC, the water generated in the cathode heavily affects the performance of fuel cell which needs better water management. The flow channel designs, dimensions, shape and size of the rib/channel, effective area of the flow channel and material properties are considered for better water management and performance enhancement of the PEMFC in addition to the inlet reactant's mass flow rate, flow directions, relative humidity, pressure and temperature. With the purpose of increasing the output energy of the fuel cell, many flow field designs are being developed continuously. In this paper, the performance of various conventional, modified, hybrid and new flow field designs of the PEMFC is studied in detail. Further the effects of channel tapering, channel bending, landing to channels width ratios, channel cross-sections and insertion of baffles/blockages/pin-fins/inserts are reviewed. The power density of the flow field designs, the physical parameters like active area, dimensions of channel/rib, number of channels; and the operating parameters like temperature and pressure are also tabulated.

Keywords: channel design, flow field, fuel cells, PEMFC, water management

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Article

Scaling up Studies on PEMFC Using a Modified Serpentine Flow Field Incorporating Porous Sponge Inserts to Observe Water Molecules

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Abstract: Flooding of the cathode flow channel is a major hindrance in achieving maximum performance from Proton Exchange Membrane Fuel Cells (PEMFC) during the scaling up process. Water accumulated between the interface region of Gas Diffusion Layer (GDL) and rib of the cathode flow field can be removed by the use of Porous Sponge Inserts (PSI) on the ribs. In the present work, the experimental investigations are carried out on PEMFC for the various reaction areas, namely 25, 50 and 100 cm². Stoichiometry value of 2 is maintained for all experiments to avoid variations in power density obtained due to differences in fuel utilization. The experiments include two flow fields, namely Serpentine Flow Field (SFF) and Modified Serpentine with Staggered provisions of 4 mm PSI (4mm × 2 mm × 2 mm) Flow Field (MSSFF). The peak power densities obtained on MSSFF are 0.420 W/cm², 0.298 W/cm² and 0.232 W/cm² compared to SFF which yields 0.242 W/cm², 0.213 W/cm² and 0.171 W/cm² for reaction areas of 25, 50 and 100 cm² respectively. Further, the reliability of experimental results is verified for SFF and MSSFF on 25 cm² PEMFC by using Electrochemical Impedance Spectroscopy (EIS). The use of 4 mm PSI is found to improve the performance of PEMFC through the better water management.

Keywords: proton exchange membrane fuel cells (PEMFC); scaling up; porous sponge; MSSFF; EIS; water management

1. Introduction

Effective management of water produced as a product of Oxygen Reduction Reaction (ORR) on the cathode side is important to obtain maximum performance from PEMFC [1]. The cell performance is reduced due to the water flooding which effectively blocks the passage of protons through the membrane [2]. Increase in flooding of flow fields causes reduced performance in PEMFC at higher current densities. However, the low amount of water present causes the dehydration of the membrane which reduces the performance of the PEMFC [3]. Flow fields that produce uniform distribution of reactants and lower pressure drop due to shorter flow length yield better performance compared to serpentine flow channel [4–6]. The SFF produces non-uniform flow due to the presence of bends in the flow channel. The presence of bends causes a lower velocity near the bends compared to the central region of flow where the velocity is higher. Similarly, the length of the serpentine

Experimental investigation on serpentine, parallel and novel zig-zag flow fields for effective water removal and enhanced performance on 25 cm² PEMFC

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Water management is decisive in the commercialisation of Polymer Electrolyte Membrane Fuel cells (PEMFCs) as poor water management leads to reduced performance and reliability. Hence, this work deals with effective water management and physically examines water removed at cathode outlet in 25 cm² PEMFC of land width by channel width of 2 × 2. Six combinations among flow fields such as parallel without slope, parallel with slope, serpentine and a novel parallel zigzag with slope are used for experimentation. Experimental results disclose that inducing cross flow among reactants, increasing exposure area of uncompressed MEA with reacting gases and backpressure increases the performance while slope at cathode increases the water removal rate of PEMFC. The novel flow field when used at the cathode with the serpentine flow field at anode accumulates advantages of the flow fields considered and enhanced the performance by about 23% than conventional serpentine flow fields due to the induced flow non-uniformity, under rib convection and better water removal rate. Additionally, to enhance the water removal and performance a silicon dioxide based ceramic ink is spray coated on the graphite plate to increase its hydrophobicity. As the electrical conductivity of silicon dioxide, a key constituent in the hydrophobic coating is limited, a blend of 2% graphene by weight with the ceramic ink is also attempted along with the durability of these flow fields for twelve hours of continuous operation.

Keywords: Zig Zag Flow Field, Back Pressure, Slope in Flow Field, Cross Flow in Reactants, Ceramic ink coating, Durability Studies.

Introduction

Diminution of conventional fossil fuels and ecological contamination has turned the focus of research on alternate power generation systems. A large number of researchers are working on alternate fuels and power generation systems like fuel cells. Fuel cells are capable of producing green energy with little pollution and hence can be considered as a potential power generation device. When weighed against other types of fuel cells, Polymer Electrolyte Membrane Fuel Cells (PEMFCs) are more efficient and have high power density. Additionally, they are easy to install, can operate on relatively low operating temperature and pressure, respond dynamically to load and have a longer lifetime however the cost of PEMFC [1] is a major hindrance to commercialization. Also, water formed as a by-product of the electrochemical oxidation and reduction reactions is to be balanced [2] reasonably to avoid flooding and dehydration of membrane as they cause a reduction in

power (poor performance) of the PEMFC. Accumulation of water is due to electro-osmotic drag from anode to cathode vide the membrane and back diffusion of water from the cathode flow field to catalyst sites causes flooding. Proper water management ensures that the membrane remains fully hydrated and maintains good ionic conductivity [3] leading to enhanced performance. Considering these facts a few pieces of research relevant to this work are discussed below.

Parallel and serpentine flow fields are predominantly used in PEMFC, efforts are made to enhance their performance by modifying their land width, number of channels, the shape of the flow path, orientation, etc. Diverse techniques have been adopted to tackle water management issues, out of which the flow field design is most noteworthy. Innovative flow channels were designed and tested to improve water management in PEMFC and demonstrated that channel cross-section design can be used to improve their performance [4, 5]. The ill effect of water accumulation was established by visualizing oxygen distribution and water blockages in an operating 3 pass-parallel-serpentine PEMFC [6]. Studies on flooding cathode channels of PEMFC and concluded that water accumulation in the flow field significantly reduces the performance [7]. Despite these

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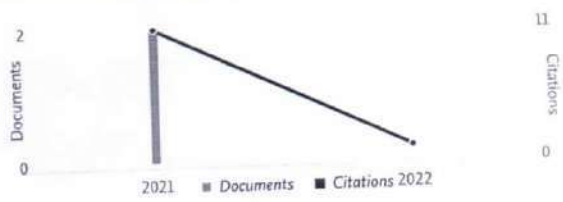
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Analysis of Shrinkage Defect in Sand Casting by Using Six Sigma Method with Taguchi Technique

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Abstract. Casting industries play a major role in the field of manufacturing. The production of complex shape and size products is manufactured in a single process, which cannot be produced in other manufacturing processes. Because the other process needs more than one step to convert a raw material into a product. When producing the casting, the quality of the casting should be maintained without defects. This is not possible as we can't produce a cent percentage of accuracy. But the percentage of defects can be reduced with the help of certain quality control tools and techniques. In this paper, the main focus is to reduce the shrinkage defect which occurs in the External Bearing Ring of ductile cast iron which is produced in the leading casting industry in Coimbatore. The data have been collected from the industry for the six months and the defects have been identified with the help of the Six-Sigma DMAIC (Define, Measure, Analyze, Improve, Control) technique. The quality control tools are applied in different stages of the DMAIC technique for identifying and controlling the defects. Also, the Taguchi technique is applied for creating the L9 orthogonal array from the Minitab software. Finally, the best possible solution is obtained and it is suggested to the industry for defects reduction.

Keywords: Casting defects; Six-sigma; DMAIC process; Taguchi; ductile iron.

1 Introduction

Casting is one of the oldest techniques in the days around 4000 B.C. The casting process was used for manufacturing of gold ornaments. Few years later, it was used for the production of weapons and tools with metals like copper as materials. Then after, the casting has been used for the production of products which were having different shapes from small to complex shape and size of products and different materials like cast iron and ductile iron, etc. Due to its major benefits and needs, the casting production plays a major role in the field of manufacturing. The occurrence of defects in the casting affected the casting industry economically. So, the defect occurrences should be reduced and the quality of the casting should be improved for which the application of some techniques like six-sigma and quality tools can be used. The defect in the particular area is identified and some changes are made to reduce the defects. In this paper, the External Bearing Ring made of ductile cast iron which is the one of the main components in the windmill is considered for analysis. The leading casting industry in Coimbatore are facing this shrinkage defect on this particular product as high in numbers. So, this shrinkage defects are reduced by applying the six-sigma technique and quality control tools, with the help of Minitab software.



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A comparative study of performance and emission characteristics of a diesel engine using various non-edible extracts

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Abstract

In this study, the performance and emission characteristics of a diesel engine fuelled with biodiesel such as cottonseed oil, castor oil, Calophyllum inophyllum oil and mustard oil by transesterification are investigated. All biodiesels are mixed together on mass basis and allowed to transesterification is named as totally mixed esterified (TMEx). Separately transesterified and mixed together on mass basis becomes separately esterified mixer (SEMx). The biodiesel samples are prepared by a volume proportions such as 10% (SEMx10, TMEx10) and 20% (SEMx20, TMEx 20). The experiment is conducted

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A comparative study of performance and emission characteristics of a diesel engine using various non-edible extracts

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Abstract: In this study, the performance and emission characteristics of a diesel engine fuelled with biodiesel such as cottonseed oil, castor oil, Calophyllum inophyllum oil and mustard oil by transesterification are investigated. All biodiesels are mixed together on mass basis and allowed to transesterification is named as totally mixed esterified (TMEx). Separately transesterified and mixed together on mass basis becomes separately esterified mixer (SEMx). The biodiesel samples are prepared by a volume proportions such as 10% (SEMx10, TMEx10) and 20% (SEMx20, TMEx 20). The experiment is conducted on a single-cylinder, water-cooled, direct injection diesel engine loaded by eddy current dynamometer at different loads. Result shows that brake thermal efficiency and specific fuel consumption of TMEx blends are closer to diesel compared with SEMx blends. Also, the emission characteristics of TMEx20 are less in comparison with other blends and it is suggested as a promising replacement for diesel without engine modification.

Keywords: biodiesel; methyl ester; diesel engine; exhaust emission.

Reference to this paper should be made as follows: Rajkumar, R., Kannan, K.G. and Mohanraj, M. (2020) 'A comparative study of performance and emission characteristics of a diesel engine using various non-edible extracts. *Progress in Industrial Ecology – An International Journal*, Vol. 14, No. 2, pp.91–103.

Biographical notes: R. Rajkumar is currently working as an Assistant Professor at Nandha Engineering College, Erode. He has an academic experience of three years and his areas of interest are IC engines, alternate fuels and heat transfer.

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An in-depth examination of opto-electrical properties of In-Yb₂O₃ thin films and fabricated Al/In-Yb₂O₃/p-Si (MIS) hetero junction diodes

K. S. Mohan¹ · A. Panneerselvam² · J. Chandrasekaran³ · R. Marnadu³ · Mohd. Shkir⁴

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Abstract

In the proposed work, the thin films have been effectively synthesized by doping the post-transition metal with rare earth metal (In-Yb₂O₃) on a large scale using a low-cost jet nebulizer spray pyrolysis technique at different indium (In) doping concentration (0, 1.5, 2.5, 3.5, and 4.5 wt %) with optimized substrate temperature 550 °C. The structural, morphological and opto-electrical properties are investigated using various characterization techniques. Here, the high-quality single-phase cubic structure film was observed by X-ray diffraction (XRD) analysis. The field emission scanning electron microscope (FESEM) image reveals the change in morphology with indium (In) concentration in Yb₂O₃ thin films. The elemental composition study approves the presence of Yb, In and O. The transmittance, optical indirect energy gap of In-Yb₂O₃ films have been analyzed by UV–Vis spectra. DC electrical analysis records an improved conductivity and reduced average activation energy for higher doping content of In-Yb₂O₃ thin films. Notably, all the diodes shows positive photo conducting properties. Specifically, when the Al/In-Yb₂O₃/p-Si Schottky barrier diode fabricated with higher doping concentration such as 4.5 wt. % produces the minimum ideality factor (1.791), maximum barrier height (0.692 eV) and higher photosensitive diodes.

Keywords Rare earth metals · Yb₂O₃ · Jet nebulizer spray pyrolysis method · MIS Schottky diode · Optical and electrical properties

Introduction

In the modern scenario, the attractive and very effective optoelectronic and photo detector devices have a wide focus by the researchers. Especially, most favored and low power consumption devices like Metal Insulator Semiconductor (MIS), Schottky Barrier Diodes (SBD), and photodiodes contain excellent electrical behaviors than the other layered

devices such as Metal–Insulator–Metal (MIM), Metal–Polymer–Semiconductor (MPS), and Metal–Oxide–Semiconductor (MOS) (Khanfar et al. 2017; Scarel et al. 2006; Riazimehr et al. 2017). The unique features of Schottky barrier diodes are low forward voltage values for the diodes between 0.2 and 0.3 V, a small amount of stored charge that can be used for high-speed switching applications and high operating frequency (Bartolomeo et al. 2019; Balaji et al. 2020a). Besides, Schottky diodes have an active role in different applications such as radiofrequency generator, biological sensors, optical communication system and microelectronic devices because of their tunable characteristics like stability and opto-electrical properties (Casalino et al. 2017; Qian et al. 2017; Terasaki et al. 2009).

Fabrication of superior metal insulator semiconductor (MIS) system is essential, since the electrical behavior of SBDs sturdily reliant to MIS interface quality. The performance of MIS devices depends on multi-factors, including the existence of interfacial layer at metal–semiconductor interface and its thickness. Interface layer having significant role in several electronic devices and the outcome from this layer on SBDs can be merely modernized by

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An in-depth examination of opto-electrical properties of In-Yb₂O₃ thin films and fabricated Al/In-Yb₂O₃/p-Si (MIS) hetero junction diodes

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Abstract

In the proposed work, the thin films have been effectively synthesized by doping the post-transition metal with rare earth metal (In-Yb₂O₃) on a large scale using a low-cost jet nebulizer spray pyrolysis technique at different indium (In) doping concentration (0, 1.5, 2.5, 3.5, and 4.5 wt %) with optimized substrate temperature 550 °C. The structural, morphological and opto-electrical properties are investigated using various characterization techniques. Here, the high-quality single-phase cubic structure film was observed by X-ray diffraction (XRD) analysis. The field emission scanning electron microscope (FESEM) image reveals the change in morphology with indium (In) concentration in Yb₂O₃ thin films. The elemental composition study approves the presence of Yb, In and O. The transmittance, optical indirect energy gap of In-Yb₂O₃ films have been analyzed by UV-Vis spectra. DC electrical analysis records an improved conductivity and reduced average activation energy for higher doping

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Short communication

A systematic influence of Cu doping on structural and opto-electrical properties of fabricated Yb₂O₃ thin films for Al/Cu-Yb₂O₃/p-Si Schottky diode applications

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ABSTRACT

In the present work, transition metal doped rare earth metal oxide (Cu-Yb₂O₃) thin films have been effectively synthesized on a large scale using low-cost jet nebulizer spray pyrolysis (JNSP) route at different copper (Cu) doping concentrations (0, 1.5, 2.5, 3.5, and 4.5 wt%) with optimized substrate temperature of 550 °C. The structural, morphological and opto-electrical properties were investigated using various characterization techniques. The X-ray diffraction (XRD) profile indicates the polycrystalline nature of all the deposited films with a cubic phase and the size of crystallites is found to increase from 11 to 31 nm. The field emission scanning electron microscope (FESEM) images reveal that the Cu doping has significant impact on the surface morphology of Cu-Yb₂O₃ films. The atomic force microscope (AFM) analysis exposed higher roughness value for 4.5 wt% of Cu-Yb₂O₃ films. The elemental composition study approves the presence of Yb, Cu and O in the film. The transmittance and indirect optical energy gap of Cu-Yb₂O₃ films have been analyzed by UV-Visible spectroscopy which established the systematic band gap reduction of Yb₂O₃ thin films from 3.68 to 3.14 eV with increasing Cu concentrations. The DC electrical studies showed a maximum conductivity and minimum average activation energy for 4.5 wt% of Cu-Yb₂O₃ film. The electrical characteristics of the fabricated Al/Cu-Yb₂O₃/p-Si Schottky diode was investigated using current-voltage (I-V) measurements performed under dark and light conditions. The Φ_B (0.911 eV in dark & 0.754 eV in illumination) and minimum n values (2.120 in dark and 1.757 in illuminations) were obtained for MIS diode having Cu doping concentration of 4.5 wt% in Yb₂O₃.

1. Introduction

In recent trend, most popular and very effective electronic devices such as metal-insulator-semiconductor (MIS) Schottky diode (SD)/Schottky barrier diode (SBD), photodiode, UV photodetector have become most favorable when compared to other layered devices like metal-insulator-metal (MIM), metal-polymer-semiconductor (MPS) and metal-oxidesemiconductor (MOS). Especially, the MIS SDs contain excellent electrical behavior compared to other devices. The MIS SDs have unique features such as low forward voltage drop values, fast switching speed and high operating frequency [1–3]. Besides, the SDs

have active role in various applications like radio frequency generator, optical communication system and microelectronic devices such as diode, transistor, capacitors and power conversion system [4–5]. Performance of MIS devices depends on several factors including the existence of an interfacial layer and interface states [6]. An interlayer of greater thickness may affect the device related parameters such as barrier height (Φ_B), ideality factor (n) and series resistance (R_s). Moreover, the MIS device becomes more popular in variation to the other types of SBDs because of their multifaceted applications [7–8].

Nowadays, rare earth metal oxides such as ytterbium trioxide (Yb₂O₃), neodymium trioxide (Nd₂O₃), samarium trioxide (Sm₂O₃) and

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Outline

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Short communication

A systematic influence of Cu doping on structural and opto-electrical properties of fabricated Yb₂O₃ thin films for Al/Cu-Yb₂O₃/p-Si Schottky diode applications

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