

3.4.4 Number of books and chapters in edited volumes/books published per teacher during the last five years (5)

3.4.4.1: Total number of books and chapters in edited volumes / books published, and papers in national/international conference-proceedings year wise during last five years

Sl. No.	Name of the teacher	Title of the book/chapters published	Title of the paper	Title of the proceedings of the conference	Name of the conference	National / International	Year of publication	ISBN/ISSN number of the proceeding	Affiliating Institute at the time of publication	Name of the publisher
CIVIL										
1	SUJIT KUMAR PRADHAN	Materials today, proceeding	Performance Assessment of Pervious Concrete Road on Strength and Permeability by using Silica Fume	Sustainable materials and practices for build environment (SMPBE-2021)	SMPBE-2021	INTERNATIONAL	2022	https://doi.org/10.1016/j.matpr.2022.02.018		Elsevier
2	SUJIT KUMAR PRADHAN	Materials today, proceeding	Utilization of reclaimed asphalt pavement (RAP) as granular sub-base material in road construction	Sustainable materials and practices for build environment (SMPBE-2021)	SMPBE-2021	INTERNATIONAL	2022	https://doi.org/10.1016/j.matpr.2021.12.564		Elsevier
ELECTRICAL										
3	Dr. Bibhu Pasad Panigrahi		Studies on Input DC and output AC Current of 1-Phase Inverter for Unipolar and Bipolar Switching	IEEE 2023 International Conference on Computer, Electronics & Electrical Engineering & their Applications (IC2E3)	IC2E3	International	2023	ISBN-979-8-3503-3800-3 https://ieeexplore.ieee.org/document/10262439	IGIT, Sarang	IEEE
4	Dr. Pranati Das	Advances in Distributed Computing and Machine Learning. Lecture Notes in Networks and Systems	Dynamic Image Contrast Enhancement Using Image Dependent Decomposition Method	Advances in Distributed Computing and Machine Learning		International	2022	ISBN-978-981-16-4806-9 https://link.springer.com/chapter/10.1007/978-981-16-4807-6_10	IGIT, Sarang	Springer Singapore
5	Mr. Ashutosh Biswal	Intelligent Systems	Frequency Control of Single Area Hybrid Power System with DG	Intelligent Systems: Proceedings of 3rd International Conference on Machine Learning, IoT and Big Data (ICMIB 2023)	ICMIB 2023	International	2023	ISBN-978-981-99-3932-9 https://link.springer.com/chapter/10.1007/978-981-99-3932-9_40	IGIT, Sarang	Springer Nature
6	Dr. Bibhu Prasad Ganthia		Power Smoothing of Photovoltaic System using Dynamic PSO with ESC under Partial Shading Condition	2023 International Conference in Advances in Power, Signal, and Information Technology (APSIT)	APSIT	International	2023	ISBN-979-8-3503-3936-9 https://ieeexplore.ieee.org/document/10201763	IGIT, Sarang	IEEE
MECHANICAL										
7	Mrs.K.S.S Sahoo	Lecture notes in Networks and Systems Book series (LNNS,Volume 431)	Optimization of Operating Parameters for Improve the Combustion in Single Cylinder Four Stroke DIC1 VCR Engine	Intelligent systems	ICMIB	International	2022	https://link.springer.com/chapter/10.1007/978-981-19-0901-6_54	IGIT Sarang	Springer
CHEMICAL										

8	H.K.Sutar, R .Murmu	Lecturer notes in Mechanical Engineering	Recent Advancements in Mechanical engineering	ICRAMERD 2021		International	2022	978-981-16-9057-0		springer
9	Mr K Barik	Advancement in Materials Processing Technology	Recycling and Reuse of Iron Ore Pellet Fines	Springer Proceedings in Materials	AMPT	International	2022	978-981-16-3297-6 https://link.springer.com/chapter/10.1007/978-981-16-3297-6_17		Springer
		Metallurgy								
10	J.Majhi, K.P.Jena, S.K.Sahoo, S.C.Patnaik		The Microstructural and Wear Properties improvement by manganese addition in Al-14Si Hypereutectic alloy	Materials Today: Proceedings	ICPCM	International	2022	https://doi.org/10.1016/j.matpr.2022.04.638 https://www.sciencedirect.com/science/article/abs/pii/S2214785322028012	NIT Rourkela	Elsevier
11	Saroj Kumar Sahu, Rahul Kumar Patra, Jogendra Majhi		Effect of addition of 3 %Al ₂ O ₃ on mechanical and microstructural properties in Al-16Si hypereutectic alloys with pouring temperature	Materials Today: Proceedings	ICPCM 2021	International	2022	https://doi.org/10.1016/j.matpr.2022.03.517 https://www.sciencedirect.com/science/article/abs/pii/S2214785322018673	NIT Rourkela	Elsevier
		ETC								
12	BIKASH CHANDRA SAHOO		Dual Band Circular Patch Flexible Wearable Antenna Design for Sub-6 GHz 5G Applications		2022 IEEE International RF and Microwave	INTERNATIONAL	2022	978-1-6654-8978-2 https://ieeexplore.ieee.org/document/10065238		IEEE
13	Dr Ashima Rout		A COMPARATIVE ANALYSIS ON 5G CELL FREE MASSIVE MIMO	ICICCSP	ICICCSP	INTERNATIONAL	2022	ISBN:978-1-6654-7258-6 https://ieeexplore.ieee.org/document/986235	SRINIDHI,HYD ERBAD	IEEE
14	Dr Urmila Bhanja		Smart Meters: Cyber Security Issues and Their Solutions	ViTECoN	2023 2nd International Conference on Vision Towards Emerging Trends in Communication and Networking Technologies	INTERNATIONAL	2023	Electronic ISBN:979-8-3503-4798-2 Smart Meters: Cyber Security Issues and Their Solutions IEEE Conference Publication IEEE Xplore		IEEE
15	Debapriya Parida		Smart Meters: Cyber Security Issues and Their Solutions	ViTECoN	2023 2nd International Conference on Vision Towards Emerging Trends in Communication and Networking Technologies	INTERNATIONAL	2023	Electronic ISBN:979-8-3503-4798-2 Smart Meters: Cyber Security Issues and Their Solutions IEEE Conference Publication IEEE Xplore		IEEE

16	Dr Ashima Rout		ACOMPATATIVE ANALYSIS ON NB-IOT TECHNOLOGY		ETETI-2023	INTERNATIONAL	2023	https://www.sciencedirect.com/science/article/pii/S1877050919310063	IGIT SARANG	TAYLOR & FRANCIS
17	Chinmayee Panda		Performance Evaluation of an OFDM-FSO-Steganography Model	International Conference on Microwave, Optical, and Communication Engineering	ICMOCE	International	2023	979-8-3503-2160-9 https://ieeexplore.ieee.org/document/10166349	IGIT, Sarang	IEEE
18	Chinmayee Panda	Lecture Notes in Networks and Systems	Performance Analysis of Chaotic OFDM-FSO Communication System	Proceedings of International Conference on Frontiers in Computing and Systems	COMSYS-2022	International	2022	2367-3389 https://link.springer.com/chapter/10.1007/978-981-99-2680-0_30	IGIT, Sarang	Springer
19	Dr Urmila Bhanja		Low RCS Target Detection with Ground Clutter in Multistatic Airborne Radar	2023 IEEE 3rd International Conference on Applied	AESPC	International	2023	Electronic ISBN:979-8-3503-5874-2 https://ieeexplore.ieee.org/document/102921		IEEE
20	Dr Dillip Dash		Low RCS Target Detection with Ground Clutter in Multistatic Airborne Radar	2023 IEEE 3rd International Conference on Applied	AESPC	International	2023	Electronic ISBN:979-8-3503-5874-2 https://ieeexplore.ieee.org/document/102921		IEEE
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27	SUNITA DHALBISOI		A COMPARATIVE ANALYSIS ON 5G CELL FREE MASSIVE MIMO	ICICCSP	ICICCSP	INTERNATIONAL	2022	ISBN:978-1-6654-7258-6 https://ieeexplore.ieee.org/document/9862350	SRINIDHI,HYD ERBAD	IEEE
28	Dr Urmila Bhanja		Effect of High Pass Filtering and Matched Filtering on Baseline Wander		CCPIS	INTERNATIONAL	2023	Electronic ISBN:979-8-3503-1576-9 https://ieeexplore.ieee.org/abstract/document/10291460		IEEE

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30	Sunita Dhalbisoi	2022 ICICCSP	A Comparative Analysis on 5G Cell Free Massive MIMO in next generation networking environment		IEEE	International	2022	Electronic ISBN:978-1-6654-7258-6 Print on Demand (PoD) ISBN:978-1-6654-7259-3 https://ieeexplore.ieee.org/document/9862350	SNIST	IEEE
CSE										
31	R.K Sahoo, A.R Prusty, A Rout,	Lecture Notes in Networks and Systems	Mental Stress Detection Using GSR Sensor Data with Filtering Methods			International	2022	Print ISBN978-981-19-0900-9 https://link.springer.com/chapter/10.1007/978-981-19-0901-6_47		Springer
MATHEMATICS										
32	Mr. Ajay.Kumar Sahoo	Lecture Notes in Electrical Engineering ((LNEE,volume 897))	New analytical Exact solutions of time fractional-Dimensional calogero-Bogoyavlenskii-schiff Equations		AACMME2021	INTERNATIONAL CONFERENCE	2022	Print ISBN978-981-19-1823-0 https://link.springer.com/chapter/10.1007/978-981-19-1824-7_7	IGIT SARANG	Springer



Utilization of reclaimed asphalt pavement (RAP) materials in HMA mixtures for flexible pavement construction

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Tensile Strength Ratio
Bituminous Concrete

ABSTRACT

Production of more RAP material waste arises the problem of deposition. To overcome this problem, RAP materials are recycled and re-used in different layers of pavement which will reduce the cost of pavement construction, reduce the environmental pollution. So, partial replacement with natural aggregate (NA) is an alternative for conservation of natural resources. RAP materials contain bitumen on their surface which will reduce the amount of natural bitumen. Replacement of RAP materials with natural aggregate needs suitable blending proportion. This paper represents laboratory evaluation of replacement of Reclaimed Asphalt Pavement (RAP) materials, a varying percentage of 0 to 30% blended with natural aggregate in terms of Marshall Stability, Indirect Tensile strength and Tensile Strength Ratio to be used in hot mix asphalt (HMA) mixtures for construction of surface course of flexible pavement. Marshall Stability, Indirect Tensile strength and tensile strength ratio (wet and dry condition) of natural aggregate blended with RAP 0%, 10%, 20% and 30% were tested and found 20% RAP mix is suitable for the bituminous road construction.

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Selection and peer-review under responsibility of the scientific committee of the 2nd International Conference on Sustainable Materials and Practices for Built Environment.

1. Introduction

Now-a-days, research has been increased to construct the sustainable flexible pavements which is environmentally friendly and require lesser natural resources [1]. In spite of the improvement of the technology, resilience of waste RAP material still causes serious problems because of scarcity of the disposal sites and the large quantity of waste production. Also, various types of waste materials produced such as bone china ceramic waste and granite cutting waste [2], concrete waste, fly ash, pond ash etc. In this study, author concern about on the RAP material utilization in bituminous pavement. If the RAP materials recycled and reused in place of natural aggregates, overall cost of construction will be reduced, help in protection of environment, and reduce the scarcity of the virgin aggregate. Fully replacement of RAP materials does

not meet the required requirements, so partial replacement could be done. Researchers has studied replacement of RAP from 0 to 100%.

Experimental studies conducted on RAP mixes with varying percentages and found good performance properties [3,4,5]. With an increase in RAP content, the stiffness of the mixture increases which results in reduction in fatigue resistance and established by [6], and refuted by others [7,8]. Enhancement of tensile strength and durability with increase in RAP quantity has been revealed by [9,10,11,12,13,14]. Mechanical properties and durability of RAP found better results at a replacement ratio of 50% to 100% [15]. Incorporation of RAP up to 90% was investigated and concluded flexible pavement may be constructed with a RAP of 90% [16]. It was seen from the literatures that high percentages of RAP may be used at high temperature but fail in low temperature due to stiffening of the binder. Generally, RAP upto 30% found satisfactory results as reported by the researchers.

This study comprises the laboratory evaluation of partial replacement of RAP materials up to 30% with natural aggregate for hot mix asphalt (HMA).

Abbreviations: RAP, Reclaimed Asphalt Pavement material; NA, Natural Aggregate; HMA, Hot Mix asphalt mixture; ITS, Indirect Tensile Strength; TSR, Tensile Strength Ratio.

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A Comparative Analysis On 5G Cell Free Massive Mimo In Next Generation Networking Environment

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Abstract:

Next generation 5G network provides solution for rigorous demand for data with increasing network speeds. Now-a-days cell free 5G network can resolve many issues such as interference that appear in cellular configuration. Massive MIMO with cell free configuration is one of the solutions for massive-MIMO with conventional cellular network. This is also called cell free (CF) MIMO in massive. A CF Massive-MIMO system consists of number of access points (APs) which are distributed uniformly. It serves few numbers of user equipment at same frequency or time resources. It is based on characteristics of channel which is measured directly. Each user and APs possess only single antenna. The channel state information is acquired by APs through time division duplex(TDD)operation. Users transmit uplink pilot signals. The Multiplexing/demultiplexing performed by APs through matched filtering during uplink and conjugate beamforming during downlink. The simplified expressions for uplink and downlink throughputs of single user would lead to maximum/minimum power control algorithms. The objective is to focus a comparative analysis on optimized cell free network which has maximum coverage area, and a minimum transmission power. The interference problem can be resolved in operation of cell free network and it can be resolved by using cell free network that appear normally in cellular network. The major challenge is to achieve the benefits of cell-free configuration that it can be scalable to large network with increase in number of users. A framework could be developed for scalable massive MIMO in cell free system by using the concept of dynamic cooperation cluster

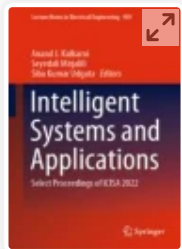
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[Jenamani Chandrakanta Badajena](#) , [Srinivas Sethi](#) & [Ramesh Kumar Sahoo](#)

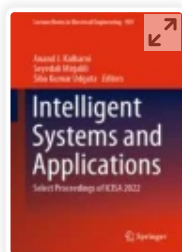
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Part of the [Lecture Notes in Electrical Engineering](#) book series (LNEE, volume 959)

Abstract

A smart wheelchair can be perceived as a wheelchair that can provide autonomous mobility and features to persons who are incapable of using their own body for self-mobility. There are broadly two categories of smart wheelchairs. In the first category, there are provisions for the usage of wheelchairs using in-built functions built



Intelligent Systems and Applications pp 107–120

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Empirical Analysis of the Impact of Homomorphic Encryption on Cloud Computing

[Chinmayee Rout](#) , [Srinivas Sethi](#), [Ramesh Kumar Sahoo](#)
& [J. Chandrakanta Badajena](#)

Conference paper | [First Online: 01 January 2023](#)

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Abstract

Cloud computing has been of greater convenience in recent years owing to its flexibility and on-demand service availability. Cloud computing services allow multiple users to access the available resources concurrently. So, trust is a key parameter from every client's point of view. While accessing the resources in the cloud security becomes the primary concern for every participant

Galvanic Skin Response-Based Mental Stress Identification Using Machine Learning



Padmini Sethi, Ramesh K. Sahoo, Ashima Rout, and M. Mufti

Abstract Stress is vital in assessing the physical and mental state of the human body with significant psychological and physiological changes. A proper and timely diagnosis of stress may make one healthier, happier, and more productive. In the workplace, undergoing many changes leads to stress, trauma, and anxiety. At the same time, hormonal changes in the human body due to stress can be reflected in terms of psychological and physiological changes. This paper has identified three different activities (normal, tension, and exercise) with varied positions (laying, sitting, and standing). Airflow, Temperature, and Galvanic Skin Response (GSR) are different sensors that sense data. This work has emphasized GSR sensors and conceptually connected them with other sensors. GSR values differ regarding the contact surface area with the body. Different machine learning algorithms such as; Naive Bayes, Support Vector Machine, Decision Tree (J48), and Random Forest have been used to analyze sensed datasets. Random Forest Algorithm has been observed to perform better in the proposed work.

Keywords Physiological data · Psychological data · GSR Sensor · Machine learning

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Secure Virtual Machine Allocation for Prevention of Side Channel Attacks in Cloud Computing

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2018 International Conference on Computing, Networking and Communications (ICNC)

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Abstract:Cloud computing allows customers to use a variety of computing resources on-demand and with no maintenance overhead. One of the major issue concerning cloud computing is ... **View more**

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Abstract:

Cloud computing allows customers to use a variety of computing resources on-demand and with no maintenance overhead. One of the major issue concerning cloud computing is security. From the end user's perception, migrating to cloud exposes them to additional security risks that are entirely considered to be produced by other occupants who may have some access to shared resources. The co-location or co-residence attack, otherwise called as co-resident assault, is the focus of this research. This is a type of attack in which malevolent individuals construct side channels and steal confidential information from VMs that share the same server. Here we have studied on the co-resident attacks and the mechanisms to detect and prevent the attack. To address this issue, we have focused on the PSSF VM allocation policy as PSSF policy has high security with low energy consumption.

Published in: 2022 International Conference on Intelligent Controller and Computing for Smart Power (ICICCSP)

Date of Conference: 21-23 July 2022 **DOI:** 10.1109/ICICCSP53532.2022.9862404

Date Added to IEEE Xplore: 25 August 2022

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Abstract:

This era brings RE ascent more popular in energy generations evolve response in enhancing concern towards environmental issues. Among all RE sources wind energy becomes more attractive in the sense of nonhazardous, cleanest and most cost-effective source of energy. This 20th century appeals the risk of shortage in fossil fuel, pollutions, carbon dioxide emissions and the surge of power demands. This develops a hope to settle our future energy demands to be recovered the wind energy can play the vital role in this aspect. Fulfilling the clean energy source, this renewable source can also be a part of growth in energy sector. This review work presents the worldwide generations of wind power and its control considering all constraints and parameters.

Published in: 2022 1st IEEE International Conference on Industrial Electronics: Developments & Applications (ICIDeA)

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Fuzzy Logic Based Fault Current Prediction in Double Fed Induction Generator Based Wind Turbine System

Subash Ranjan Kabat^a  , Chinmoy Kumar Panigrahi^a, Bibhu Prasad Ganthia^b

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Materials Today: Proceedings, Volume 80, Part 3, 2023, Pages 1703

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Abstract

Over the past few years, the wind turbine industry has expanded widely and is increasingly taking production into account. There are various reasons why wind energy in electricity networks can be accumulated. In the event of a wind production, it not only remains safe and sustainable, but has low operating costs. DFIG's numerous advantages in the production of power electronic converters and the growth of double feeding induction generators, and their benefits of low conversion capacities, high energy and flexible power control were extensively used in large-scale wind power applications. DFIG as a wind turbine linked to a grid which is subjected to various forms of faults in this innovation. Crowbar is used and is a kind of a safety mechanism for wind turbine generators. Fuzzy Logic is also used to safeguard DFIG for defects presented in this paper.

Introduction

People's use of wind or wind power has a long history. In Persia, the earliest windmill design for grain grinding and water pumping in approximately 500–900 CE The first wind turbine producing electricity in the world was installed at the end of July 1887. A major benefit of wind power is the fact that it is a renewable energy source. Renewable energy is generally defined as energy from resources which, on a human schedule such as thermal, wind, hydraulic and tides, are continuously refilled with nature. The use of renewable energy for electricity production has been developed worldwide due to heavy pollutants produced from traditional fossil energy sources. It is estimated that approximately 208 GW of renewable energy generated electricity were installed worldwide and a total of 1360 GW of renewable energy capacity was achieved in 2011. For non-hydro-powered renewable, the capacity exceeded 390 GW, an increase of 24% over 2010. Worldwide, wind energy accounted for nearly 40% of renewable energy, solar photovoltaics for nearly 30% and hydropower almost 25%. By the end of 2011, renewable energy generation was more than 25% and it supplied around 20,3% of the world's electricity supply. Wind as a source of renewable energy has been given more attention and is now playing an increasingly important role as a source of energy because of its inherent characteristic of carbon-free electricity generation. In total, 306 wind farms had operated in the UK up to 2011, producing 5,737,60MW of grid power. Over 35 GW were added to wind power in 2013, for a total of more than 318 GW. All types of renewable energy have

Radial Basis Function Artificial Neural Network Optimized Stability Analysis in Modified Mathematical Modeled Type-III Wind Turbine System Using Bode Plot and Nyquist Plot

Bibhu Prasad Ganthia¹, Subrat Kumar Barik¹ and Byamakesh Nayak¹

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ECS Transactions, Volume 107, Number 1

Citation Bibhu Prasad Ganthia *et al* 2022 *ECS Trans.* **107** 5663

DOI 10.1149/10701.5663ecst

¹ KIIT Deemed to be University, Bhubaneswar

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Abstract

Stability is the major factor that should be maintained in every power system. To predict and to optimize the nonlinear parameters this research provides a control system transient analysis using Bode plot and Nyquist plot to regulate the stability in wind power generation. The rotor speed should be balanced with respect to the generation of generator power for viable wind power generation. This study introduces a sliding mode controller for controlling wind speed and preserving system stability, and it may be improved using an Artificial Neural Network based Radial Basis Function Neural Network to eliminate nonlinearities induced by changing wind speed. The tip speed ratio approach is utilized in this study to harvest the most power from wind energy. To optimize this TSR method, a PI-RBFN tuned sliding mode controller was utilized to get maximum power while minimizing active power losses. This proposed approach may be used to address nonlinearities in the pitch angle caused by changing wind speed. As a result, the resilience of the redesigned Type-III wind turbine system is investigated using MATLAB simulink in this study. The simulation results are compared to the current DFIG-based modified Type-III wind turbine method.

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Genetic Algorithm Optimized and Type-I fuzzy logic controlled power smoothing of mathematical modeled Type-III DFIG based wind turbine system

[Bibhu Prasad Ganthia](#), [Subrat Kumar Barik](#), [Byamakesh Nayak](#)

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Abstract

This study focused on compensating for reactive power loss and minimizing active power loss during transients caused by fast changes in wind speed. Under transient circumstances, reactive power is critical for improving the voltage profile. In this work, we discuss how to compensate for reactive power losses while reducing active power losses. The goal function of the rotor side and grid side controllers, which are related with active power losses, is minimized using a genetic algorithm approach for voltage profile improvement and power smoothing. Two constraints for rotor side and for both rotor and grid side converter designed here to improve the voltage profile during faults. Further this work carried out by MATLAB simulink and GA optimization technique used for power smoothing. The comparative results on active and reactive power smoothing presented in this paper using Type-I Mode IV FLC and Genetic Algorithm Technique under transient conditions. The main motive is to validate that the Modified Type III wind turbine system can give efficient results using adaptive techniques to control active and reactive power. This research work can be helpful for the researchers to analyze their work reference with these research findings.

Introduction

Wind energy as a renewable source of energy now such a demand for all power sectors because of the clean and free availability. For balancing the power demand it can play a valuable role to enhance the efficiency of the energy for both commercial and domestic utilities. The best part of this source of energy is there is no hazardous emission of harmful gases from it which cause environmental pollution. Hence it is used as a perfect source of energy and can fulfill our energy demand. We need balance and stable power system with full control to achieve high output. Renewable sources now a day's play a vital roles to balance out huge power GTD system. Now we produce 15 to 20 million MW power from renewable sources and wind is most economic source of power generation. This can be used as standalone mode as well as grid integrated for smoothing the power demands. Technical wind turbine system needs both mechanical and electrical components for full control over the generation, transmission and distribution of power. Initially we are using DFIGs that is doubly fed Induction generator without any control mechanism which cause losses due to sudden changes in wind speed as these are designed for fixed speed mode of operation [1], [2]. Later on we develop Type-III wind turbine system which uses DFIGs with full control over speed and power generations. These are designed with Rotor side and grid side converter based with Maximum power point tracking abilities. Then Type-IV PMSG based used but

Frequency control of single area Hybrid power system with DG

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Abstract. Analysis of power output vs load profile in a system with scattered generation resources connected to the existing traditional energy system is critical, because even a minor frequency shift might cause a total blackout. The load frequency management problem for a hybrid coal-based system incorporated with DG, consisting of fuel cells, diesel engine generators, wind turbine generators, aqua-electrolyzer, and battery energy storage system is explored in this work. Due to the significant output power variation of wind energy systems, integrating them into DG offers a challenge for the creation of an appropriate controller. The stochastic volatility of the load profile makes this issue more difficult. The study's suggested control method relies on differential evolution (DE). For various disturbances, the efficiency of frequency stabilization is studied. The results demonstrate how the hybrid DG system's PID controller was able to achieve the least amount of frequency variation.

Keywords: *Differential evolution (DE) algorithm; Distribution generator (DG); Proportional integral derivative (PID); Renewable energy source (RES).*

1 Introduction

The two primary objectives of power system controls are to preserve system integrity and return the system to normal functioning following any kind of physical disruption. In other words, maintaining the system's planned performance and restoring it following a disruption like a short circuit and loss of generation or load are both included in power system control [1-2]. Significant advancements in both the technology of distribution generators (DGs) and renewable energy sources have been made in recent years (RESs). Utilization of RES/DG and micro-grids is increasing, which has a variety of technical effects and critical implications for how well-suited conventional power system control methods are

Frequency control of two region two-unit systems with PDF + (1+PI) controller

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Abstract— Unpredictable load variation in the power system results a frequency shift and if the variance is significant enough, the process may fail. Due to the growth in dimension and complexity of power infrastructures as well as the increase in power consumption, the use of intelligent systems power systems has become essential so, a better controller is always welcome. In this study, a widely utilized two-zone non-reheat type system is employed to examine the performance of PDF + (1+PI) controller. The Differential Evolution Algorithm is used to set the controller parameters with ITAE serving as the goal function. The system is created in the MATLAB/SIMULINK environment. The result shows that, in comparison to other controllers, the PDF + (1+PI) controller offers greater dynamic response by reducing time needed to settle and undershoots.

Keywords—Differential Evolution (DE) algorithm; Proportional Integral Derivative (PID); Tilted Integral Derivative (TID); Tilted Integral Derivative with Filter (TIDF)

1. INTRODUCTION

Any imbalance between supply and demand causes a frequency shift [1-3]. And if the variance is significant enough, the process may fail. Putting in quick-acting energy storage devices can help to mitigate this issue. However, adding similar devices in all units raises the system costs [4-5]. Because of the delayed response of the governor, it is not always possible to keep the frequency variation to a lowest. Since the first grid operations involving a linked power system, there has been worry about the effectiveness of the power system's control. The notion of good control in the operation of an electric utility must be linked to the service quality, which must then be quantified. Due to the growth in dimension and complexity of power infrastructures as well as the increase in power consumption, the use of intelligent systems power systems has become essential. The smart technologies have human-like knowledge in a particular field, are able to adjust to changing settings and learn how to perform better, and can articulate their thought processes. The power system control has undergone significant changes in the last few decades, moving from a straightforward process control to a distributed processing system that can handle multiple layers of application operations. The challenge of an interconnected system's AGC is to balance generation and

demand while also allocating generation across multiple systems to maintain the overall system's operation schedules. As a result, following a first round of random load accommodation via governor action, the purpose of AGC in an interconnected system that is either manually or automatically operated is to assign newly generated updates to already chosen machines. It is essential to achieve significantly higher frequency stability than the speed governor can provide. In order to do this, we must adapt our speed keeping with an effective control plan. In order to reduce frequency variations, the purpose of load frequency control (LFC) is to preserve balance between load profile and power production. In an electric power systems LFC is being used to control the active power, generators output in response of load variation [6-7].

Different types of load frequency controllers like PI and PID controllers are used in power systems because they are very simple for implementation but its performances degraded when the system become complex due to disturbances. So, for this reason we need better controller design to overcome load fluctuation.

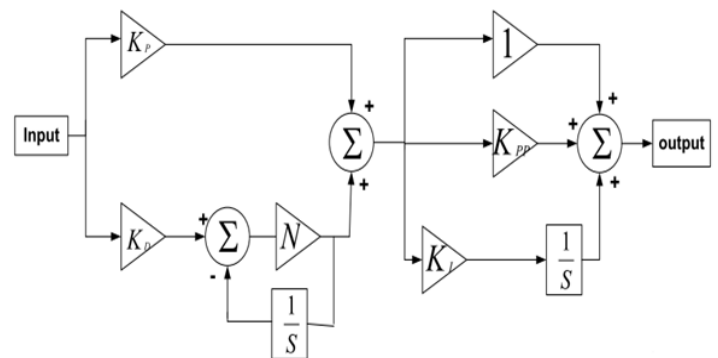


Fig.1 Structure of PDF plus (1+PI) controller

S. panda et al. [10], apply the FA algorithm to tune the controller parameter and the controller's effectiveness is determined by examine the results with distinct paper like BFOA [8], GA [8], DE [9] and PSO [9] approaches. The TID controller for LFC is presented in [11]. In terms of ITAE and Settling time,

A DE algorithm optimized TIDF plus second derivative Order controller for Load Frequency Control of two-area thermal power system

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Abstract— In this paper a unique TIDF plus Second Derivative Order (TIDFD²) controller is recommended for load frequency control of two-area non reheat thermal unit power systems where the unique TIDFD² controller is placed in first area and second area. In the below system model controller parameter are tuned by the help of differential evolution algorithm. An effort has been made to prove that the TIDFD² controller is showing better result as compared to other controller which is recently being published like Firefly Algorithm optimized PID controllers and differential evolution algorithm optimized TIDF controllers in the same thermal power system. From Simulink response it is found that settling times, overshoots of tie-line power deviation and frequency are better as compared to recently published work. Hence TIDFD² controller is having better response following a disturbance.

Keywords— Proportional Integral Derivative (PID); Tilted Integral Derivative Controller with Filter (TIDF); Tilt Integral Derivative with Filter plus Second Derivative Order (TIDFD²); Differential Evolution (DE).

1. INTRODUCTION

The role of Load Frequency control (LFC) is to maintain the symmetry between power generation and load demand because to minimize the deviations of frequency. In an electric power systems LFC is being used to control the active power, generators output in response of load variation [1-3]. Different types of load frequency controllers like PI and PID controllers are used in power systems because they are very simple for implementation but its performances degraded when the system become complex due to disturbances. So, for this reason we need better controller design to overcome load fluctuation. S. panda et al. [7], apply the FA algorithm to tune the controller parameter and the performance of the controller is establish by examine the results with distinct paper like BFOA [4], GA [4], DE [5] and PSO [6] approaches. The TID controller for LFC is presented in [8]. Here an effort has been made to improve the performance with TIDFD² controller.

2. METHODS

2.1 Investigated power system

The Figure 2 considered for investigation [7].

2.2 Control structure

TIDFD² controller is nothing but a TIDF controller with addition of a second derivative order term. TIDFD² controllers are placed in both area. TIDFD² control is easy to adjust, has a high spurious removal rate and is more robust than the TIDF control. Its structure is shown in Figure1; second derivative gain (K_{DD}), nonzero real number (n) and derivative filter coefficient (N) are present in the controller in addition to K_P , K_D and K_I [8]. The formula for the controller is shown in equation (1).

$$TF_{TIDFD^2} = \frac{K_P}{s^n} + \frac{K_I}{s} + K_D \left(\frac{N_C s}{s + N_C} \right) + K_{DD} s^2 \quad (1)$$

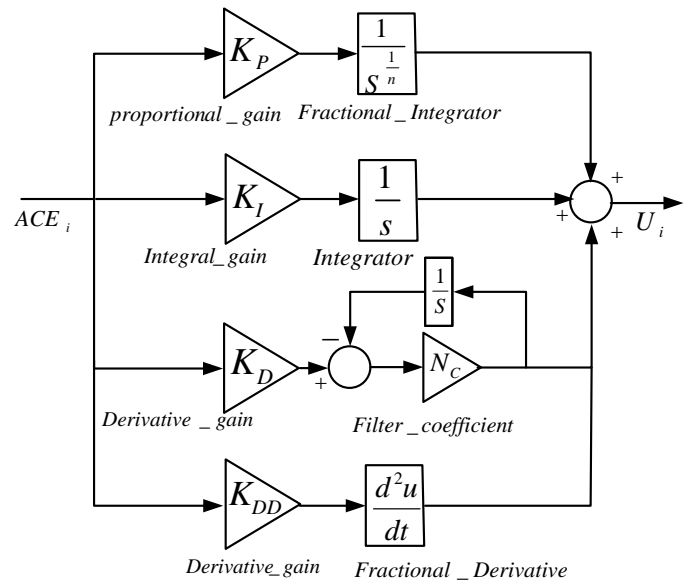


Figure 1: Proposed TIDFD² controller

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In this study, a fuzzy control energy management system (EMS) for a microgrid system is designed and implemented, as well as an analysis of the reactive power performance... [View more](#)

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Abstract:

In this study, a fuzzy control energy management system (EMS) for a microgrid system is designed and implemented, as well as an analysis of the reactive power performance of solar-PV systems with battery and non-battery energy storage devices (BESS). Applying fault scenarios to the system will properly validate the study. In order to run distributed power sources and energy storage systems after a failure, the reactive power, voltage, and current at the point of common coupling of the solar PV-based system and the solar PV with BESS and without BESS system are compared and utilized in MATLAB/Simulink. The intended state of charge is managed through fuzzy control to extend the battery's life. In order to guarantee the dependability of the power supply by the generating and distribution systems, the energy management system in microgrids has the ability to direct and give effective control.

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Abstract:

Renewable energy sources have emerged as a viable option to meet the rising energy demand, slow down climate change, and promote sustainable development. This paper offers a collection of unique solutions that permit information interchange between the consumers and the distributed generating center, which state that they need to be managed effectively. The integration of these systems is performed in a distributed manner using microgrid systems. In microgrids, the energy management system should be able to guide and provide efficient control to ensure power supply reliability by both the generation and distribution systems at the lowest possible operating cost. The application of renewable energy sources for energy management in a microgrid system is discussed in this paper, along with performance analysis and a look at the impact of load variation on system performance.

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Sarat Chandra Swain

A d-q-0 Frame based Deadbeat Controller for VSC-HVDC Systems and its performance under L-L AC fault condition

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Abstract— The focus of this paper is verification and analysis of the performance of deadbeat based regulator in the d-q-0 frame i.e the synchronous frame for the regulation of HVDC employing VSC. The performance analysis of deadbeat controller along with its dynamic response is of prime importance. The design of deadbeat control system is carried on and the controller so obtained is implemented in the detailed model. The system performance is verified owing to variations in the per unit value of the active power, current, reactive power and voltage (the system being subjected to L-L AC fault). The perk of developing and implementing the deadbeat controller is it shows fast tracing and detecting ability, it is accurate and robust and has fast response and feedback abilities to any grid transient disturbances. The MATLAB/SIMULINK platform is put into use for the verification of simulation test results.

Keywords— PI, HVDC, Deadbeat based Controller, VSC

I. INTRODUCTION

Since time past, the engineers and scientist have been working to reduce transmission loss and lessen economic rates. This is precisely the reason why HVDC i.e High Voltage Direct Current came to limelight. It has an upperhand over HVAC i.e High Voltage Alternating Current because of its cost effectiveness and reduced transmission losses. At the onset, LCC i.e line commutated converter served the purpose of both rectifier station and inverter station. The problem with line-commutated converter(LCC-HVDC) is that it has no provision of full controllability of the system parameters. Rapid development in the discipline of power electronics was seen in the last century. By making use of these electronic switches and devices like IGBTs and GTOs, the use of VSC(Voltage source converter) based HVDC became a new normal. VSC-HVDC has a number of advantages as compared to LCC-HVDC. There is no requirement of any external commutation circuit for the VSC based HVDC system. It has an advantage of bidirectional current flow which means there is no requirement of changing the voltage polarity back and forth. Also, the active power along with the reactive power have the provision of being controlled and regulated in a VSC-HVDC system, in an independent manner [1,2]. It is proven to be feasible in supplying power to AC systems which are weak in nature and also to the networks which are passive in nature. Loads at far and remote ends can also be powered by using

HVDC system. [2], [3]. Non-renewable energy resources like solar and wind require small scale power generation which is fed through HVDC

HVDC system contains two VSCs coupled by the help of a high voltage DC link(HVDC). The conventional PI controller is used widely but its operation is limited to only certain and specific range of bandwidth. Operation beyond this pre-defined bandwidth makes the system exhibit instability in its functioning. The PI based non-linear controller also needs effective tuning also. So, PI based regulator can be replaced and substituted by the deadbeat regulator. As a result such a controller can be designed which appropriately gets by with the uncertain parameters, thereby showing trouble-free tuning. The deadbeat controller can be implemented and verification can be carried on as to how the system behaves on being subjected to the grid transient disturbances [3],[4],[5].

The article targets the implementation of the deadbeat regulatory system for regulating and controlling the active power and reactive power. The functioning of the control system can be understood by representing it in the form of two loops viz. an outer loop which processes slowly and an inner loop which processes swiftly [5], [6]. The outer loop uses PI based regulator whereas the inner loop makes use of the deadbeat regulator. Fast tracing and detecting ability and the ability of fast feedback response to any grid transient errors of the deadbeat controller makes the verification accurate and exact. Deadbeat controller has proven to be an efficient one with respect to coordination with other converters. Performance analysis of the system i.e variation in the magnitude (in per unit) of parameters due to grid transient faulty disturbances besides errors, is described in the paper [7],[8].

The synopsis of the paper goes this way. VSC based HVDC system's modelling is demonstrated in Section II and Section III gives a vivid study of deadbeat based regulator. Then, the modeling and designing of proposed deadbeat based regulator; and simulation test outcomes are included in Section IV and section V respectively. Besides that the summary of the entire paper is in Section VI.

Industry 5.0 and Sustainable Development in the Developing World

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Abstract

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- III. Fifth Industry Definitions

Abstract:

After World War II, India emerged as one of the world's largest industrial powers, opening its political and economic influence. The Fifth Industrial Revolution is the next industrial revolution, and its goal is to harness human experts in cooperation with smart machines and robots, to obtain manufacturing with higher resource efficiency and easier use compared to the Fourth Industrial Revolution. It is expected that the focus will be on the human side, sustainability, and the environment. This paper looks at the industrial policy in India, emphasizing the continuous coordinating role of the government in various fields and that India will be one of the world's most trends towards investment and a suitable environment to keep pace with the latest industrial transformations. We aim to present a vision of the fifth industry, its applications, the techniques used, and the importance of developing countries in this field.



The Fourth Industrial Revolution and The

Published in: 2023 IEEE 3rd International Conference on Sustainable Energy and Future Electric

Optimized T2FFOPID Regulator for Interconnected Power Grid

Publisher: IEEE

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Smrutiranjana Nayak ; Sanjeeb Kumar Kar ; Subhansu Sekhar Dash [All Authors](#)

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Abstract

Abstract:

The vague qualities of sun based, wind sources, and burden make current AC microgrids exceptionally intricate and cause recurrence variances. It is especially needed to keep up with power harmony among age and request by arranging a reasonable recurrence guideline regulator. From now on, this examination presents utilization of a HHO-PS based T2FFOPID regulator for recurrence guideline of a two-area system. In the following stage, predominance of determined T2FFOPID over PID, T1FPID & T1FFOPID regulator is illustrated. To confirm the viability of the recommended limitation strategy, diverse burden aggravations just as different paces of sun oriented and wind sources infiltration have been thought of. The proposed restriction approach shows critical improvement in unique reactions with quick damping of motions. Examinations of results insist the better presentation of T2FFOPID over different regulators with respect to minulest mistake models and undershoot/overshoot of recurrence deviations at different aggravations. Moreover, affectability

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Change Detection Filter Technique of HVDC Transmission Link Fed by a Wind Farm

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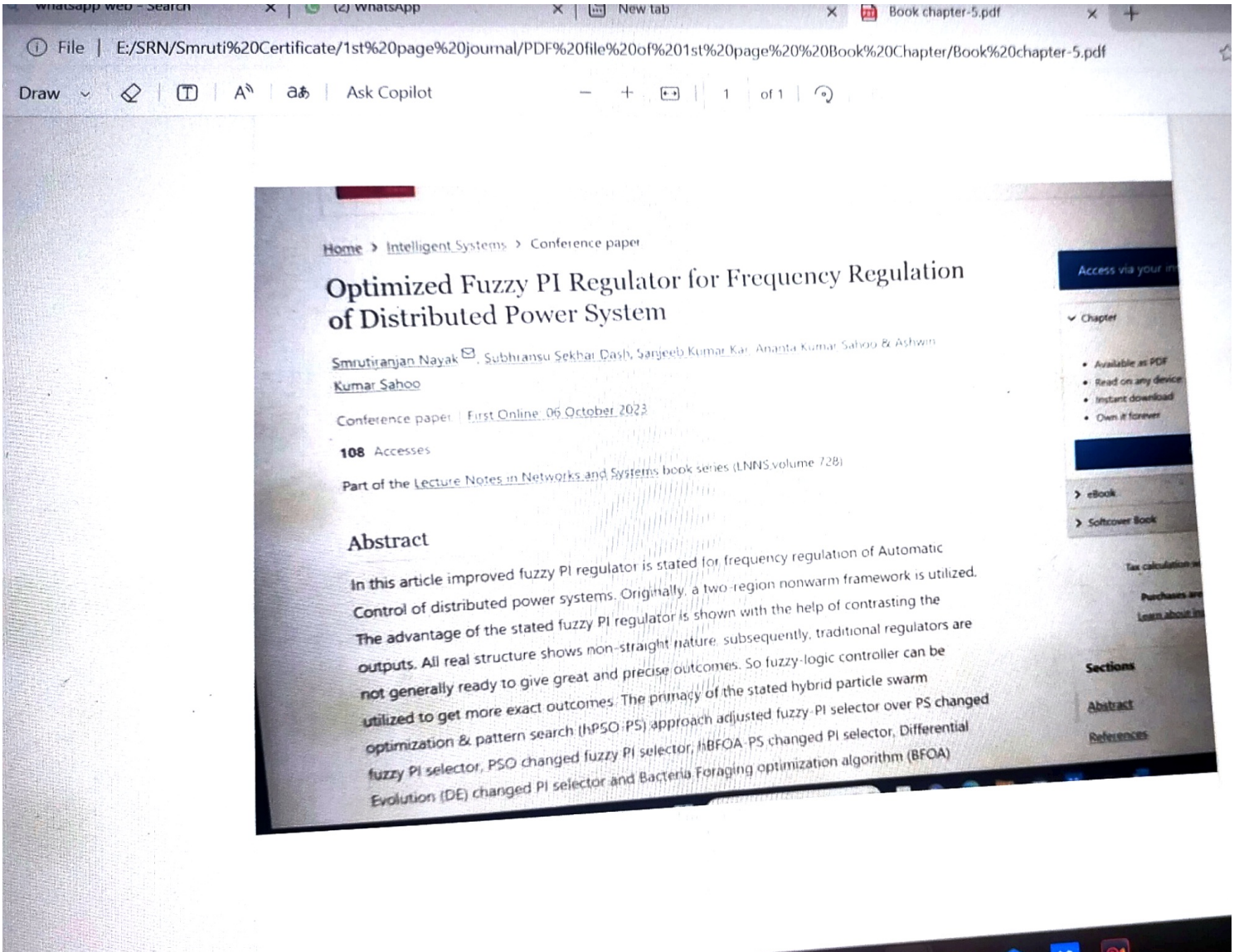
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- II. METHODS
- III. DESCRIPTION OF THE DESIGNED MODEL
- IV. RESULTS AND

Abstract:

This research paper investigates the change detection filter technique (CDFT) with a decision tree-based event (fault type) classifier for recognizing and categorizing power system disturbances on the HVDC transmission link. A change detection filter is employed to the average and differential current components, which detects the point of fault initiation and records a change detection point (CDP). The half-cycle differential and average currents on both sides of the change detection point are sent through the signal processing unit, which produces the respective target. The extracted target indices are sent through a decision tree-based fault classifier mechanism for fault classification. In comparison with conventional differential current protection systems, the developed framework is faster in fault detection and classification, accuracy. The new technology allows for prompt identification of the fault category, allowing electrical grids to be restored as quickly as



Application of Different Control Techniques of Multi-area Power Systems

Smrutiranjay Nayak, Sanjeeb Kumar Kar & Subhansu Sekhar Dash

Conference paper, First Online: 18 October 2021

77 Accesses

Part of the Artificial Intelligence, Enhanced Software and Systems Engineering book series (AISSE, volume 1)

Abstract

A fire-fly calculation is stated for load recurrence for control of many-district power frameworks. At first, both equivalent zone and non-warm framework are thought of & the ideal additions of the corresponding basic subsidiary regulator are upgraded utilizing the firefly calculation strategy. The prevalence of the proposed approach is exhibited by contrasting the outcomes and some as of late distributed strategies like hereditary calculation, microbes scrounging enhancement calculation, differential development, molecule swarm advancement, crossbreed microscopic organisms for-maturing improvement calculation, molecule swarm streamlining, and Ziegler-Nichols-based regulators for a similar interconnected force framework. Further, the proposed approach is reached out to a three-inconsistent territory warm framework considering age rate limitation and lead representative dead-band. Examinations uncover on correlation that corresponding essential subsidiary regulator gives much better response contrasted with vital and relative necessary regulators.

Smart Meters: Cyber Security Issues and Their Solutions

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Abstract—Smart meter, the advanced energy meters [1] is one of the most important components of Smart grid (regarded as the future generation of today's power infrastructure distribution). If the power company begins for the smart grid implementation, every house and premises need to be installed with smart meters. All information such as consumers' private information and consumers' electricity transactions stored in a database. So, Attacks on Data in smart meters is considered our main concern. These databases may be got into with or fall into the hands of blackmailers, criminals, cyber hackers, power company workers, and other anonymous groups who may perform spiteful actions, which have no limits. Several attacks on data and existing solutions to such attacks are discussed in this paper. In our proposed model, algorithms like RSA, Blowfish, AES, DES, 3DES are used. Two cryptographic algorithms are proposed- Hybrid RSA-Blowfish Algorithm and Eigenvalue Encryption Algorithm. In the Hybrid RSA-Blowfish Algorithm, the plain text is taken and encrypted into an intermediate cipher using the Blowfish algorithm. Then this intermediate cipher is again enciphered using the RSA algorithm which now creates a more protected cipher producing a public and a private key. In the Eigenvalue Encryption Algorithm, the Eigenvalue of the matrix taken is calculated and the positive eigenvalue becomes the key. This key is then multiplied with subsequent reversed ASCII values of the plain text and a numerical series and forms the ciphertext. In this paper, the output of both the algorithms along with the decryption process is shown. Later on, our proposed algorithms with the existing algorithms are compared on the basis of four parameters- Avalanche Effect, Encryption Time, Decryption Time and Memory Used. A comparative study based on the Statistical Data is done and graphically shown. The attacks prevented by our proposed algorithms are also discussed in this paper.

Index Terms—AMI, BLOWFISH, SCADA, Cryptography

I. INTRODUCTION

In these Present days the electrical power system which is used by different companies, organizations, businesses have remained nearly the similar ways as like as times before. With the growth in electrical power demands, problems like voltage sags, overloads and blackouts have also increased. Additionally, these electrical power systems also release a lot of carbon emissions. Smart grid is the next generation of power distribution system that is probably to upgrade the electrical power distribution system and resolve many of these current problems raised in power distribution [2]. The term smart grid offers electricity demand from the centralized

and distributed generation stations to the customers through transmission and distribution systems. Security be one of the most important problems in smart grid systems. The three main security objectives such as (a) Availability (b) Integrity (c) Confidentiality must be incorporated in the smart grid system [3]. Security plays a vital role to store information and communicate it across the undefined networks with protected manner. Hence, the secure communication is the elementary requirement of every operation over networks. It has been observed that Cryptography is an important technique for a secured communication environment and transmission of data through the security services like data integrity, confidentiality, authentication, access control and non-repudiation [4]. It acts as a shield to the sensitive data by communicating it in such a jumbled manner so that only the authorized user can have an access to this information after recovering to the original text [5].

II. LITERATURE REVIEW

In 2012 Fadi Aloula et al. discussed about the complexity and the Vulnerabilities of the smart grid system, precisely to this massive heterogeneous network is emphasized. The challenges which exist in Smart Grid network for secured environment and the Security Solutions provided to the networks are not adequate enough to secure Smart Grid networks. Henceforth concluded by over viewing the recent and required security solutions for the Smart Grid [3]. The Cyber-security test-bed which is based on SCADA (supervisory control and data acquisition) has two main components such as communication infrastructure and SCADA software. This Cyber-security test-bed is used to examine the Attack that occurs in Man-in-the-middle like an ARP spoofing which allows the attackers to have an interruption in the communication. Y Yang, K McLaughlin et al. proposes a future work strategy which focuses on Cyber-security issues in the SCADA System by applying intrusion detection and prevention technology [5]. The AMI architecture consists of a network of computers, meters, sensors, and devices for data analysis and data recording [6]. So, it is more vulnerable to cyber-attacks [7]. As a result, the security of Smart Grid (SG) will have to be provided but not limited to the Advanced Metering Infrastructure (AMI). Abdul rah man Okino Outoze a.b et al. discussed Several

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Conference paper


Performance Analysis of a Chaotic OFDM–FSO Communication System

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Abstract

Free Space Optical (FSO) communication offers enormous solution to last-mile connectivity and serves as complementary access technology to Radio Frequency (RF) and millimeter wave wireless systems. However, different weather conditions such as thick fog, smoke, and turbulences affect the system performance for which Q-factor degrades. This work implements chaotic concept to the hybrid OFDM–FSO system which successfully mitigates inter-channel interference (ICI) and fading. In this paper, the Q-factor under different weather conditions is estimated and compared with the conventional chaotic FSO system. Again, the BER performance of the proposed model is measured for different turbulence conditions and is compared with existing FSO systems. The proposed chaotic OFDM–FSO

Performance Evaluation of An OFDM-FSO-Steganography Model

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Abstract— A steganography technique for a secured free space optical communication system is presented in this work. In this technique, the original message is hidden by a cover image and hidden message is extracted at the receiver without being eavesdropped. The work is carried out by considering gamma-gamma channel model under adverse turbulence and weather conditions. The proposed orthogonal frequency division multiplexing-free space optical communication-Steganography (OFDM-FSO-Steganography) model yields better BER and covers maximum distance as compared to the existing FSO system.

Keywords — FSO, Gamma-Gamma Channel Model, OFDM, Steganography.

I. INTRODUCTION

Free space optical communication (FSO) has recently evolved as a complimentary technology to radio frequency wireless system due to its high bandwidth, data rate, immunity to electromagnetic interference and license free spectrum. The goal of FSO is to send data, audio, video, and pictures at high data rates. For last-mile access networks, FSO system is extensively used [1]. On the other hand, high spectral efficiency of orthogonal frequency division multiplexing (OFDM) makes it useful for digital audio/video broadcasting, wired/wireless communication systems [2, 3]. OFDM technology provides higher data rates and reduces inter-symbol interference (ISI). OFDM is integrated with FSO that offers a potential solution for transporting data with a high data rate, a long link range and improved BER [4,5]. The performance of the proposed model referred as OFDM-FSO-Steganography model is analyzed for various weather conditions under Gamma Gamma channel model.

Steganography is used to safeguard sensitive or secret information against various intrusion attacks [6-8]. Various authors have used different techniques to secure the data. In [9,10] authors have addressed the architecture of steganography with different cover objects and various other security techniques such as cryptography, steganography, and watermarking are discussed [10]. Eyssa et al. have used steganography technique with OFDM system in wireless medium [11]. However, none of the authors have utilized the steganography technique in hybrid OFDM-FSO model.

The contribution of the paper is mentioned below.

- For the first time, the performance of OFDM-FSO-Steganography model is analysed for a FSO under various turbulence and weather conditions over a gamma gamma channel and compared with the existing FSO system.

The arrangement of paper is given as follows. OFDM-FSO-Steganography model is described in Section II. The steps and flow chart of Image Steganography is explained in Section III. OFDM-FSO channel model is discussed in Section IV. Section V and VI discusses the result and concludes the paper respectively.

II. OFDM-FSO-STEGANOGRAPHY MODEL

The generated pseudo random bit sequences are given to quadrature amplitude modulator followed by OFDM modulator. The optical carrier is generated by continuous wave (CW) Laser. The OFDM modulated data and optical signal are given to Mach Zehnder modulator. The modulated data is encoded by the steganographic encoder to hide the modulated data with a cover image and a stego key generated by the encoder referred as stego object. The resulted stego object is transmitted through a FSO channel. The stego object gets deteriorated by the atmospheric turbulence and weather conditions. At receiver side, the stego key is removed and the secret data is extracted from the cover image in the steganographic decoder. Further, the decoder data is processed through a photo detector OFDM demodulator QAM demodulator to extract the original data shown in Fig.1.

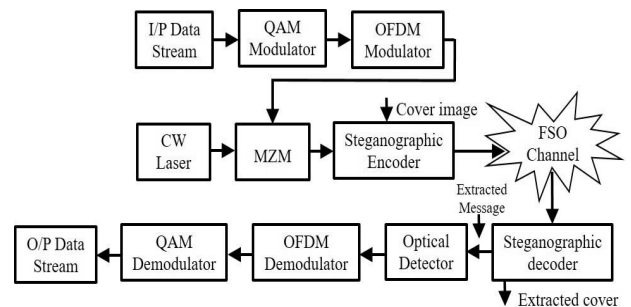


Fig. 1. OFDM-FSO-Steganography model

III. STEGANOGRAPHY FLOWCHART USED IN THE PROPOSED MODEL [7]

As shown in Fig.2, the hiding or embedding process includes cover image, unique random number generation, pixel manipulation, which produces stego image. At the receiver, the original image is extracted referred as recovering process. The flow chart is explained below.

A. Embedding Process

Step 1: A cover image of size (256 x 256) is considered.

Low RCS Target Detection with Ground Clutter in Multistatic Airborne Radar

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Abstract—Multistatic radar plays an important role in the detection of low RCS targets. The detection process becomes complicated in multiple target scenarios. Although multistatic radar provides better detection performance, the performance degrades when clutters are present in the received signal. In this paper a space-time adaptive processing technique is implemented to detect multiple targets and cancellation of ground clutters. A transmitted waveform with a large time-bandwidth product is required to detect small targets with long distances in the increased coverage area. So an orthogonal frequency division multiplexing- linear frequency modulated signal is used as the transmitted waveform. A performance comparison has been made for the multistatic radar in terms of probability detection with space-time processing techniques with different transmitter and receiver configurations. The multistatic radar performance is evaluated through simulations and it has been observed that when the number of receiving antenna increases the probability of detection increases.

Keywords—Airborne radar, Clutter, Multistatic radar, Space time processing, Target detection.

I. INTRODUCTION

Detection of low radar cross section (RCS) targets or stealth targets in the presence of clutter is one of the most important parts of modern electronic warfare. The radar cross-section characterizes the degree of visibility of the target to the radar [1]. Due to very less radar signature it is a challenging task for the conventional monostatic and bistatic radars to detect the stealth targets. To deal with this problem, multistatic radars where multiple radar transmitters and receivers are deployed for efficient detection capability and increased coverage area. Because of these benefits in the real-time defense and civilian applications, multistatic radar has been regarded as an emerging research area in the last few decades [2]. Although multistatic radar stands as a solution to detect the stealth targets using the transmitter and receiver diversity, but as multiple transmitter transmits a verity of transmitted signals, design a waveform, with less cross-correlation and a low peak-average power ratio (PAPR), is an ambitious task.

In [3] authors presented an orthogonal frequency division multiplexing linear frequency modulated (OFDM-LFM) waveform generation technique where the waveform attains large time-bandwidth product. This OFDM-LFM waveform may be regarded as a primary requirement for the detection of targets in a multistatic radar.

Space-time processing exploits temporal and spatial properties of the signal to enhance the target detection in the presence of ground clutter [4]. But even though with space-time processing the performance of the multistatic system degrades due to lack of time-bandwidth product in the transmitted waveform, which are orthogonal and uncorrelated to each other. The target response of a multistatic airborne radar is mainly degraded by the ground clutter associated with the received signal which degrades the probability of detection as well as the performance of the radar system [5]. This paper proposes a multistatic radar system that transmits the OFDM-LFM signal to achieve a large time-bandwidth product and implements the space-time adaptive processing to remove the ground clutter and enhance the probability of detection. A comparison has been made in terms of probability of detection and the probability of false alarm for a particular signal-to-noise ratio condition in the multistatic radar with the space-time coding and without the space-time coding.

II. PROBLEM FORMULATION

When a low RCS target backscatters the signal not in the direction of a radar it is very difficult to identify the presence of the target. Although the multistatic radars are used for the detection, only linear frequency modulated (LFM) signal may not detect small target with a long-range in the increased coverage area due to lack of time-bandwidth product. To detect a low RCS target with high-density ground clutter is one of the most important problem for airborne radars. The presence of clutter in the received signal in case of an airborne radar degrades the probability of detection for a particular signal-to-noise ratio condition. The detection process

Effect of High Pass Filtering and Matched Filtering on Baseline Wander

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Abstract—Optical Wireless Communication (OWC) channel can be the best suitable substitute of Radio Frequency (RF) channel. The high data rate transmission capability and reliable connectivity makes it eligible to support the IoT requirements. There are some unavoidable drawbacks associated with OWC channel in different environments. In this paper a drawback of indoor OWC channel has been discussed which is known as fluorescent light interference (FLI). While using the OWC transmission in indoor environment in form of LiFi, the background light coming from the other radiation sources present inside makes undesirable interference with the signal. The effect of this interference can be mitigated by applying various techniques. One of the techniques is the use of High Pass filter. As the FLI affects the low frequency components, the application of HPF with a suitable cut off frequency can be seemed to reduce the effect of FLI. But this HPF technique produces a form of Inter symbol interference (ISI) which is also known as Baseline Wandering (BW) that has a negative influence on the performance of the base band modulation technique. An alternative way to detect the signal can be the use of Matched Filter (MF) which always tries to match the signal with the original shape. In this paper the performance of a simple BPSK based system under FLI has been analyzed where the signal has been detected by using two different methods, that is by using HPF and by using HPF followed by MF. In both the cases the variation that causes baseline wandering has been found. The comparative studies of both the cases show that the system employing MF exhibits better performance as compared to the system with HPF. Also to verify the effect of this baseline wander on the system performance, the BER of both systems has been compared. By comparing the BER for the system with HPF and MF with the theoretical value of BER, it has been observed that the BER curve of the system with MF is closer to the theoretical BER curve. For the given scenario the minimum achievable BER for the MF based system comes down to a value about the order of 10^{-3} at an SNR of 8dB whereas for HPF based system it comes down to an order of 10^{-1} even at an SNR of 12dB, which proves that the MF based optical receiver performs better as compared to HPF based optical receiver.

Keywords— OWC, DPSK, FLI, Matched Filter, High Pass Filter. Baseline wander.

I. INTRODUCTION

Florescent Light Interference (FLI) is an unavoidable adverse condition in an Optical Wireless Communication (OWC) situation [1]. Optical communication techniques use different modulation schemes where some techniques are power efficient and some others are spectrally efficient. The spectral efficiency of a modulated signal depends upon the modulation scheme as well as the line-coding technique [2,3].

In [4] a comparative study has been carried out between the performance of On-Off Keying (OOK), Pulse Position Modulation (PPM) and Digital Pulse Interval Modulation (DPIM) systems in presence of florescent light interference (FLI) by considering normalized optical power required (NOPR) and optical power penalty (OPP) as the performance metrics where the result shows that the OPP value gets reduced by the use of High pass filter (HPF). Also it has been suggested that the same filtering process can be applied to other modulation techniques to achieve a better level of performance. In [5], FLI corrupted OOK signal is being detected by using matched filter followed by a wavelet transform (DWT) based denoising filter. It may be due to the fact that spectral component of FLI signal occurs mostly around the lower frequency region [1, 5]. The effect of FLI depends on the source by which it has been radiated [6]. It has been observed that the type of modulation scheme also affects the link performance in presence of FLI [7]. Conventionally, the sources of ambient light produce interference components having spectral range from 50Hz to a few KHz [8]. It also contains the harmonics of the switching frequency [8-10]. HPF has been considered as the most common method to remove the effect of FLI [1] as it affect more to the low frequency components. But this HPF is also responsible to introduce a type of Inter Symbol Interference (ISI) which is also known as Baseline Wander. Baseline wandering refers to low frequency fluctuation or drifts that are superimposed on the baseline of the signal [1].

In this paper the baseline wandering produced by two different optical receivers has been compared. The transmitted signal is an Optical modulated BPSK signal. The signal has been transmitted over free space. The

A Multipurpose Smart Canteen Management System Using VHDL

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Abstract—This paper implements a multi-purpose smart automat for managing the canteen of an institute. The automat performs multi operations such as discount offers, employee identification and sitting allocation for a college canteen scenario. The proposed model identifies the employee of an institute and a discount of 10% is provided to the employee after a proper investigation. The model segregates the employee's department-wise, by the ID provided to the departments. The sitting arrangement is done as per the department identification. The designed model is functionally simulated by using Xilinx ISE 14.7 and Modelsim 20.1.

Keywords—Smart Automat, Xilinx ISE simulator, Modelsim 20.1, Finite State Machine.

I. INTRODUCTION

In recent times, people had begun to adapt to technologies and demand for automation is increasing at a brisk rate. So, keeping in view the increasing popularity, we have purposed a smart automated canteen management system for food ordering that reduces time mismanagement during rush hours. The model is simulated using VHDL.

When we look at some of the basic systems like food ordering in cafes, canteens, or restaurants, it remains the same old-fashioned. Due to this, we are still stuck waiting for the waiter to take our order which becomes irritating and time-consuming. Then during rush hour, there is mismanagement of seats and orders, creating a bad impression. So, a simple and smart solution to this issue is introducing a smart automated food ordering machine.

Various research works related to this scenario have been done previously. V. V. S Vijay Krishna et al. proposed an automatic beverages machine that is based on the mealy model of finite machine with auto-billing and cancel features. It is implemented in "Virtex 5 XC5VLX50T FPGA board" and performance is evaluated with the help of Xilinx ISE and Cadence [1]. F. Zainuddin et al. have created a steaming frozen food machine utilizing theoretical modelling and they used process flow and control logic to carry out the model for steam buns. The power along with switching time of the circuit are compared with the CMOS technology [2]. B. Jyothi et al. have proposed a vending machine with four main states along with control logic to implement street snack machine

[3]. E. Kho et al gave the attribute for designing and implementing multi-select state vending machines[4]. Joshi et al. used radio frequency recognition to detect and validate users which is quite an expensive system [5]. Kadir et. all have implemented a cashless payment system for smart canteen [6]. T. Yokouchi have designed a unique mechanized service used in Japan [7]. Yadav et al. proposed an energy-saving LVCMOS-based vending device with the facility to cancel orders but lack review and discount features in the canteen management system [8]. P. Garapati and S. Musala described Moore and Mealy machines using a negative edge detector circuit for FSM, which gave us a fair idea to implement FSM in the canteen management system [9]. Roy et al. designed a coffee vending machine utilizing one electron device which is compared with CMOS technology for speed of operation [10]. The authors made a comparison between contrasting attributes in modelling an FSM-based machine [11]. P. Garapati and S. Musala discussed a Moore and Mealy-based finite state machine[12]. Toma et al discussed how the canteen management system performs an essential role in the food industry for the smart city [13]. Considering various limitations of the existing machine, this smart machine works more efficiently with additional features.

This automated machine can be implemented in a modern FPGA kit, providing more efficiency and quick response than traditional CMOS-based automation.

The multipurpose smart automated food ordering machine provides the following additional features.

- Employee identification for an organization.
- Discount offers to the identified employee.
- Sitting arrangement for the identified employee.

This paper is organized in the following manner. Section I introduces the research writings. Section II covers the steps for VHDL implementation. Section III implements the design methodology. Section IV shows the simulation outcomes and Section V concludes the work.

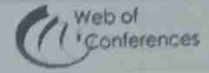
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An encryption-encoding architecture for security enhancement in 5G communication networks

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Smart meter, the advanced energy meters [1] is one of the most important components of Smart grid (regarded as the future generation of today's power infrastructure distribution). If the power company begins for the smart grid implementation, every house and premises need to be installed with smart meters. All information such as consumers' private information and consumers' electricity transactions stored in a database. So, Attacks on Data in smart meters is considered our main concern. These databases may be got into with or fall into the hands of blackmailers, criminals, cyber hackers, power company workers, and other anonymous groups who may perform spiteful actions, which have no limits. Several attacks on data and existing solutions to such attacks are discussed in this paper. In our proposed model, algorithms like RSA, Blowfish, AES, DES, 3DES are used. Two cryptographic algorithms are proposed- Hybrid RSA-Blowfish Algorithm and Eigenvalue Encryption Algorithm. In the Hybrid RSA - Blowfish Algorithm, the plain text is taken and encrypted into an intermediate cipher using the Blowfish algorithm. Then this intermediate cipher is again enciphered using the RSA algorithm which now creates a more protected cipher producing a public and a private key. In the Eigenvalue Encryption Algorithm, the Eigenvalue of the matrix taken is calculated and the positive eigenvalue becomes the key. This key is then multiplied with subsequent reversed ASCII values of the plain text and a numerical series and forms the ciphertext. In this paper, the output of both the algorithms along with the decryption process is shown. Later on, our proposed algorithms with the existing algorithms are compared on the basis of four parameters- Avalanche Effect, Encryption Time, Decryption Time and Memory Used. A comparative study based on the Statistical Data is done and graphically shown. The attacks prevented by our proposed algorithms are also discussed in this paper.

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Chapter

Performance Analysis of a Chaotic OFDM-FSO Communication System

August 2023

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Abstract

Free Space Optical (FSO) communication offers enormous solution to last-mile connectivity and serves as complementary access technology to Radio Frequency (RF) and millimeter wave wireless systems. However, different weather conditions such as thick fog, smoke, and turbulences affect the system performance for which Q-factor degrades. This work implements chaotic concept to the hybrid OFDM-FSO system which successfully mitigates inter-channel interference (ICI) and fading. In this paper, the Q-factor under different weather conditions is estimated and compared with the conventional chaotic FSO system. Again, the BER performance of the proposed model is measured for different turbulence conditions and is compared with existing FSO systems. The proposed chaotic OFDM-FSO system provides a secure communication having higher Q-factor and significant bit error rate. Keywords FSO Chaotic mask OFDM

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Abstract:

A steganography technique for a secured free space optical communication system is presented in this work. In this technique, the original message is hidden by a cover image and hidden message is extracted at the receiver without being eavesdropped. The work is carried out by considering gamma-gamma channel model under adverse turbulence and weather conditions. The proposed orthogonal frequency division multiplexing-free space optical communication-Steganography (OFDM-FSO-Steganography) model yields better BER and covers maximum distance as compared to the existing FSO system.

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Contents

I. Introduction

Free space optical communication (FSO) has recently evolved as a complimentary technology to radio frequency wireless system due to its high bandwidth, data rate, immunity to electromagnetic



ENHANCED CLOUD COMPUTING ADOPTION BY DISTINGUISHED ENGINEERING INSTITUTIONS OF CUTTACK DISTRICT-A COMPARATIVE ANALYSIS

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Abstract

Cloud computing can be considered as the most emerging technology of this era. Cloud computing can be defined as a collection of software, applications & other IT services which are provided by cloud service provider, which are stored in different scattered locations like cloud in the sky & can be used by the user through internet as per their need & requirement by cloud service provider on a rent basis or pay-per-service basis. The researcher observed that most of the engineering institutions of Cuttack district are surviving to get better student retention rate & to attract new students, the cause being lack of complete migration to emerging technology like cloud. From this pandemic COVID-19 it has been proved that cloud computing is the software to be adopted in an enhanced way for today & tomorrow. It has become the necessary required software & backbone for virtual platform for common man of Odisha, India & whole world to carry out their regular digital & virtual work from home.

Keywords- cloud computing, COVID-19, Enhanced

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RESEARCH ARTICLE

A Novel Agent-Based Multipath Routing Protocol to Extend Lifetime and Enhancing Reliability of Clustered Wireless Sensor Networks

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Abstract – Over the clustered wireless network systems, development in wireless technology has had a more substantial influence. Entities need to communicate with one another in order to create a sustainable ecosystem. Clustering methods help connect and organise the sensor nodes by load balancing and extending the network lifetime. Only now, various techniques have been developed for solving routing problems but have yet to focus on routing reliability with avoidance of data collision in real scenarios. This research is carried out for the reliability of routing by multi-objective optimization in static and dynamic environments through agent-based analysis with avoidance of data collision and depletion of energy. This study introduces a fuzzy-based multipath clustering technique that exhibits both static and dynamic clustering formation properties. The designated region starts the clustering process once the sensor nodes are ready to begin the data transmission procedure. The proposed technique works in two steps: a) fuzzy cluster head selection; and b) multi-objective agent-based multipath routing protocols for shortest route path discovery. The enhancement made in cluster creation and selection is the critical feature. A well-organized sensor ecosystem has lessened the negative impacts of network collision and energy exhaustion. The packet delivery ratio, communication overhead, and energy consumption are the performance metrics examined when simulating the specified protocol using the computer language NS2. The devised fuzzy-based multi-path routing (FC-MRP) clustering technique outperforms the AODV (Ad-hoc on-demand distance vector routing) protocol, according to the results. The average percentage of improvement concerning PDR, Throughput, end-to-end latency, Overhead, Energy utilised,

Energy efficiency, Network lifetime, and PLR is found to be +2.53, +2.23, -18.58, -22.46, -17.95, +23.00, +4.11, -18.09 respectively.

Index Terms – Clustering Approach, Multi-Objective Optimization, Fuzzy Logic System, Routing Protocols and Multipath Agents, FC-MRP, AODV.

1. INTRODUCTION

Many real-time applications, including the military, the air force, etc., have been impressed by current research in Wireless Sensor Networks (WSNs) technology. A wireless sensor network generally transmits and receives data using radio frequency [1]. It significantly decreased the requirement for wired connectivity. Hop radio relays function without an infrastructure. Contrarily, in the case of dispersed mode, the sink will assist in coordinating for the sake of data transfer. Despite the availability of a variety of information services, WSNs guarantee accurate data exchange by localising in time and place in response to user demand. A typical WSN [2] functions well under specific resource limitations. Energy efficiency is not managed since the sensor nodes are dispersed. Based on its capabilities for computing and communication, each sensor node in the sensing field makes a judgment. The node gathers and transmits the data to its other node in the network with the aid of a base station. As a result, the designated area network becomes overcrowded [3]. Clustering techniques are used in WSNs to address concerns

Energy-efficient PEGASIS Clustering based multipath routing with Lion Swarm and Chicken swarm optimization (PEGALS-CS) for Wireless Sensor Network

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Abstract

Due to the popularity gain in the wide research area in different field of application wireless sensor network (WSN) have been subject to deployed in the last decades. WSN due to use in harsh environment difficult to exchange batteries physically. For that reason Energy efficiency acts as a major factor to restoration of battery power in sensor network. The proposed algorithm prolong the lifetime of the sensor network by enhancing load distributions in the WSN. This work used the chain-based routing PEGASIS (Power Energy Gathering in sensor information system) as basis. In this approach optimal path model Lion swarm and chicken swarm in PEGASIS based chain clustering (PEGALS-CS) has been used. The optimal path is chosen by using Lion Swarm Optimization (LSO) and to reduce the energy consumption of the network the Enhanced Clustering approach is initiated using Chicken Swarm Optimization (CSO). As a result the noticeably improvement of lifetime in this approach has been showing. Other result like residual energy, packet delivery ratio and end to end delay are also considered.

Key Words: WSN, PEGASIS, LSO, CSO, Clustering.

1. Introduction about WSN

Wireless Sensor Networks (WSNs) are widely used for military purposes, health monitoring, and other purposes. The important circumstance, i.e. the precise positioning of sensor nodes, may arise in these types of applications. The sensor nodes can be found using localization techniques. Meta-heuristic methods can be recommended for optimizing the current localisation solutions. The positioning of sensor nodes is made easier by using this optimization strategy [1]. Using reusable communication protocols in a generic WSN architecture, the sensors are efficiently arranged. These protocols are isolated from the protocols used at the top layers [2]. The sensors that are typically equipped with tiny batteries that cannot be recharged since they have been distributed more quickly and to unattended sites [3]. As a result, in networks with limited energy resources, lowering energy consumption is the most difficult challenge. Although there are several elements at play in this scenario, numerous studies have focused on routing methods for WSNs [4]. According to the gathered works, lifespan is defined as the amount of time left before the first sensor's node energy runs out [5].

WSN discusses a wide range of applications in real-world sectors, but it also face difficulties [3]. The current wireless sensor network-based healthcare systems include e-healthcare, M-healthcare, and remote healthcare systems. The stakeholders in the E-health care system can enhance the services and their information with the use of appropriate technology. It is an educational and cooperative healthcare system. In an electronic healthcare system, patients and medical assistants might meet and converse online. M-healthcare systems rely on mobile devices to collect personal health information from users. This approach aids in gathering data for researchers, patients, and health aides.

Here, real-time monitoring and telemedicine are included to enable direct patient care [4]. Education on physical computing, particularly with the aid of WSN, has made some progress. This may be due to a lack of knowledge



Improving navigational parameters and control of autonomous robot using hybrid SOMA–PSO technique

Manoj Kumar Muni¹ · Pragyan Kumar Pradhan¹ · Prasant Ranjan Dhal¹ · Saroj Kumar² · Rabinarayan Sethi¹ · Sanjay Kumar Patra³

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Abstract

With the development of science and technology, robots gained their popularity in automation and industrial applications. Because of this the researchers are more focussed towards motion planning analysis of mobile robots, bipeds and humans. During the investigation, it was discovered that the robots are more likely to become trapped in local minima and dead ends. So, this paper aims to provide a novel hybridized artificial intelligence technique by combining the Self organizing migrating algorithm (SOMA) and Particle Swarm Optimization (PSO) for optimal path planning and control of single and multiple mobile robots in a static and dynamic environment. Different parameters of SOMA and PSO algorithm guides the robots to reach global optimized path in obstacle prone environment. The developed hybrid SOMA–PSO technique is tested in V-REP simulation environment with single and multiple robots, and the simulation outcomes have been authenticated in an experimental setup under laboratory conditions. Whenever sensors detects obstacle then the SOMA–PSO activates and negotiates with obstacles to move up to specified target. After simulation and real-time experiments the proposed novel hybrid technique is successfully achieved their target in an optimized manner. Further, a comparison analysis with its standalone techniques reveals that there is a significant improvement in navigational parameters. Again, the technique is tested against existing paper and an average improvement of 17.76% is observed by using the proposed hybrid technique.

Keywords Hybrid SOMA–PSO · Motion planning · Control · V-REP simulator

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1 Introduction

A robot is an automated machine that can do specified tasks quickly and precisely with little or no human assistance. In the last 50 years, the area of robotics, which deals with the design engineering and operation of robots, has grown rapidly. Mobile robots on wheels are becoming gradually important in the industry for the purpose of transportation, inspection, and operation due to their proficiency and versatility. Because of their superior traversal abilities, the mobile robots are progressively being employed in automotive industries, entertainment, military, medicine, mining, rescue, education, agriculture, space, and a variety of other fields. Mobile robots are rapidly being used in static as well as dynamic environments.

The navigational control and optimal path planning of mobile robots has remained a difficult task since their development. Robots, on the other hand, have become an essential

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[Amulya Bihari Pattnaik & Smrutiranjana Parida](#)

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Abstract

Low alloy steels, extensively used for structural applications, are prone to atmospheric corrosion. Atmospheric corrosion of these metallic materials causes nearly five times more loss than other forms of corrosion. Typically, the ability to form an oxide layer is a proven strategy for protection against atmospheric corrosion. But the oxides formed on the low alloy steels are not protective. However, composition modification can promote the passive protective layer formation in these steels. Furthermore, weather resistance in such compositionally modified low alloy steel is governed by the nature and structure of the oxide layer formed. Therefore, a thorough investigation of the chemistry and structure of oxide layer(s) has been carried out in different environments to determine its protective nature. The protectiveness indices were also defined based on such studies.



Effect of addition of 3%Al₂O₃ on mechanical and microstructural properties in Al-16Si hypereutectic alloys with pouring temperature

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Abstract

It is well known that the mechanical properties of hypereutectic Al-Si alloys are affected by the size, volume fraction and distribution of primary and eutectic Si particles. However, the pouring temperature of the alloy also acts as the vital role for simultaneous refine and modifying Si particles in hypereutectic Al-Si alloys by conventional means. The particles distribution of nano particles on the melt is different at different pouring temperature which affects the physical, mechanical and the microstructural behavior of Al-Si alloys. Various content of gamma Al₂O₃ nano particles were added in hypereutectic Al-16Si alloy melt and further dispersed through an ultrasonic cavitation based technique. The cast hypereutectic Al-16Si alloy with the nano particles' addition showed a significant enhancement in hardness, strengths and ductility. The wear behaviour of the materials depends on the distribution of intermetallic compound over melt. This paper suggests that gamma Al₂O₃ nano





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Stimulation of microstructure and wear properties by pouring temperatures of Al-Si-Al₂O₃ hypereutectic alloy

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Abstract

The replacement of cast iron by recent developed Al-hypereutectic composites are highly impacted to lower down the cost of production and enhances fuel efficiency. Parts like pistons, engine blocks and cylinder heads, brake plates and rocker arms manufactured from Al-hypereutectic composites can reduce and improve vehicle emissions. The present investigation to make the Al-hypereutectic composites reinforced with 1% Al₂O₃ using the stir casting method at different pouring temperatures. Addition of Al₂O₃ in Al-alloy which act as nucleating agent and causes for refinement of grain size and the effect of pouring temperature on microstructure as well as wear properties of composites are reported here. The morphology of primary as well as eutectic silicon was emphasized in this paper. The irregular primary silicon and eutectic silicon shapes are changes to fine globular shape of primary Si and fibrous and regular fine shape of eutectic Si. The study of microstructure-property relations are co-related here by means of changing the pouring temperature of the Al-hypereutectic composites.



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Synthesis and wear properties of near eutectic Al-Si-TiB₂/Al₂O₃ hybrid composites

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Abstract

In metal matrix composites a metal/alloy is often combined with non-metallic/inter-metallic phases to produce a novel material possessing attractive engineering attributes of its own. AMCs or Aluminium matrix composites refer to the group of light weight, high performance, aluminium based material systems which are employed to meet the demand of automotive and aerospace sectors. The present study emphasises on casting of Al–11.8wt% Si metal-matrix composites with the help of an exothermic reaction among the melt and halide salts (K₂TiF₆ and KBF₄) to incorporate 2 and 3wt% TiB₂ in the base alloy matrix. Al₂O₃ particles (0.5, 1 and 2wt%) were also mixed with these in-situ prepared composites to produce hybrid composites which were characterized using optical microscopy. Optical Emission Spectroscopy revealed some amount of silicon loss during casting. XRD analysis indicated the presence of Al₂O₃ and TiB₂ in the cast composites. Hardness, density and dry sliding wear tests were carried out and analysed. The results of the present investigation revealed that the wear rate of the composites decreases when there is an increase in the TiB₂ content but this behaviour is limited to 1 wt% reinforcement in case of Al₂O₃. Increasing load promoted wear rate. At higher sliding distances wear rate decreased though wear volume was more. Density values of the composites were found to increase with increasing amounts of reinforcements. Increasing Al₂O₃ up



The microstructural and wear properties improvement by manganese addition in Al-14Si hypereutectic alloy

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Abstract

Hyper eutectic Al-Si alloys, which are a great candidate for aerospace and automotive industries and are utilized to manufacture engine blocks, cylinder heads and pistons, rocker arms and fraction plates, all of which can reduce and improve vehicle emissions. The goal of this investigation is to make an Al-14Si alloy with different proportions of manganese as an addition to produce a composite using the stir casting method. The effect of manganese in microstructure and impact on the morphology of silicon, both primary and eutectic was highlighted in this paper. The amorphous form of silicon (primary) and silicon (eutectic) is changed to the fine globular shape of primary Si and fibrous and numerous fine eutectic Si. With the inclusion of Mn, the mechanical properties and wear characteristics of the composites are determined. Increase in manganese content decreases the wear rate in Al-14Si-1.5Mn. The microstructural-properties relations are co-related utilizing the addition of manganese into the Al-14Si alloy.

Recent Advancement in Preparation Strategy of Efficient Graphene-Cds-Based Photocatalysts for H₂ Production by Water Splitting



Bachcha Lal, Chandradhwaj Nayak, Sanjay Kumar, Amit Kumar Gupta, and Arvind Singh

Abstract The most promising and lucrative alternative to nonrenewable fossil fuels has been identified as hydrogen (H₂). Photocatalytic water splitting is regarded as one of the most ecologically benign ways to long-term H₂ generation. Because of its bandgap and band placement, CdS is regarded as the finest photocatalyst. Because of its unique structure and characteristics, such as its hierarchical network, enormous specific surface area, and good electrical conductivity, graphene has been largely used as a cocatalyst and support for CdS. These characteristics allow active areas to be exposed and facilitate electron transport. CdS photocatalysts based on graphene showed tremendous potential as high-performance catalysts for photocatalytic H₂ generation. Recent preparation approaches for synthesizing graphene-based CdS are described and addressed in this study.

Keywords Hydrogen · Water splitting · CdS · Graphene · Preparation techniques

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