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IEI EPITOME

A Century of Service to the Nation

In this issue

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TechSAMARITANS

PRELUDE

We are passing through one of the most unprecedented time of this era. As a learned society, we feel it appropriate to share with you all the experiences, unique perspectives and technical contribution of our esteemed members towards alleviating the sufferings of the people affected directly or indirectly by this pandemic. Besides demonstrating a lot of heart and empathy, they have also shown unmatched grit and tenacity that may be just what is needed to make real, positive change. In face of adversity and the unknown, they persisted in their pursuit of bringing relief and respite for the society leveraging technology and science. That takes character and faith and would also go a long way in reposing the faith of the humanity on this noble profession of engineering.

Because of the dearth of space, we regret not being able to include the details of the contribution by these **Samaritans**, but we earnestly recognize all these efforts through this column of IEI Epitome. Their efforts yielded desired result as these were built on the tenets of flexibility, sustainability and adaptability and could meander across the impediments and challenges of a hybrid work environment, new to most of us. They didn't cave in under the immense pressure, the debilitating circumstances which speak of their dedication to this profession and work as they rose to the occasion.

As an esoteric body of professional engineers, we have a fair share of role in rebuilding the 'next normal' and the attributes exemplified by our own members will be critical in shaping our policies and services as we move forward together.

Development of Devices, Equipments & Research Initiatives

The Institution acknowledges the effort of the members who have demonstrated unmatched passion, tenacity and ingenuity to rise to the occasion and develop technically assistive devices in solo or in collaboration which are commercially scalable, cheap and can be put to use by the masses without much technical knowhow. We need to remember that these efforts were initiated and delivered during amidst unprecedented crisis, uncertainties and insecurities. More importantly, they have been developed with resource constraints coupled with restrictions imposed on workspace, laboratories etc.

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ganathippu@gmail.com

Er B Ganapathy Ram, a faculty with National Engineering College Tamil Nadu and an engineering entrepreneur, co-founded M/s. Cogniot Technology Private Limited on 05 July 2020 with the aim of delivering IoT based solutions and services to improve healthcare management system.

The start-up received an initial seed money of INR 88,000/- in November 2020 from K R Innovation Centre, the business incubator wing of National Engineering College. Finally, in December 2020, the start-up was duly recognized as a SME unit by Ministry of MSME, Government of India.

TechSAMARITANS

Er Sujoy Kumar Goswami, MIE
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Er Sujoy Kumar Goswami and his team from TVS Group of Companies have developed/ deployed '**social distancing meter**' and '**mask wearing detection**' across various plants/ offices of '**TVS Group of Companies**' to fight COVID19.

Under this exercise the existing security cameras within stores and workplaces were integrated with an artificial intelligence software platform that can track compliance with health guidelines including 'social distancing' and 'use of mask'.

TVS has deployed Social Distance Monitoring mechanism at the following places till date:

1. TVS Motor -Indonesia, Himachal Pradesh, Mysore, Hosur, Bangalore, Area-Ware-Houses (Hapur, Patna etc.)
2. TVS Credit- Chennai, HUBs across various cities
3. SACL- Hosur
4. TVS Digital- Singapore (proposed)

Mask wearing monitoring mechanism has been deployed at:

1. TVS Motor-Bangalore, Chennai
2. TVS Credit- Chennai

Awards/ Recognitions

- Received 'Significant Contributor' award by TVS CEO
- Honoured and privileged with inclusion in 'TVS Elite LTI Program'
- Selected for IBAE 2020 'Rising Star' Award

This column is a tribute to the **COVID** specific initiatives of these '**TECH SAMARITANS**' and many others behind the scene who have demonstrated exemplary selfless determination for the sake of saving lives, in these challenging times and have resolved to rise to the occasion and reaffirmed the credence of the profession of engineering.

Members in the News

Er A N Sivaramakrishnan, FIE
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Head Business, AL Commercial Vehicles Division,
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The year 2020 turned out to be a juggernaut given that not only was it the year of BS-IV to BS-VI transition but also one when the corona virus brought the world's economy to a screeching halt.

The government of India announced in January 2016 that effective from 1st April 2020 the diesel and petrol engines should comply with the Bharat Stage -VI emissions norms.

The decision was bold in as much as the government was skipping one stage i.e., BS-V by this order. Er A N Sivaramakrishnan, in this article, takes stock of all that has happened since the first rumblings of change began to take place.

Motor India had sought articles from leading Automotive industry Experts, players in the value chain on how the transition from BS-IV to BS-VI was managed by them. The article titled "**BS-IV to BS-VI A leap of faith by Automotive Dealers**" captures succinctly the huge challenges that was faced not only by flip of a switch on the norms but also by the fact that the pandemic covid bought the business to a standstill for one quarter in 2020. The article describes in detail how the business continuity was maintained by focusing on Rightsizing, Controlling Costs, Focus on Innovative digital marketing methods to communicate with customers and to restart/increase sales.

Title of Journal : MOTOR INDIA
With Volume No : 65
Issue No : 9
Page No : 78 - 81
Soft Copy Link : http://emagazine.motorindiaonline.in/31650/16_04_2021#page/78

Er Sachchidanand Dhar, FIE
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Patent Status:	Received
Application No.:	708/MUM/2013
Application Type:	Ordinary Application
Date of Filing of Application :	08/03/2013
Name of Applicants :	Sachchidanand Dhar
Title of the Invention :	Geared Belt Drive For Marine Propulsion
Field of Invention:	Mechanical Engineering
Request for Examination Date:	08/03/2013
Publication Date (U/S 11a):	16/01/2015
Date of Certificate Issue:	02/07/2021
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Patent No. :	371067
Patent Publication Date :	02/07/2021
Application Status:	Granted
Patent Number :	371067

Patent Received from Intellectual Property India, Government of India

Abstract: *This invention, named GEARED BELT DRIVE FOR MARINE PROPULSION, has the advantage that it pushes the water linearly opposite to the direction of motion. It does not induct rotational, radial or eddy current movements into the water, thus reduces losses. Its power absorption can be varied by varying the length or width of the belt. It can work equally well in partially submerged or fully submerged condition, irrespective of positioning of the shaft in horizontal or vertical manner. It can be conveniently located either on the side of the boat, back of the boat or on the underside of the boat. The shaft can be placed either in a horizontal position or vertical position, as long as the axis of the shaft is not along the length of the marine craft. It can even be designed to be placed as an outboard unit.*

Members in the News

Er N Subramanian Narayanan, FIE
Consulting Engineer

Dr N Subramanian, a well known consultant, award winning author, researcher, entrepreneur, and mentor has recently been elected as a Fellow of the prestigious Indian National Academy of Engineering (INAE). The Academy honours Indian and Foreign nationals who are elected by peer committees in recognition of their personal achievements in "Engineering" which are of exceptional merit and demonstrated distinctive eminence in the new and developing fields of technology. Election to the National Academy of Engineering is among the highest professional distinctions accorded to an engineer.

Dr Jayant Gajanan Joshi, MIE
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"**Circularly Polarized Microstrip Antenna using DGS for IRNSS Services**" has been awarded as **IEEE K Shankar Meritorious Paper** of IEEE Bombay Section.
Published in: 2020 IEEE Bombay Section Signature Conference (IBSSC)
Publisher: IEEE
Date of Conference: 4-6 December 2020
Date Added to IEEE Xplore: 28 January 2021
Electronic ISBN: 978-1-7281-8993-2
Print on Demand (PoD) ISBN: 978-1-7281-8994-9
INSPEC Accession Number: 20400715
DOI: 10.1109/IBSSC51096.2020.9332166
Co-authors: Mandar P Joshi & Umesh Gite

PUBLICATION by MEMBERS

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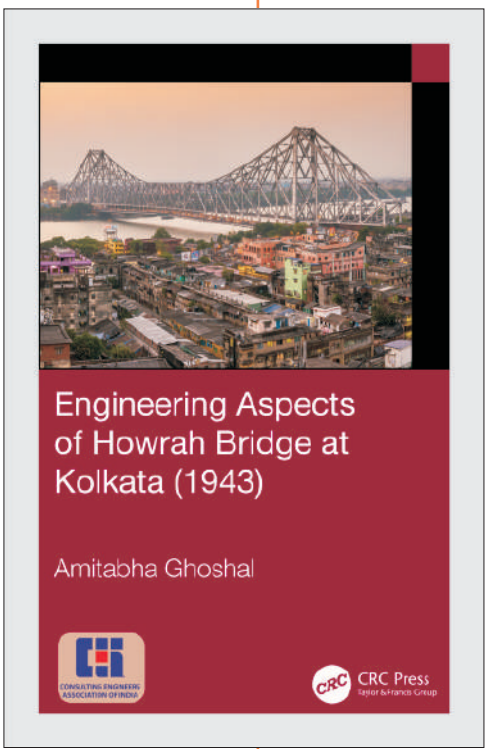
Engineering Aspects of Howrah Bridge at Kolkata (1943)

This book is dedicated to the memory of the Indian workmen who worked through rain and sun, at dizzy heights, to improve the daily lives of city dwellers; to men like Omeruddin Khan and Harbans Singh, who mastered the skill and contributed to successful completion of this and many more large bridges in India.

Book Description

Howrah Bridge is an iconic engineering structure of Kolkata (formerly Calcutta) and is in excellent condition after 78 years of extensive use. The bridge is a balanced cantilever structure, has a central span of 457 meters, used 26,500 tons of high-grade steel and was entirely fabricated at Kolkata to a high precision as a riveted structure. The bridge is an example of the high-quality work that went into bridge building in earlier years and offers unique design and detailing features. This current book covers all the engineering aspects of the structure explaining planning, design of superstructures, substructures and foundations along with fabrication and erection with a separate section on special features.

Aimed at civil and bridge engineering students and graduate engineers, professionals, practicing structural engineers and also heritage structure enthusiasts, this book offers a detailed case study and a thorough description of a well-known and iconic bridge. It covers the planning process to design and construction aspects. It discusses conceptual design aspects and alternatives considered at the time of construction. It explains the planning of the foundations in a clayey silt river bed, subject to tidal variations, the design and construction of foundations, and illustrates the fabrication of steel work and the use of pre-cambering principle.



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PUBLICATION by MEMBERS

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Spectrum Sensing Over Fading Channels in Cognitive RadioNetwork
An Analysis of Energy Detection Spectrum Sensing

Preface

The recent rapid growth of wireless communications has made the problem of spectrum under utilization ever more critical. Increasing diversity and demand of high quality of service applications resulted in overcrowding of the allocated spectrum bands, leading to significantly reduced user satisfaction. Cognitive Radio technology has come out as a way to solve this problem by allowing the unlicensed (secondary) users to use licensed (primary) users bands opportunistically. However, these unlicensed users need to be monitoring the spectrum continuously to avoid possible interface with licensed users. To sense existence of licensed users, many spectrum sensing techniques have been devised in this book.

This book presented energy detection based spectrum sensing techniques. Mathematical description of energy detection based spectrum sensing is discussed and closed form expressions for various wireless fading channels are illustrated. The experimentation shown in this book is carried out in MATLAB (R2010a) software.

The purpose of the book is to provide a good understanding of the Spectrum utilization and Spectrum Sensing methods based on sensing accuracy and its complexities. The book begins with the study of underutilization of spectrum followed by solution to the issue is to use Cognitive Radio (CR). Then characteristics, cycle and network architecture of Cognitive Radio are presented in a lucid detail. Major part of the book is intended to serve as an advanced course in Software Defined Radio to the undergraduate and postgraduate students of Electronics, E&TC, Computer Engineering and Information Technology. It is presumed that the reader is familiar with modern wireless system based on OFDM, MIMO and Smart Antenna. The book contains five chapters. Chapter 1 gives an overview of electromagnetic radio spectrum policy as defined by Federal Communication Commission (FCC). This chapter also touches upon the significance of flexible spectrum management technique to improve spectrum efficiency. Chapter 2 describes historical background of Cognitive Radio Network. Also, in this chapter concept of spectrum hole is explained followed by various spectrum sensing methods adopted in Cognitive Radio Network. Furthermore, the classification of Wireless Fading Channels with its Probability Density Function is elaborated. In Chapter 3, the block diagram and flowchart of Energy Detection based Spectrum Sensing are presented. The Probability of detection for wireless fading channels is mathematically represented in this same chapter. Performance metrics like probability of false alarm, probability of detection and signal to noise ratio are evaluated by analyzing receiver operating characteristics curve over Additive White Gaussian Noise (AWGN), Rayleigh and Nakagami Wireless Fading Channels in Chapter 4. The interpretations of results are thoroughly discussed in the end.

I am thankful to Lambert Academic Publishing to publish this book in the domain of Cognitive Radio Network. Finally I express my gratitude to my parents for their perennial encouragement and my wife Snehal for her patience and understanding during the preparation of this book. Finally I dedicate this book to my lovely daughter Ridhima who is the pride and joy of my life!

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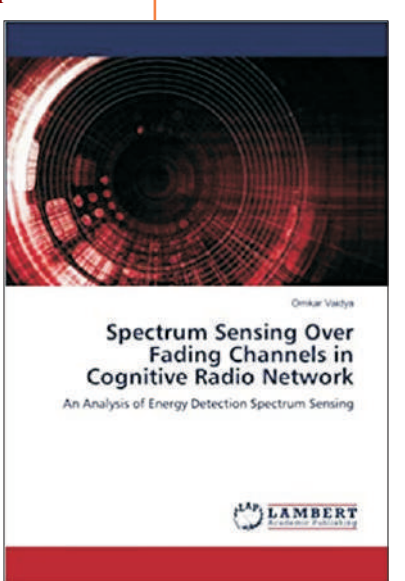

PUBLICATION by MEMBERS

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Title of Paper: **Development of High-performance Aluminium 6061/SiC Nanocomposites by Ultrasonic Aided Rheo-squeeze Casting Method**

Ultrasonics Sonochemistry, Elsevier, Volume 76, August 2021, Online Published: 13 June 2021
DOI: https://doi.org/10.1016/j.ultsonch.2021.105631

Co-authors: Arunkumar Thirugnanasambandam, Ram Subbiah, Karthikeyan Ramachandran & Sivakumar Manickam

Abstract: *In the modern era, the need for new products with novel processing and multipurpose materials is increased. The current market requirements for engineering applications are lightweight, high strength and low-cost materials. This paper explores the novel development process of high-performance nano cermet material for aerospace applications. Herein, lightweight aluminium 6061 + 2% of SiC (40 nm) nano cermet was fabricated through the casting method. The effects of ultrasonication, double stir casting or rheocasting, and squeezing pressure on nano cermet fabrication were successfully investigated by comparing their physical, thermal and mechanical properties. Scanning electron microscopy was employed to analyse the morphology of the cermets, and the presence of reinforcements was verified through EDS. The reinforcement of SiC into Al 6061 improved density, hardness, and reduction in porosity and grain refinement. This study reveals a novel fabrication process of ultrasonic-aided rheo-squeeze casting technique which enhanced the mechanical properties of the cermets compared to Al 6061 alloy due to nanoparticles homogeneous distribution, nominal agglomeration and porosity.*

Keywords: *Ultrasonication, Rheocasting, Al 6061/SiC, Grain refinement, Homogeneous distribution*

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Title of Paper: **Feature-based Ontological Framework for Semantic Interoperability in Product Development**

Advanced Engineering Informatics, Elsevier, Volume 48, April 2021, 101260
DOI: https://doi.org/10.1016/j.aei.2021.101260

Co-author: Balan Gurumoorthy

Abstract: *An essential requirement in integrating tasks in product development is to have a seamless exchange of product information through the entire product lifecycle. A key challenge in the integration is the exchange of shape semantics in terms of understandable labels and representations. A unified taxonomy is proposed to represent, classify, and extract shape features. This taxonomy is built using the Domain-Independent Form Feature (DIFF) model as the representation of features. All the shape features in a product model are classified under three main classes, namely, volumetric features, deformation features and free-form surface features. Shape feature ontology is developed using the unified taxonomy, which brings the shape features under a single reasoning framework. One-to-many reasoning framework is presented for mapping semantically equivalent information (label and representation) of the feature to be exchanged to target applications, and the reconstruction of the shape model automatically in that target application. An algorithm has been developed to extract the semantics of shape features and construct the model in the target application. The algorithm developed has been tested for shape models taken from literature and test cases are selected based on variations of topology and geometry. Results of exchanging product information are presented and discussed. Finally, the limitations of the proposed method for exchanging product information are explained.*

Keywords: *Information exchange, Shape feature taxonomy, Product informatics, Computer-aided design, Product lifecycle management, Product development*

PUBLICATION by MEMBERS

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Title of Paper: **A Review on Cryogenic Treatment of Tungsten Carbide (WC-Co) Tool Material**

Materials and Manufacturing Processes, Volume 36, 2021 - Issue 6
DOI: https://doi.org/10.1080/10426914.2020.1843668

Abstract: *Cryogenic treatment is a thermal treatment process in which the parts are usually cooled to temperature below −70 C (< 203 K) to induce metallurgical changes in materials. The treatment has shown a significant performance improvement in most of the ferrous materials and it's alloy, by transforming retained austenite to martensite and precipitating secondary carbides. However, the effect of such low-temperature treatment on highly stable super hard material like tungsten carbide (commonly referred to as "cemented carbide") is uncertain. But researchers have reported precipitation of eta-phase carbides, densification of cobalt binder, refinement of tungsten carbide grains, phase transformation of cobalt, and changes in residual stress in cryogenically treated tungsten carbide (WC-Co) material which resulted in increased hardness and wear resistance. Hence, this paper focuses on summarizing the cryogenic treatment parameters used in different studies, the rate of performance improvement in different applications, and reported mechanical and metallurgical changes, which would serve as a pool of knowledge for future researchers.*

Keywords: *Cryogenic treatment; tungsten carbide; cutting tools; metallurgical properties; phase transformation.*

Title of Paper: **Effect of Cutting Parameters and High-pressure Coolant on Forces, Surface Roughness and Tool Life in Turning AISI 1045 Steel**

Materials Today: Proceedings, Volume 43, Part 1, 2021, pp. 482-489
DOI: https://doi.org/10.https://doi.org/10.1016/j.matpr.2020.12.020

Abstract *: The machining industries constantly look for novel techniques to decrease the forces generated in metal cutting, enhance the tool life and improve the surface quality. High-pressure coolant delivery is one such technique that is believed to enhance the overall machining process with its superior cooling capabilities. Hence, an investigation was made to compare the behavior of a turning tool in machining AISI 1045 steel material under conventional coolant (CC) and high-pressure coolant (HPC) conditions. The influence of applying coolant at high pressure on forces and surface finish was measured at various cutting speeds and feeds, and tool life analysis was performed at a constant cutting parameter. The study reveals that a 12-23% reduction in cutting force, a 17-27% reduction in feed force, and a 14-33% reduction in surface roughness values can be obtained when a high-pressure coolant is used. Besides, around 40% improvement in tool life was also seen. The capability of the coolant in the effective removal of heat from the tool-chip interface zone, decrease in frictional forces between the tool and work material, and superior chip breaking capabilities at high-pressure conditions are attributed to the performance improvement.*

Keywords: *Coolant, Surface integrity, Turning, Machining, Tool life, Cutting force*

Title of Paper: **Evaluation of Mechanical and Metallurgical Properties of Cryo-treated Tungsten Carbide with 25% Cobalt**

Materials Today: Proceedings, Volume 43, Part 6, 2021, pp. 3463-3469
DOI: https://doi.org/10.1016/j.matpr.2020.09.374

Abstract: *In this study, the impact of cryo-treatment on mechanical and metallurgical properties of straight tungsten carbide (unalloyed) specimens manufactured with a binder content of 25% cobalt was evaluated. Wear rate of the untreated and cryo-treated specimens were compared in pin-on-disc dry sliding friction test and the mechanical properties like Vickers hardness and transverse rupture strength were studied. Metallurgical properties like saturation magnetization (Ms), coercivity (Hc), and microscopic evaluation to study the grain morphology, distribution, and presence of elements like η-carbides were evaluated to validate the outcomes of wear testing. The results show that cryo-treated specimens showed a significant reduction in wear rate. The coercivity and Vickers hardness showed an increase of around 9% and 2%, respectively in the cryo-treated specimens. From the metallurgical evaluation, the reduction in wear rate of cryo-treated specimens was credited to the martensitic phase transformation of the binder element. The microscopic evaluation confirmed that the morphology of tungsten carbide grains was unaffected.*

Keywords: *Tungsten carbide, Metallurgical properties, Wear testing, Vickers hardness, Mechanical properties, Cryogenic treatment*

PUBLICATION by MEMBERS

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Title of Paper: **Novel Pyrochlore-structured Bismuth Iron Antimonates: Structural, Impedance and Lectrochemical Studies**
Results in Physics, Elsevier, Volume 27, August 2021
DOI: https://doi.org/10.1016/j.rinp.2021.104542
Co-authors: F A Jusoh, K B Tan, Z Zainal, S K Chen, C C Khaw, O J Lee & H C Ananda Murthy

Abstract: *A moderate pyrochlore solid solution range of 0.00 £ x £ 0.64 was observed in the $Bi_{3.36}Fe_{2.08+x}Sb_{2.56-x}O_{14.56-x}$ (BFS) system prepared by solid-state reaction at 925°C for 2 days. The overall charge compensation required a one-to-one cationic replacement and oxygen vacancies, i.e. $Sb^{5+} \leftrightarrow Fe^{3+} - O^{2-}$. BFS cubic pyrochlores showed their refined lattice parameters varying linearly in the range of 10.4284 (8)-10.4513(8), thus obeying the Vegard's rule. The measured crystallite sizes by both Scherrer and Williamson-Hall methods were found to be in the range of 46–67 nm; whilst, the larger grain sizes in the range of 0.2–2.9 μm were calculated using scanning electron microscopy (SEM) analysis. The AC impedance analysis also verified a few electrical responses of BFS pyrochlores: (i) BFS pyrochlores had moderate dielectric constants in the range of 24–35 and dielectric losses in the order of 10^{-1} at room temperature and 1 MHz, (ii) BFS pyrochlores were not electrically homogeneous with bulk capacitances in the order of 10^{-12} Fcm^{-1}, (iii) a non-Debye type and temperature-dependent relaxation process were discernible and (iv) the movement of charge carrier were either in the long-range or short-range migration subjected to time availability. In addition, BFS pyrochlore thin films had a good capacitive behaviour and electrochemical reversibility, according to the cyclic voltammetry (CV) and galvanostatic charge–discharge (GCD) analyses. All these excellent properties rendered BFS pyrochlores to be a suitable material for Class 1 ceramic capacitors.*

Keywords: A. Powders: solid-state reaction, C. Dielectric properties,E. Capacitors: Pyrochlore

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Title of Paper : **Investigation of Taper Sloped Fin for Heat Transfer Enhancement in Plate Fin Heat Sink**
Materials Today: Proceedings, Elsevier, Published Online: 08 June 2021
DOI: https://doi.org/10.1016/j.matpr.2021.05.567
Co-author: Vandana Somkuwar

Abstract: *Heat transfer is a challenging part in complex heat generating devices such as electronic components, heat sink plays a vital role in dissipation of heat and maintaining temperature it works as electronic cooling device embargo with heat generating device, this study focuses on enhancement in thermal performance of heat sink those fins are tapered in 1 , 2 , and 3 with constant fin crest angle of 10 degree the numerical simulations were performed by considering finite difference method with wind velocity of 6.5, 8, 10, 12.2 m/s with constant base temperature of 3665 w/m^2, it is evident that stagnation effect is reduced in present proposed configurations compared to normal fin heat sink, the nusselt number, thermal resistance and coefficient of enhancement were evaluated numerically and mathematically to predict thermal characteristics of taper sloped fin heat sink (TSFHS).*

Keywords: *Taper sloped fin heat sink (TSFHS), Normal heat sink, Nusselt number, Thermal resistance, Coefficient of enhancement*

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Title of Paper : **Analysis of Alpha and Theta Band to Detect Driver Drowsiness using Electroencephalogram (EEG) Signals**
The International Arab Journal of Information Technology, Volume 18, No 4, July 2021, pp.578-584
DOI: https://doi.org/10.34028/18/4/10
Co-authors: Jerritta Selvaraj, Krishnakumar Ramaraj & Arun Sahayadhas
Abstract: *Driver drowsiness is recognized as a leading cause for crashes and road accidents in the present day. This paper presents an analysis of Alpha and Theta band for drowsinesss detection using Electroencephalogram (EEG) signals. The EEG signal of 21 channels is acquired from 10 subjects to detect drowsiness. The Alpha and Theta bands of raw EEG signal are filtered to remove noises and both linear and non-linear features were extracted. The feature Hurst and kurtosis shows the significant difference level ($p<0.05$) for most of the channels based on Analysis of Variance (ANOVA) test. So, they were used to classify the drowsy and alert states using Quadratic Discriminant Analysis (QDA), Linear Discriminant Analysis (LDA) and K-Nearest Neighbour (KNN) classifiers. In the case of Alpha band, the channels F8 and T6 achieved a maximum accuracy of 92.86% using Hurst and the channel T5 attained 100% accuracy for kurtosis. In the case of Theta band, Hurst achieved 100% accuracy for the channel F8 and Kurtosis obtained a maximum accuracy of 92.85% in the channels FP1, CZ and O1. A comparison between Alpha and Theta band for the various channels using KNN Classifier was done and the results indicate that the selected channels from Alpha and Theta bands can be used to detect drowsiness and alert the driver.*
Keywords: *Electroencephalogram, Alpha band, Theta band, Drowsiness, KNN, ANOVA*

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Title of Paper: **Designing of Energy Efficient Rotary Steam Coil Air Pre-Heater (SCAPH) for Fossil Fueled Thermal Power Plant**
International Journal of Engineering Research & Technology (IJERT), Volume 10, Issue 03, March-2021, pp 167, ISSN: 2278-0181
URL: https://www.ijert.org/research/designing-of-energy-efficient-rotary-steam-coil-air-pre-heater-scaph-for-fossil-fueled-thermal-power-plant-IJERTV10IS030098.pdf
Co-author: Sunil Kumar Gupta
Abstract: *Steam coil air preheaters (SCAPH) are found in most fossil-fueled utility and large industrial power plants. Their primary function is to pre-heat combustion air before it enters rotary regenerative air preheater. SCAPH provides corrosion protection for the air pre heater and maintains its cold end average temperature above acid dew point temperature during cold stringent weather condition. Most units use vertical, fixed finned tube coils embedded in the ductwork connection of the discharge side of combustion air source, Forced Draft fans, and the cold end inlet of Air Pre-Heater. This equipment can also have an additional purpose of preheating the combustion air during unit start-up by increasing the ambient air temperature up to a desirable temperature to reduce fuel oil consumption, thus aiding operators to take pulverizer into service early. Along with the advantages of this static bulky heat exchanger there lays a hidden disadvantage which impacts the auxiliary power consumption during normal unit operation at normal ambient conditions. As it is present in the discharge of forced draft fan a considerable amount of pressure drop occurs across the coils which leads to an increase of forced draft fan loading thus leading to an increase in auxiliary power consumption even in normal weather conditions. Without hampering the normal functionality of the SCAPH system an innovative approach has been taken and described in this paper through redesigning of a Static SCAPH system into a Rotary SCAPH system.*
Keywords: *Steam coil air preheater, auxiliary power, innovation, modification, energy efficiency, SCAPH*

PUBLICATION by MEMBERS

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Title of Paper: **Nanomechanical behaviour of ZrO_2 Dispersed Sisal-based Polymeric Composites**
Proceedings of the Institution of Mechanical Engineers, Part L: Journal of Materials: Design and Applications, First Published: 27 May 2021, ISSN: 1464-4207, Online ISSN: 2041-3076
DOI: https://doi.org/10.1177/14644207211016015
Co-authors : Bhabatosh Biswas, Biplab Hazra & Nillohit Mukherjee
Abstract: *Alkali-treated sisal fibre-incorporated silanized ZrO_2 dispersed unsaturated polyester composites were fabricated with a filler loading of 5, 15, 25, 35, 45 wt%, respectively. The mechanical characterization of the composites was suitably executed at the sub-micron scale using the nanoindentation technique. Various mechanical properties were derived from the standard nanoindentation measurements namely, nanohardness, reduced modulus, recovery index, residual depth, wear rate and indentation creep, respectively. A marked improvement in the mechanical properties of the unsaturated polyester matrix due to the incorporation of the fillers (sisal and/or ZrO_2) was observed through indentation-derived parameters namely, nanohardness (~186%), reduced modulus (~175%), recovery index (~62%), wear rate (~63%) and indentation creep (~33%), respectively. A simulated dynamic mechanical analysis was performed using the sinus mode of the nanoindentation technique. A similar enhancement in the dynamic mechanical properties of the matrix was further observed through dynamic mechanical analysis as storage modulus (~71%), loss modulus (~60%), loss factor (~150%) and specific damping coefficient (~200%), respectively*
Keywords: *Sisal, ZrO_2, polymer matrix composites, mechanical properties, nanoindentation*

Title of Paper: **Indentation behavior of Cellulosic Fibers/Fly Ash-incorporated Polymer Composites at Sub-micron Scale**
Proceedings of the Institution of Mechanical Engineers, Part J: Journal of Engineering Tribology, First Published: 02 July 2021, ISSN: 1350-6501, Online ISSN: 2041-305X
DOI: 10.1177/13506501211030049
Co-authors: Bhabatosh Biswas & Nillohit Mukherjee
Abstract: *Chemically treated short cellulosic fibers (jute and sisal) reinforced heat-treated silanized fly ash-dispersed hybrid polymer composites were synthesized by a compression molding technique. The 35 wt.% filler loading unsaturated polyester matrix-based composites were fabricated. The mechanical behavior of the unsaturated polyester matrix and unsaturated polyester-based composites was successfully assessed at the sub-micron length scale using the nanoindentation or depth-sensing instrumented indentation technique. It was observed that along with filler addition, the mechanical properties at the sub-micron scale improved significantly. A successful attempt to investigate the effect of filler inclusion within the unsaturated polyester matrix through various nanoindentation-derived parameters, namely, nanohardness, reduced modulus, elastic recovery, residual depth, wear rate as well the dynamic mechanical properties was also executed in the current investigation.*
Keywords: *Cellulosic fibers, Fly ash, Unsaturated polyester, Nanoindentation, Wear rate*

Er Soham Ghosh, AMIE
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sghosh27@ieee.org

Title of Paper : **Ensemble Machine Learning Methods for Better Dynamic Assessment of Transformer Status**
Journal of The Institution of Engineers (India): Series B, Springer, Online Published: 19 May 2021
DOI: https://doi.org/10.1007/s40031-021-00599-1
Co-author: Sreejata Dutta

PUBLICATION by MEMBERS

Abstract: *Analyzing dissolved gases in the transformer's mineral oil helps to detect and classify the systemic faults in electric power transformers. Formerly, empirical methods such as Rogers ratio, Duval triangles 1–4–5, and pentagons 1–2 were used for transformer fault classification. Loose fit for every transformer type is one of the most prominent disadvantages of conventional methods. Formulating robust machine learning algorithms, such as the decision trees, can significantly overcome the loose fit issue. This paper focuses on implementing four different decision tree algorithms, including a regular decision tree classifier, a bagging classifier, a boosting classifier, and a stacking classifier to classify six different transformer fault types distinctly. Further, this study shows that the efficacy and accuracy of the four mentioned classifiers could be far exceeded when combined using a wisdom of the crowd approach. The wisdom of the crowd approach essentially merges the predicted classes from the four individual classifiers and decides on the final prediction via a hard-voting routine. The computational evaluation revealed that the given voting approach could significantly improve power transformers' online diagnostic accuracy up to 91%, thus aiding early forecast of power transformers' preventive maintenance.*
Keywords: *Dissolved gas analysis, Ensemble learning, Random forest, XG boost, Stacking classifier, Transformer protection*

Er Yogendra Arya, AMIE
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Department of Electrical Engineering, J.C. Bose University of Science and Technology, YMCA, Faridabad, Haryana
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Title of Paper : **Impact of Ultra-capacitor and Redox Flow Battery with JAYA Optimization for Frequency Stabilization in Linked Photovoltaic-thermal System**
International Transactions on Electrical Energy Systems, Volume 31, Number 5, May 2021
DOI: https://doi.org/10.1002/2050-7038.12883
Co-authors: Gulshan Sharma, Narayanan Krishnan & Akhilesh Panwar
Abstract: *This paper presents an initial work to design frequency stabilization strategies through, I, PI, PID, ID, and IDD calculated via the JAYA optimization process for load frequency control (LFC) framework of photovoltaic (PV) and thermal generators linked via AC tie-line. Firstly, a comparative analysis of all LFC designs is conducted for typical load alterations, and the LFC recital is evaluated on basis of pick-up value, inverse absolute error (IAE), inverse time multiplied by absolute error (ITAE) and the interpretation of graphical results. Additionally, the effects of an ultracapacitor combined with a redox flow battery and an ultracapacitor in each zone of the PV-thermal system is also investigated and evaluated to improve the results of the PV-thermal system. Finally, the effectiveness of the proposed plan is assessed for nonlinearity, continuous load alteration, and broad parametric varieties from the ordinary plant values. The application results are presented to show the novelty and benefits of the proposed work.*
Keywords: *JAYA optimization, Load frequency control, Parametric evaluation, PV-thermal system, RFB, Ultracapacitor (UC)*

Title of Paper: **Frequency Stabilization in Deregulated Energy System using Coordinated Operation of Fuzzy Controller and Redox Flow Battery**
International Journal of Energy Research, Volume 45, Number 5, April 2021, pp. 7457–7475
DOI: https://doi.org/10.1002/er.6328
Co-authors: Mandeep Sharma, Sandeep Dhundhara & Surya Prakash
Abstract: *The increasing integration of regional power grids, rising penetration of multi-generation sources, and day-ahead power agreements have raised the operational challenges on deregulated modern electric energy systems. Among various challenges, frequency regulation becomes more prominent in the restructured power system (RPS) due to increased uncertainties and intricacies among other operational challenges. A minor deviation in system frequency affects the safety, quality, stability, and operation of the interconnected power system (IPS). An appropriate control mechanism and energy storage device are essential to regulate the system's dynamic responses during continuously varying loading conditions. This study proposed a novel Salp swarm algorithm (SSA) optimized fuzzy-based proportional-integral-derivative filter (FPIDF) controller with redox flow battery (RFB) to regulate the frequency of a realistic multi-area multi-source (thermal-hydro-gas) interconnected power system. All probable contract transaction scenarios are simulated that can be possible in a deregulated power industry. Various nonlinearities such as time delay (TD), governor dead band (GBD), and generation rate constraint (GRC) are incorporated to resemble the realistic operational conditions of the IPS. The effectiveness of the suggested controller has been validated by comparing the system performances with a recently published sine-*

cosine algorithm (SCA) based proportional-integral (PI) controller and SSA-PID controller. The investigation has been further extended by incorporating RFB in the proposed system. The study reveals that the suggested controller provided superior system control under various system uncertainties in all contact scenarios of the competitive electricity market. Additionally, the system performances have been significantly enhanced due to quick response and precise control offered by RFB.

Keywords: *Electric energy system, Energy storage system, Load frequency control, Optimal fuzzy controller, Redox flow battery, Restructured power system, Salp swarm algorithm*

Title of Paper: **AGC Performance Amelioration in Multi-area Interconnected Thermal and Thermal-hydro-gas Power Systems using a Novel Controller**

Engineering Science and Technology, an International Journal, Volume 24, Number 2, April 2021, pp. 384–396
DOI: https://doi.org/10.1016/j.jestch.2020.08.015

Co-authors: Pankaj Dahiya, Emre Çelik, Gulshan Sharma, Haluk Gözde & Ibraheem Nasiruddin

Abstract: *Due to varying structure, random load demands, nonlinearities, parameters ambiguity, steadily escalating size and intricacy of the interconnected power system (IPS), automatic generation control (AGC) is treated as one of the biggest crucial issues in IPS. Hence, expert, intelligent and robust control scheme is indispensable for stable operation of IPS and supply of electricity under sudden load demand disturbances. In vision of this, in this work, a novel cascade fuzzy-proportional integral derivative incorporating filter (PIDN)-fractional order PIDN (FPIDN-FOPIDN) controller is offered as an expert control strategy to deal effectively with AGC issue of IPS. Imperialist competitive algorithm is prolifically utilized for optimizing the controller parameters. Initially, a two area non-reheat thermal IPS is studied in detail and next to attest the efficacy of the technique, the study is extended to realistic two-area multi-source thermal-hydro-gas and reheat thermal three-area systems. The prominent benefit of cascade FPIDN-FOPIDN strategy comprises its great lethargy to large load demands and its supremacy over various latest intelligent classical/fuzzy controllers. The control strategy beats several techniques concerning significant lesser settling time, oscillations, over/under shoots and different performance index values. Finally, a robustness investigation is performed in order to validate the robustness of the controller.*

Keywords: *Multi-source thermal-hydro-gas power system, Reheat thermal power system, Optimal fractional order fuzzy controller, Interconnected electric power system, Generation control of energy system, Robust control operation*

Title of Paper: **Cascade-I$^{\lambda}$D$^{\mu}$N Controller Design for AGC of Thermal and Hydro-thermal Power Systems Integrated with Renewable Energy Sources**

IET Renewable Power Generation, Volume 15, Number 3, February 2021, pp. 504-520
DOI: https://doi.org/10.1049/rpg2.12061

Co-author: N. Kumar, P. Dahiya, G. Sharma, E. Çelik, S. Dhundhara, and M. Sharma

Abstract: *Expert, intelligent and robust automatic generation control (AGC) scheme is requisite for stable operation and control of power system (PS) integrated with renewable energy sources (RES) under sudden/random small load disturbances. Large frequency deviations appear if AGC capacity is inept to compensate for the imbalances of generation and demand. In this paper, a cascade-fractional order ID with filter (C-IλDμN) controller is proposed as an expert supplementary controller to promote AGC recital adequately in electric power systems incorporated with RES like solar, wind and fuel cells. The imperialist competitive algorithm is fruitfully exploited for optimizing the controller parameters. First, a 2-area reheat thermal system is examined critically and then to authorize the worth of the proposed controller, the study is protracted to a 2-area multi-source hydro-thermal system. The prominent benefits of C-I$^{\lambda}$D$^{\mu}$N controller with/without renewable energy sources consist of its great indolence to large load disturbances and superiority over various optimized classical/fuzzy controllers published recently. The sensitivity study validates the robustness of the recommended controller against ±20% deviations in the system parameters and random step load perturbations.*

Keywords: *Automatic generation control (AGC), Power system (PS), Renewable energy sources (RES), Cascade-fractional order ID with filter controller, Hydro-thermal power system, Sensitivity study*

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Aerospace Engineering Division

Volume No 5

deadline for submission
31 October 2021

Theme : **Small Satellites Initiatives in India**

On the Theme:

The small satellite is envisaged to provide platform for stand-alone payloads, which facilitate earth imaging and science missions within a quick turnaround time. Small satellites are miniaturized satellites with wider range of users, all over the world. Small satellites have several advantages over large satellites namely cost effective ways to test newer technologies, opportunities for local industry, bigger basket of potential users and thus a large variety of mission possibilities. Small satellites are transforming the dynamics and economics of space industry and ensure that space technology is no longer monopolized by nations, but is accessible to smaller and newer entities. As a space-faring nation for over last five decades, India is set to become the hub for the small satellite launch market, which is projected to be valued a substantial amount in near future. Start-ups will be the key drivers in this space, with a few among them on the final stages of developing low-cost solutions that conform to global standards. The recent reforms by the Government of India will further accelerate private sector participation in the sector. Although small spacecraft have existed for decades, in recent years, small satellites have gained considerable importance, particularly in defense sectors, which have recently gained prominence owing to technological advances in their development and integration into the armed services of the major space faring countries across the world.

Sub-themes:

* Technological Innovations, Business Opportunities and Commercialization of Indian Space Industry
* Role of MSMEs and Start Ups in Small Satellite initiatives and development
* Cryogenic Engine Technology and Indian Space Market
* Design and Advancement in Satellite Launch Vehicle
* Business Initiatives for Components, Sub-assemblies and Spare Manufacturing in Aerospace Startups
* Provisions and Norms to initiate Start Ups and Entrepreneurship in Aerospace Sector

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Marine Engineering Division

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Theme :

Advancements in Ship Building Technology — Way Ahead towards New Normal

On the Theme:

The COVID-19 pandemic has underscored the global interdependency of nations and set in motion new trends, which is reshaping the maritime transport landscape. The Indian maritime sector is at a pivotal moment facing not only immediate concerns resulting from the pandemic but also longer-term considerations, ranging from shifts in supply-chain design and globalization patterns to changes in consumption and spending habits, a growing focus on risk assessment and resilience-building, as well as a heightened global sustainability and low-carbon agenda. The sector is also dealing with the knock-on effects of growing trade protectionism and inward-looking policies. The shipbuilding industry is now witnessing an unparalleled transformation with growing demand to build new vessels and expand geographic routes, tight budgetary measures, and most importantly, the need to deliver reliable designs at affordable costs. The shipbuilding industry is now characterized with complex value chain, which involves construction of large structures. Moreover, rising demand for flexible ships poses a challenge due to the traditional construction approach prevalent in the industry. In the presence of these demanding market requirements, advanced technologies such as Industrial Internet of Things (IIoT) plays a crucial role in modernizing fleets in a cost-effective manner and also within a shorter time span. IIoT addresses various constraints pertaining to capital allocation, design, and build, and more importantly, supports optimal utilization of vessels during the commissioning and decommissioning phase of new and existing ships.

Sub-themes:

* Technological Advancement in Shipping Industry in New Normal
* Global Recovery in Shipping in New Normal: The Way forward
* Maritime Industry 4.0
* Digital Transformation of Ship Building Industry – The Way Ahead
* Advancements in Shipbuilding Value Chain
* Reorientation of post pandemic marine workforce and Seafarers

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Mechanical Engineering Division

Volume No 6

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Theme :

Applications of Artificial Intelligence and Machine Learning in Mechanical Engineering — The Post Pandemic Pathway

On the Theme:

Amidst the ongoing global crisis, the engineers, scientists, and professionals have so far played a stellar role and have constantly scaling up their efforts and have been responsive to the challenges posed by the COVID-19 pandemic. The application of Machine Learning (ML) and Artificial Intelligence (AI) during the first wave of pandemic encouraged the researchers to outline new angles to explore different fields of mechanical engineering contributing to uninterrupted industrial growth of the country. The rapid advancements in the field of fluid mechanics leads to, unprecedented volumes of data driven experiments, field measurements, and large-scale simulations at multiple spatiotemporal scales. Moreover, Machine Learning algorithms can augment domain knowledge and automate tasks related to flow control and optimization. Tribology is another area which has been empowered with AI, ML, Big Data tools and led to evolution of '**Tribo-informatics / Intelligent Tribology**'. As we embrace the new normal, most of the facets of mechanical engineering will be data driven and AI and ML need to be vectored in to optimize workspace, product and services.

Sub-themes:

* Study of IC Engine in light of Artificial Intelligence (AI) and Machine Learning (ML)
* Design, Operation and Maintenance of Turbine: A Machine Learning Approach
* Advancement in Boiler Design, Operation & Maintenance through AI and ML Approach
* Advancement in Machine Design through AI and ML Approach
* Advances in Thermodynamics and Heat Transfer: The Machine Learning Approach
* Neural Network in Kinematics: Challenges and Opportunities
* Predictive Maintenance and Failure Analysis: AI and ML Approach
* Tribology and Condition Monitoring: Supervised and Unsupervised Learning Approach
* Fluid Mechanics and Heat Transfer: A Data Driven Approach
* Application of Machine Learning in Mechanical System Modeling and Simulation
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Metallurgical & Materials Engineering Division

Volume No 5

deadline for submission
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Theme: **Integrated Computational Materials Engineering**

On the Theme:

Integrated computational materials engineering (ICME) is an emergent field that aims to integrate computational materials science tools into a holistic system that can accelerate materials development, transform the engineering design optimization process, and unify design and manufacturing. Even though in its nascent state, ICME presents a grand challenge laden with prospects of achieving significant economic benefit and accelerate innovation in the engineering of materials and manufactured products. Papers from eminent engineers and technologists on contemporary issues having technical relevance to the theme shall be included in this volume. It is expected that the articles will be of academic values, and reflect experience of professional engineers.

Sub-themes:

* Computer Simulations at Different Time Scales,
* Multi scale Aspects of Materials,
* Creating Newer Materials,
* Thermodynamics of Materials Engineering,
* Principles of Engineering Practice,
* Fundamentals of Materials Science and Engineering,
* Electronic Structure Theory and Methods,
* Applications of First-Principles Methods,
* Molecular Dynamics (MD),
* Material Structures using Finite Element Methods (FEM);
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Mining Engineering Division

Volume No 4

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Theme: Future of Mining

On the Theme:

The evolution of technology, from advanced data analytics to artificial intelligence (AI), has always had the potential to transform the mining industry by realizing operational efficiency improvements, enhancing productivity, improving safety performance, empowering employees to do more meaningful work, and allowing communities to be more prosperous. The COVID-19 crisis has exposed the siloed nature of mining companies and highlighted the need for integrated operations. This is likely to accelerate the adoption of digital technologies, artificial intelligence, and analytics in the mining industry. This volume will discuss what future has in store for the mining sector and the likelihood of vectoring in the intelligent, integrated operations in mining in a comprehensive manner. Papers from eminent engineers, technologists, professionals and researchers on contemporary issues having technical relevance to the theme shall be included in this volume.

Sub-themes:

* Climate-Smart Mining
* Responsible Sourcing (Decrease environmental footprint, Increase social footprint)
* Adoption of low carbon product strategies
* Collaboration to set new mining standards based on environmental, social and governance (ESG) principles
* Digitalization for more sustainable use of resources & lowering input cost
* Automation for enhancing productivity
* Smart mine power distribution and energy management
* New frontiers: deep sea, space exploration
* Resilient Mining Practices

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Production Engineering Division

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Theme :

Applications of Machine Learning, Deep Learning and Artificial Intelligence in Manufacturing — The Way Forward

On the Theme:

The advent of fourth industrial revolution ushered in huge industrial reforms and a paradigm shift in manufacturing from conventional product oriented labour intensive approach to a customer oriented data driven one and reinstated that promoting digital innovations coupled with intelligent decision making is the way forward. With the introduction of IIoT, Digital Twins, Smart Factories, Cyber-Physical Systems, Indian manufacturing sector has created a niche for itself in terms of productivity, efficiency and overall growth. Smart manufacturing revolution has enabled the manufacturing units to achieve timeless manufacturing goal with the objective to produce products with stated degree of precision and accuracy in a cost effective manner. In this context, Artificial Intelligence and Machine Learning are the core technologies which have provided stimulus for this transformation. These technologies, leveraged by Industry 4.0, namely Internet of Things, Advanced Embedded Systems, Cloud Computing, Big Data, Cognitive Systems, Virtual and Augmented Reality needs to be leveraged further as we prepare ourselves for adopting a newer, resilient and a self-reliant manufacturing eco-system.

Sub-themes:

* Data Driven Decision Making in Production Planning and Control
* Advances in Machine Tools: Artificial Intelligence and Deep Learning Approach
* Assessment of Industrial Automation in Machine Learning Environment
* Deep Learning and Smart Manufacturing – The Way forward
* Application of Big Data Analytics in Manufacturing
* Smart Warehousing, Warehouse Optimization and Inventory Management
* Artificial Intelligence and Robotics in Welding Industry
* Lean and Agile Supply Chain: Machine Learning Approach
* Digital Fabrication and 3D Printing
* Industry 4.0 and Project Management: The Way Forward
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Theme:

Development and Application of Functional Textiles

On the Theme:

Functional textiles, as we all know, are textiles with integrated functions of controlling or adjusting according to its application area. Functional textiles, over the years, have developed a niche for itself in textile industry and the associated fraternity. This range includes breathable, heat and cold-resistant materials, ultra-strong fabrics (e.g. as reinforcement for composites), new flame retardant fabrics (e.g. intumescent materials), optimized textile fabrics for acoustic properties, etc. Functional textiles became more and more important materials for various applications and interest in them grew year by year. Papers from eminent engineers, technologists, professionals and researchers on contemporary issues having technical relevance to the theme shall be included in this volume. It is expected that the articles will be of academic values, and will provide a comprehensive coverage of the subject.

Sub-themes:

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  - Performance wear
  - Ready to wear
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* Based on the type of fiber
  - Polyester and advancements
  - Viscose
* Based on the type of functions
  - Anti-bacterial
  - UV-protection
  - Temperature regulating
  - Water and oil repellent
* Based on the application area
  - Geotextiles
  - Personal Protection
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4	Name and address of the Bank Branch (where payments are to be sent by Applicant)	Axis Bank Ltd, Kolkata Main Branch, 7 Shakespeare Sarani, Kolkata 700 071
5	Branch Code	005
6	The 9 Digit MICR code of the Branch (as appearing on the MICR cheque)	700 211 002
7	IFSC Code of the Bank Branch for RTGS mode	UTIB0000005
8	IFSC Code of the Bank Branch for NEFT mode	UTIB0000005
9	Email ID of Beneficiary for advice of payment by Bank	technical@ieindia.org
10	PAN	AAATT3439Q
11	Name in PAN	The Institution of Engineers (India)
12	GSTIN	19AAATT3439Q1ZR
13	Service Tax Registration Number	AAATT3439QSD027