3.4.3 Number of research papers published per teacher in the Journals as notified on UGC CARE list during the last five years											
	Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal				
Sl. No							Link to website of the Journal	Link to article/paper/abstract of the article	Is it listed in UGC Care list	Scopus	Web of Science
1	A New Perspective on the Green Strategy of Close Cycle Dissociation of H2S	Bachcha Lal, Dan Bahadur Pal, Chandradhwaj Nayak, Amit Kumar Gupta & Arvind Singh	Chemical Engg.	Journal of The Institution of Engineers (India): Series E	2022		Home | Journal o	https://doi.org/10.1007/s40034-022-00239-3		Scopus	Web of Science
2	Development of chitosan-based hybrid membrane modified with ionic-liquid and carbon nanotubes for direct methanol fuel cell operating at moderate temperature.	Dr H Sutar , R. Murmu	Chemical Engg.	Polymer Bulletin	2022		Home | Polymer I	https://doi.org/10.1007/s00289-022-04246-7		Scopus	Web of Science
3	Optimization Process Parameter by RSM BBD for the removal of titan yellow dye from acqueous solution by acid treated phyllantus acidus leaves	Chandradhwaj Nayak, Babitha Babu, V. Manoj, Chelluboyana Vaishnava Raghunath, M. Laxmi Deepak Bhatlu & Poornima Pandey	Chemical Engg.	Biomass conversion and bio refinery	2022		Home | Biomass Conversion and Biorefinery (springer.com)	https://doi.org/10.1007/s13399-023-04474-5		Scopus	Web of Science
4	Mineralogical investigation on preheating studies of high LOI iron ore pellet	Kashinath Barik , Pallishree Prusti , Shatrughan Soren, B.C. Meikap, S.K. Biswal	Chemical Engg.	Powder Technology	2022		Powder Technology | Journal | ScienceDirect.com by Elsevier	https://doi.org/10.1016/j.powtec.2023.118315		Scopus	Web of Science
5	Mathematical approach and experimental validation on criteria for instability of interface between liquid droplet and water	Amit Kumar Gupta, Arvind Singh, Rajen Kumar Nayak, Ravi Shankar Prasad, Chelluboyana Vaishnava Raghunath, Chandradhwaj Nayak & Amar Kumar	Chemical Engg.	Journal of Applied Mathematics and Physics / Journal de Mathématiques et de Physique appliquées	2022		Home | Zeitschrift für angewandte Mathematik und Physik (springer.com)	https://doi.org/10.1007/s00033-022-01928-0		Scopus	Web of Science
6	Effect of Sulphuric acid on the physiochemical properties of chitosan PVA blend for direct methanol fuel cell	RABIRANJAN MURMU, DEBASHIS ROY, HAREKRUSHNA SUTAR,PRAGYAN SENAPATI, AND SWETAK ABHISEK MOHAPATRA	Chemical Engg.	J. of polymer Material	2022		Journal of Polymer Materials | ScienceDirect.com by Elsevier	http://dx.doi.org/10.32381/JPM.2022.39.1-2.6		Scopus	Web of Science
7	Development of highly performed chitosan based thin film towards the sustainability of direct methanol fuel cell	Rabiranjan Murmu, Debashis Roy, Harekrushna Sutar, Pragyan Senapati &Sarat Chandra Patra	Chemical Engg.	Polymer Plastic technology and materials	2022		Polymer-Plastics T	https://doi.org/10.1080/25740881.2022.2133616		Scopus	
8	Development of highly performed chitosan based thin film towards the sustainability of direct methanol fuel cell	R. Murmu, rP Senapati, D Roy, Dr H Sutar, S C Patra	Chemical Engg.	Polymer Plastic technology and materials	2022		Polymer-Plastics T	https://doi.org/10.1080/25740881.2022.2133616		Scopus	

9	polypropelene and graphene composites: Effect of selected 2D Nanofiller's plate sizes on fundamental physiochemical Properties	Sarat Chandra Patra , Sumit Swain ,Pragyan Senapati ORCID, Himadri Sahu , Rabiranjan Murmu andHarekrushna Sutar	Chemical Engg.	Inventions and Innovation in Applied Chemistry and Physics	2022		Inventions and Innovation in Applied Chemistry and Physics - A section of Inventions (mdpi.com)	https://doi.org/10.3390/inventions8010008		Scopus	
10	polypropelene and graphene composites: Effect of selected 2D Nanofiller's plate sizes on fundamental physiochemical Properties	S C Patra, S SWAin, P Senapati, R. Murmu, D Roy, Dr H Sutar	Chemical Engg.	Inventions and Innovation in Applied Chemistry and Physics	2022		Inventions and Innovation in Applied Chemistry and Physics - A section of Inventions (mdpi.com)	https://doi.org/10.3390/inventions8010008		Scopus	
11	Effect of Sulphuric acid on the physiochemical properties of chitosan PVA blend for direct methanol fuel cell	RABIRANJAN MURMU, DEBASHIS ROY, HAREKRUSHNA SUTAR,PRAGYAN SENAPATI, AND SWETAK ABHISEK MOHAPATRA	Chemical Engg.	J. of polymer Material	2022		Journal of Polymer Materials | ScienceDirect.com by Elsevier	http://dx.doi.org/10.32381/JPM.2022.39.1-2.6		Scopus	Web of Science
12	Mathematical modelling and simulation of active direct methanol fuel cell	RABIRANJAN MURMU, DEBASHIS ROY, HAREKRUSHNA SUTAR, PRAGYAN SENAPATI, SWETAK ABHISEK MOHAPATRA	Chemical Engg.	J. of polymer Material	2022		Journal of Polymer Materials | ScienceDirect.com by Elsevier	http://dx.doi.org/10.32381/JPM.2023.40.3-4.1		Scopus	Web of Science
13	Mathematical modelling and simulation of active direct methanol fuel cell	RABIRANJAN MURMU, DEBASHIS ROY, HAREKRUSHNA SUTAR, PRAGYAN SENAPATI, SWETAK ABHISEK MOHAPATRA	Chemical Engg.	J. of polymer Material	2022		Journal of Polymer Materials | ScienceDirect.com by Elsevier	http://dx.doi.org/10.32381/JPM.2023.40.3-4.1		Scopus	Web of Science
14	Coal and its benefication technique: A review	B. Sahoo, K S S Sahoo	Chemical Engg.	Euro Chemical Bulletin	2022	2063-5346	European Chemical Bulletin (eurchembull.com)				
15	Experimental Investigation and optimizationof the FDM process using PLA	Sujata Sahoo Harekrushna Sutar Pragyan Senapati Bhabani Shankar Mohanto Prasant Ranjan Dhal Subrat Kumar Baral	Chemical Engg.	Materials Today: Proceedings	2022		Materials Today: Proceedings | Journal | ScienceDirect.com by Elsevier	https://doi.org/10.1016/j.matpr.2022.11.208		Scopus	Web of Science
16	Performance of Bioremediation Strategy in waste lubricating oil pollutants : A Review	J Kanungo, T sahoo, I D Behera	Chemical Engg.	Geomicrobiology Journal	2022		Geomicrobiology	https://doi.org/10.1080/01490451.2023.2245395		Scopus	
17	Effect of C/N ratio, temperature, and pH on the removal of ammonia-nitrogen from wastewater using inverse fluidized bed biofilm reactor	Dr Anup K Swain	Chemical Engg.	Indian Journal of Chemical Technology,	2022		Vol. 29 No. 4 (202	https://doi.org/10.56042/ijct.v29i4.59667		Scopus	

18	Performance investigation of MISO soft sensors in predicting AQI: A comparative analysis	S. Banerjee, Dipa Das	Chemical Engg.	Indian Chemical Engineer	2022		Indian Chemical E	https://doi.org/10.1080/00194506.2024.2313493		Scopus	
19	Performance investigation of MISO soft sensors in predicting AQI: A comparative analysis	S. Banerjee, Dipa Das	Chemical Engg.	Indian Chemical Engineer	2022		Indian Chemical E	https://doi.org/10.1080/00194506.2024.2313493		Scopus	
20	Applicability of Teetered bed separator for benefiaciting indian iron ore Fines: An Experimental study	B. Pradhan, I D Behera, K Sahoo, S Mohanta	Chemical Engg.	Journals of Mine, Metals and fuels	2022		Journal of Mines,	http://dx.doi.org/10.18311/jmmf/2023/31100		Scopus	
21	Applicability of Teetered bed separator for benefiaciting indian iron ore Fines: An Experimental study	B. Pradhan, I D Behera, K Sahoo, S Mohanta	Chemical Engg.	Journals of Mine, Metals and fuels	2022		Journal of Mines,	http://dx.doi.org/10.18311/jmmf/2023/31100		Scopus	
22	Capturing Pseudocritical property change in steam in a spiral steam pipe of a boiler through Numerical technique	D K Kanungo, P Senapati, H K Sutar	Chemical Engg.	Euro Chemical Bulletin	2022						
23	Micro fiber pollution and its Microbial mitigation: A review on current trends and future perspect	A P Das, K Dutta, R Khatun, I D Behera, S Singh	Chemical Engg.	Journal of the Taiwan Institute of Chemical Engineer	2022		Journal of the Tai	https://doi.org/10.1016/j.jtice.2023.105104		Scopus	Web of Science
24	Green synthesis of sub 10 nm silver nanoparticles in gram scale using free impinging jet reactor	Dr K Sahoo	Chemical Engg.	Chemical Engineering and Processing-Process Intensification	2022		CEP:PI | Chemical	https://doi.org/10.1016/j.cep.2021.108439		Scopus	Web of Science
25	Preparation and characterization of Red Mud modified Chitosan-PVA composite membrane for direct methanol fuel cell	Dr H Sutar, R. Murmu	Chemical Engg.	Journal of Electrochemical Energy Conversion and Storage	2022		J. Electrochem. Er	https://doi.org/10.1115/1.4055693		Scopus	
26	An appropriate Numerical model to capture Pseudocritical Property change of steam flowing inside straight tube	D K Kanungo, B Sahoo,H K Sutar, R Murmu,	Chemical Engg.	Euro Chemical Bulletin	2022	2063-5346	European Chemic	http://dx.doi.org/10.48047/ecb/2023.12.10.8072023.17/08/2023			
27	An appropriate Numerical model to capture Pseudocritical Property change of steam flowing inside straight tube	D K Kanungo, B Sahoo,H K Sutar, R Murmu,	Chemical Engg.	Euro Chemical Bulletin	2022	2063-5346	European Chemic	http://dx.doi.org/10.48047/ecb/2023.12.10.8072023.17/08/2023			
28	An appropriate Numerical model to capture Pseudocritical Property change of steam flowing inside straight tube	D K Kanungo, B Sahoo,H K Sutar, R Murmu,	Chemical Engg.	Euro Chemical Bulletin	2022	2063-5346	European Chemic	http://dx.doi.org/10.48047/ecb/2023.12.10.8072023.17/08/2023			
29	The Mechanical and Thermal behaviour of unsaturated polyster Matrix composite filled with pistachio shell particles	Dr H Sutar, R. Murmu	Chemical Engg.	Materials Today: Proceedings	2022		Materials Today: Proceedings | Journal | ScienceDirect.com by Elsevier	https://doi.org/10.1016/j.matpr.2022.09.460		Scopus	Web of Science
30	The Mechanical and Thermal behaviour of unsaturated polyster Matrix composite filled with pistachio shell particles	Dr H Sutar, R. Murmu	Chemical Engg.	Materials Today: Proceedings	2022		Materials Today: Proceedings | Journal | ScienceDirect.com by Elsevier	https://doi.org/10.1016/j.matpr.2022.09.460		Scopus	Web of Science

31	Effect of zinc oxide on the mechanical , thermal and physiochemical properties of chitosan based hybrid membrane for DMFC application	N R Dash , Dr H Sutar, R. Murmu	Chemical Engg.	Materials Today: Proceedings	2022		Materials Today: Proceedings | Journal | ScienceDirect.com by Elsevier	https://doi.org/10.1016/j.matpr.2023.06.082		**Scopus**	**Web of Science**
32	Effect of zinc oxide on the mechanical , thermal and physiochemical properties of chitosan based hybrid membrane for DMFC application	N R Dash , Dr H Sutar, R. Murmu	Chemical Engg.	Materials Today: Proceedings	2022		Materials Today: Proceedings | Journal | ScienceDirect.com by Elsevier	https://doi.org/10.1016/j.matpr.2023.06.082		**Scopus**	**Web of Science**
33	Effect of Sulphuric acid on the physiochemical properties of chitosan PVA blend for direct methanol fuel cell	RABIRANJAN MURMU, DEBASHIS ROY, HAREKRUSHNA SUTAR,PRAGYAN SENAPATI, AND SWETAK ABHISEK MOHAPATRA	Chemical Engg.	J. of polymer Material	2022		Journal of Polymer Materials | ScienceDirect.com by Elsevier	http://dx.doi.org/10.32381/JPM.2022.39.1-2.6		**Scopus**	**Web of Science**
34	Band gap tailoring and photosensitivity study of Al-doped SnO2 nanocrystallites prepared by sol–gel technique	Binod Bihari Panda, Debakanta Tripathy, Niladri Maity	Chemistry	Journal of Materials Science: Materials in Electronics	2022		Home | Journal o	https://doi.org/10.1007/s10854-022-09167-9		**Scopus**	**Web of Science**
35	Chlorophyll-a functionalised Zn-Cd-S thin film fabricated by SILAR technique for dye sensitised solar cells	Mahesh Kumar Ghosh, Rabindra Kumar Send, Prasanta Kumar Mahapatra, Binod Bihari Panda	Chemistry	Inorganic Chemistry Communications, ELSEVIER	2022	1387-7003	Inorganic Chemist	https://doi.org/10.1016/j.inoche.2022.109670		**Scopus**	**Web of Science**
36	Design aspects of a continuous flow photocatalytic reactor and its application to degrade methylene blue and textile wastewater	Chittaranjan Sahoo, Binod Bihari Panda, Ashok Kumar Gupta	Chemistry	Chemistry Select	2022		Chemistry Europe	https://doi.org/10.1002/slct.202201179		**Scopus**	
37	Lanthanide based inorganic phosphates and biological nucleotides sensor	Jashobanta Sahoo, Chidharth Krishnaraj, JiaminSun, Binod Bihari Panda, Palani S. Subramanian, Himanshu Sekhar Jena,	Chemistry	Coordination Chemistry Reviews	2022	0010-8545.	Coordination Che	https://doi.org/10.1016/j.ccr.2022.214583		**Scopus**	**Web of Science**
38	Design aspects of a continuous flow photocatalytic reactor and its application to degrade methylene blue and textile wastewater	Chittaranjan Sahoo, Binod Bihari Panda, Ashok Kumar Gupta	CIVIL	Chemistry Select	2022		Chemistry Europe	https://doi.org/10.1002/slct.202201179		**Scopus**	
39	Design aspects of a continuous flow photocatalytic reactor andf its application to degrade methylene blue and textile wastewater	K Rout, M K sahoo, C R Sahoo	CIVIL	Chemistry Select	2022	e202201179	https://chemistry-europe.onlinelibrary.wiley.com/	https://doi.org/10.1002/slct.202201179		**Scopus**	
40	Effect of shrinkage on slant shear and fexure bond strength of cement based micro-concrete for durable concrete repair	DR Nayak, P R R, BC Panda	CIVIL	Journal of Building Pathology and Rehabilitation	2022	2365-3167	https://www.springer.com	https://doi.org/10.1007/s41024-021-00161-y		scopus	Web of science
41	A new approach of image denoising based on adaptive multi-resolution technique	Lalit Mohan Satapathy, Pranati Das	EE	Nigerian Journal of Technological Development	2022	2437-2110	Nigerian Journal of Technological Development (ajol.info)	10.4314/njtd.v19i1.10		Scopus	

42	Automated segmentation of blood vessels in retinal images based on entropy weighted thresholding	Deepak Kumar Maharana, Pranati Das, Ranjeet Kumar Rout	EE	Computer Methods in Biomechanics and Biomedical Engineering: Imaging & Visualization	2022	2168-1163	Computer Methods in Biomechanics and Biomedical Engineering: Imaging & Visualization | Taylor & Francis Online (tandfonline.com)	https://doi.org/10.1080/21681163.2022.2083982		Scopus	
43	Controller Design for the Pitch Control of an Autonomous Underwater Vehicle	L Priyadarshini, Shubhasri Kundu, Manoj Kumar Maharana, Bibhu Prasad Ganthia	EE	Engineering, Technology & Applied Science Research	2022	1792-8036	Engineering, Technology & Applied Science Research (etasr.com)	https://doi.org/10.48084/etasr		Scopus	
44	Delay-discretization-based sliding mode H∞ load frequency control scheme considering actuator saturation of wind-integrated power system	Subrat Kumar Pradhan, Dushmanta Kumar Das	EE	The Journal of Supercomputing	2022		Home | The Journal of Supercomputing (springer.com)	10.1007/s11227-022-04397-4		Scopus	
45	Design and Implementation of a Floating PV Model to Analyse the Power Generation	Mohamad Reda A Refaai, Lavanya Dhanesh, Bibhu Prasad Ganthia, Monalisa Mohanty, Ram Subbiah, Endalkachew Mergia Anbese	EE	International Journal of Photoenergy, Hindawi	2022	1687-529X	International Journal of Photoenergy - Wiley Online Library	https://doi.org/10.1155/2022/3891881		Scopus	
46	Fault Analysis of PI and Fuzzy-Logic-Controlled DFIG-based Grid-Connected Wind Energy Conversion System	Bibhu Prasad Ganthia, Subrat Kumar Barik	EE	Journal of The Institution of Engineers (India): Series B, Springer	2022		Home | Journal of The Institution of Engineers (India): Series B (springer.com)	https://doi.org/10.1007/s40031-021-00664-9		Scopus	**Web of Science**
47	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	EE	Materials Today Proceedings, Elsevier	2022		Materials Today: Proceedings | Journal | ScienceDirect.com by Elsevier	https://doi.org/10.1016/j.matpr.2021.10.193		Scopus	**Web of Science**
48	H∞ Controller Design for Frequency Control of Delayed Power System with Actuator Saturation and Wind Source Integration	Subrat Kumar Pradhan, Dushmanta Kumar Das	EE	Arabian Journal for Science and Engineering	2022	2193-567X	Home | Arabian Journal for Science and Engineering (springer.com)	10.1007/s13369-021-06479-6		Scopus	**Web of Science**
49	Improvement in Fault Tolerant Capability of ST-DTC for Five-Phase Induction Motor using Neural Network	U Mahanta, AK Panda, BP Panigrahi	EE	Journal of The Institution of Engineers (India) Series B April 2022	2022	2250-2114	Home | Journal of The Institution of Engineers (India): Series B (springer.com)	doi.org/10.1007/s40031-022-00742-6		Scopus	**Web of Science**
50	Improvement in Fault Tolerant Capability of ST-DTC for Five-Phase Induction Motor using Neural Network	Umakanta Mahanta	EE	Journal of The Institution of Engineers (India): Series B	2022	2250-2114	Home | Journal of The Institution of Engineers (India): Series B (springer.com)	doi.org/10.1007/s40031-022-00742-6		Scopus	**Web of Science**
51	Internal model control based proportional-integral controller with class topper optimization for power control of molten salt breeder reactor core	Subrat Kumar Pradhan, Debasis Acharya, Dushmanta Kumar Das	EE	Annals of Nuclear Energy	2022		Annals of Nuclear Energy | Journal | ScienceDirect.com by Elsevier	10.1016/j.anucene.2021.108675		Scopus	**Web of Science**

52	JAYA Algorithm-Optimized Load Frequency Control of a Four-Area Interconnected Power System Tuning Using PID Controller	Sunita Pahadasingh, Chitralekha Jena, Chinmoy Kumar Panigrahi, Bibhu Prasad Ganthia	EE	Engineering, Technology & Applied Science Research	2022	1792-8036	Engineering, Technology & Applied Science Research (etasr.com)	https://doi.org/10.48084/etasr		Scopus	
53	Modular unmanned aerial vehicle platform design: Multi-objective evolutionary system method	Wenyi Zheng, Abolfazl Mehbodniya, Rahul Neware, Surindar Gopalrao Wawale, Bibhu Prasad Ganthia, Mohammad Shabaz	EE	Computers and Electrical Engineering, Pergamon, Elsevier	2022		Computers and Electrical Engineering | Journal | ScienceDirect.com by Elsevier	https://doi.org/10.1016/j.compeleceng.2022.107838		Scopus	**Web of Science**
54	Monitoring Nonlinearities and Power Smoothing in Modified Mathematical Modeled Type-III Wind Turbine System using Artificial Neural Network	Bibhu Prasad Ganthia, Shilpa Patra, Binodinee Swain, Monalisa Mohanty, Sunita Pahadasingh	EE	International Journal of Mechanical Engineering, Kalahari	2022	0974-5823	https://www.kalaharijournals.com/	https://kalaharijournals.com/resources/FebV7_I2_39	**UGC-CARE List Group II**	Scopus	
55	Monitoring Nonlinearities and Power Smoothing in Modified Mathematical Modeled Type-III Wind Turbine System using Artificial Neural Network	Bibhu Prasad Ganthia, Shilpa Patra, Binodinee Swain, Monalisa Mohanty, Sunita Pahadasingh	EE	International Journal of Mechanical Engineering, Kalahari	2022	0974-5823	https://www.kalaharijournals.com/	https://kalaharijournals.com/resources/FebV7_I2_39	**UGC-CARE List Group II**	Scopus	
56	Monitoring Nonlinearities and Power Smoothing in Modified Mathematical Modeled Type-III Wind Turbine System using Artificial Neural Network	Bibhu Prasad Ganthia, Shilpa Patra, Binodinee Swain, Monalisa Mohanty, Sunita Pahadasingh	EE	International Journal of Mechanical Engineering, Kalahari	2022	0974-5823	https://www.kalaharijournals.com/	https://kalaharijournals.com/resources/FebV7_I2_39	**UGC-CARE List Group II**	Scopus	
57	Nonlinear dynamic measurement method of software reliability based on data mining	Yinsheng Fu, Jullius Kumar, Bibhu Prasad Ganthia, Rahul Neware	EE	International Journal of System Assurance Engineering and Management,Springer	2022		Home | International Journal of System Assurance Engineering and Management (springer.com)	https://doi.org/10.1007/s13198-021-01389-0		Scopus	**Web of Science**
58	Positional Identifcation Based Whale Optimization Algorithm for Dynamic Thermal–Wind–PV Economic Emission Dispatch Problem	S Padhi, BP Panigrahi, DP Dash	EE	Transactions of the Indian National Academy of Engineering Springer Publication	2022	2662-5423	Home | Transactions of the Indian National Academy of Engineering (springer.com)	https://doi.org/10.1007/s41403-022-00343		Scopus	**Web of Science**
59	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 Ganthia, Subrat Kumar Barik, Byamakesh Nayak	EE	ECS Transactions, IOP Publishing	2022		ECS Transactions - IOPscience	https://doi.org/10.1149/10701.5663ecst		Scopus	
60	Simulation Model of PV System Function in Standalone Mode for Grid Blackout Area	Bibhu Prasad Ganthia, R Dharmaprakash, Tushar Choudhary, T Vijay Muni, Essam A Al-Ammar, AH Seikh, MH Siddique, Abdi Diriba	EE	International Journal of Photoenergy, Hindawi	2022	1687-529X	International Journal of Photoenergy - Wiley Online Library	https://doi.org/10.1155/2022/6202802		Scopus	

61	Strategic integration of photovoltaic, battery energy storage and switchable capacitor for multi-objective optimization of low voltage electricity grid: Assessing grid benefits	Chinmay Kumar Nayak	EE	Renewable Energy Focus	2022	1878-0229	Renewable Energy Focus | Journal | ScienceDirect.com by Elsevier	https://doi.org/10.1016/j.ref.2022.02.006		Scopus	**Web of Science**
62	VMD Based Image Quality Enhancement Using Multi Technology Fusion	Lalit Mohan Satapathy, Pranati Das	EE	Review of Computer Engineering Research	2022	2410-9142	Conscientia Beam || conscientiabeam.com	https://doi.org/10.18488/76.v9i1.2991		Scopus	
63	Design of 256-bit Data Security Unit with the Analysis of Security Attacks	Paresh Kumar Pasayat, Soumya Ranjan Panigrahi, Manaswini Mishra, Ajay Kumar Manadhata	ETC	International Journal of Innovative Research in Computer and Communication Engineering	2022	e-ISSN: 2320-9801, p-ISSN: 2320-9798	www.ijircce.com	DOI: 10.15680/IJIRCCE.2022.1005098	UGC Care		
64	A proposal for testing kit of corona viruses using 3D photonic structure	Sangram Kishore Mohanty, Subhankar Das, K. P. Swain, Urmila Bhanja & G. Palai	ETC	Microsystem Technologies	2022		Home | Microsyst	doi.org/10.1007/s00542-020-05050-x (0123456789().,-volV)(0123456789().,-volV)		Scopus	**Web of Science**
65	Micro Cylindrical Ultrasonic Motor with Improvised Power and Efficiency	Gyanabrata Sahoo, Baruna Kumar Turuk & Basudeba Behera	ETC	Springer Nature	2022	Online ISSN 2092-7592 Print ISSN 1229-7607	Home | Transacti	https://link.springer.com/article/10.1007/s42341-023-00441-z		**Scopus**	**Web of Science**
66	Performance Evaluation of MIMO-OFDM-FSO with Modified Receiver	Chinmayee Panda, U Bhanja	ETC	IETE Journal of Research	2022		IETE Journal of Re	https://doi.org/10.1080/03772063.2023.2173674		**Scopus**	**Web of Science**
67	Performance Evaluation of MIMO-OFDM-FSO with Modified Receiver	Chinmayee Panda, U Bhanja	ETC	IETE Journal of Research	2022		IETE Journal of Re	https://doi.org/10.1080/03772063.2023.2173674		**Scopus**	**Web of Science**
68	Coal and its benefication technique: A review	B. Sahoo, K S S Sahoo	Mechanical Engg.	Euro Chemical Bulletin	2022	2063-5346	European Chemical Bulletin (eurchembull.com)				
69	An advanced mean field dislocation density reliant physical model to predict the creep deformation of 304HCu austenitic stainless steel	Pankhuri Mehrotra, Nilesh Kumar, Alphy George, Kanhu Charan Sahoo, Vaidyanathan Ganesan, Mohammad Reza Ahmadi, Shivam Trivedi, Surya D. Yadav	MME	Materials Today Communications	2022	Vol.32, (2022), PP. 104-128	Materials Today: Proceedings | Journal | ScienceDirect.com by Elsevier	https://doi.org/10.1016/j.mtcomm.2022.104128		**Scopus**	**Web of Science**
70	Development of Improved Flexural and Impact Performance of Kevlar/Carbon/Glass Fibers Reinforced Polymer Hybrid Composites	Sonali Rout, Ramesh Kumar Nayak, Suresh Chandra Patnaik, Hamed Yazdani Nezhad	MME	Journal of Composites Science, MDPI	2022		Journal of Compo	https://doi.org/10.3390/jcs6090245		**Scopus**	
71	Multiaxial creep deformation and influence of different precipitate on creep cavitation failure of 304HCu SS	Kanhu Charan Sahoo, P. Parameswaranand K. Laha	MME	Journal of Material Engineering and performances	2022		Home | Journal o	https://doi.org/10.1007/s11665-022-07103-w		**Scopus**	**Web of Science**
72	Tailoring the Processing Route to Optimize the Strength–Toughness Combination of Pearlitic Steel	Swarnalata Behera, Rakesh Kumar Barik, Sk. Md. Hasan, Rahul Mitra & Debalay Chakrabarti	MME	Metallurgical and Materials Transactions A (2022)	2022		Home | Metallurg	https://doi.org/10.1007/s11661-022-06789-w		**Scopus**	**Web of Science**

73	**The Defining Role of Micro-fissures on the Mechanical Behavior of Laser-Welded Fully Austenitic Stainless Steel**	Arnab Sarkar, Soudip Basu, **Amulya Bihari Pattnaik,** Balila Nagamani Jaya, Shyamprasad Karagadde, Indradev Samajdar, Hemant Kumar, Ravi Kumar, R. Mythili, Chanchal Ghosh, Arup Dasgupta & Shaju Albert	MME	Metallurgical and Materials Transactions A: Physical Metallurgy and Materials Science	**2022**	**53(6), pp. 2116–2129**	Home | Metallurg	https://doi.org/10.1007/s11661-022-06654-w		**Scopus**	**Web of Science**
74	Big Rip Scenario in Brans-Dicke Theory	S K Pradhan, Z Naik and D Behera	Physics	foundations	2022	2673-9321	Foundations | Spe	https://doi.org/10.3390/foundations2010007		**Scopus**	
75	Bouncing Cosmological Models in a Functional form of F(R) F(R) F(R) Gravity	A S Agrawal, S Mishra and S K Tripathy, B Mishra	Physics	Gravitation and Cosmology	2022	0202-2893	Home | Gravitatio	DOI: 10.1134/S0202289323030027		**Scopus**	**Web of Science**
76	Bouncing Cosmology in Modified Gravity with Higher order Gauss-Bonnet curvature term	S V Lohakare, F Tello-Ortiz, S K Tripathy and B Mishra	Physics	Universe	2022	2218-1997	Universe | Specia	doi.org/10.3390/universe8120636		**Scopus**	
77	Evolution of Generalized Brans–Dicke Parameter within a Superbounce Scenario	S K Tripathy, S K Pradhan, B Barik, Z Naik and B Mishra	Physics	Symmetry	2022	2073-8994	Symmetry | An O	https://doi.org/10.3390/sym15040790		**Scopus**	
78	Observationally constrained accelerating cosmological model with higher power of non-metricity and squared trace	A S Agrawal, B Mishra and S K Tripathy	Physics	Journal of High energy Astrophysics	2022	2214-4048	Journal of High En	https://doi.org/10.1016/j.jheap.2023.04.001		**Scopus**	**Web of Science**
79	Rip Behaviour in Brans-Dicke Theory	S K Pradhan, Z Naik and S K Tripathy	Physics	Chinese Journal of Physics	2022		Chinese Journal o	https://doi.org/10.1016/j.cjph.2023.06.015		**Scopus**	**Web of Science**
80	Tunable room temperature ferromagnetism in fullerene thin film induced by 1 MeV proton microbeam irradiation	Ram Kumar, Krishna Mohan, Amala Augusthy, Sandeep Bari, Anukul P. Parhi, Aditya H. Kelkar, Sujay Chakravarty, Neeraj Shukla,	Physics	Thin Solid Films	2022	0040-6090	Thin Solid Films |	https://doi.org/10.1016/j.tsf.2022.139350		**Scopus**	**Web of Science**
81	A Novel Studyof Synthesis, Characterizationand ErosionWear Analysisof Glass–JutePolyesterHybridComposite	Satya Ranjan Pal	Production engineering	Journal of the Institution of Engineers (India):Series E	2022	22502491	Home | Journal o	https://doi.org/10.1007/s40034-023-00268-6		**Scopus**	**Web of Science**
82	A comparative study on network slicing using meta heuristic algorithm in a networking environment	A Rout, S Dhalbisoyi, D J Mishra, R C Sahoo		International Journal of Creative Research Thoughts	2022	2320-2882	IJCRT.org		UGC Care		
83	A comparative study on network slicing using meta heuristic algorithm in a networking environment	A Rout, S Dhalbisoyi, D J Mishra, R C Sahoo		International Journal of Creative Research Thoughts	2022	2320-2882	IJCRT.org		UGC Care		
84	A comparative study on network slicing using meta heuristic algorithm in a networking environment	A Rout, S Dhalbisoyi, D J Mishra, R C Sahoo		International Journal of Creative Research Thoughts	2022	2320-2882	IJCRT.org		UGC Care		
85	A comparative study on network slicing using meta heuristic algorithm in a networking environment	A Rout, S Dhalbisoi, D J Mishra, R C Sahoo		International Journal of Creative Research Thoughts	2022	2320-2882	IJCRT.org		UGC Care		

86	Optimal solution for resource allocation in a crahn for eco friendly environment	A Rout, S Dhalbisoi, R C Sahoo		European Chemical Bulletin	2022	2063-5346	European Chemical Bulletin (eurchembull.vercel.app)		UGC Care		
87	Optimal solution for resource allocation in a crahn for eco friendly environment	A Rout, S Dhalbisoi, R C Sahoo		European Chemical Bulletin	2022	2063-5346	European Chemical Bulletin (eurchembull.vercel.app)		UGC Care		
88	Optimal solution for resource allocation in a crahn for eco friendly environment	A Rout, S Dhalbisoi, R C Sahoo		European Chemical Bulletin	2022	2063-5346	European Chemical Bulletin (eurchembull.vercel.app)		UGC Care		
89	An approach of network slicing in next generation networking Environment	A Rout, S Dhalbisoi, R C Sahoo		Journal of Engineering, computing and architecture	2022		Journal of Engineering, Computing and Architecture – Care UGC Approved group-II Journal (journaleca.com)		UGC Care		
90	An approach of network slicing in next generation networking Environment	A Rout, S Dhalbisoi, R C Sahoo		Journal of Engineering, computing and architecture	2022		Journal of Engineering, Computing and Architecture – Care UGC Approved group-II Journal (journaleca.com)		UGC Care		
91	An approach of network slicing in next generation networking Environment	A Rout, S Dhalbisoi, R C Sahoo		Journal of Engineering, computing and architecture	2022		Journal of Engineering, Computing and Architecture – Care UGC Approved group-II Journal (journaleca.com)		UGC Care		
92	A kinetic model and parameters estimate for the synthesis of 2-phenyloctane: a starting material of bio-degradablesurfactant	Dr S Banerjee	Chemical Engg.	Indian Chemical Engineer	In press		Indian Chemical Engineer | Taylor & Francis Online (tandfonline.com)	https://doi.org/10.1080/00194506.2022.2068077		**Scopus**	
93	Impact of Remediation of petroleum Hydrocarbon pollutants in Agricultural land: A Review	S Mohanta, B pradhan, I D Behera	Chemical Engg.	Geomicrobiology Journal			Geomicrobiology	https://doi.org/10.1080/01490451.2023.2243925		**Scopus**	
94	Accelerating Universe and anisotropic dark energy models	S K Tripathy, A Anand, A. Parida, B. Mishra and S. Ray	Physics	Scientific Voyage		2395-5546	Scientific Voyage	https://doi.org/10.1016/j.dark.2022.101020			

95	Bouncing Cosmology in Extended Gravity and Its Reconstruction as Dark EnergyModel	A S Agrawal, F. T. Ortiz, B. Mishra and S. K. Tripathy	Physics	Physics of the Dark Universe		NA	Physics of the Dark Universe | Journal | ScienceDirect.com by Elsevier	https://doi.org/10.1002/prop.202100065		**Scopus**	**Web of Science**
96	Cosmological model with time varying deceleration parameter inF(R,G) gravity	S. V. Lohakare, S. K. Tripathy and B. Mishra	Physics	Physica Scripta		NA	Physica Scripta - I	DOI 10.1088/1402-4896/ac40d6		**Scopus**	**Web of Science**
97	Dynamical stability analysis of accelerating f(T) gravity models	V. Lohakare, B. Mishra and S. K. Tripathy	Physics	European Physics Journal C		1434-6044 (Print Edition) ISSN: 1434-6052 (Electronic Edition)	Home | The Euro	https://doi.org/10.1140/epjc/s10052-022-10406-w		**Scopus**	**Web of Science**
98	Viscous fluid accelerating model in modified gravity	S. Tarai, P. P. Ray, B. Mishra and S. K. Tripathy	Physics	International Journal of Geometrical Methods in Modern Physics		0219-8878 (print); 1793-6977 (web)	International Jour	https://doi.org/10.1142/S0219887822500608		**Scopus**	

Polymer-Plastics Technology and Materials ›
Volume 62, 2023 - Issue 6

Research Article

Development of the highly performed chitosan based thin film towards the sustainability of direct methanol fuel cell

Rabiranjan Murmu, Debashis Roy, Harekrushna Sutar, Pragyan Senapati & Sarat Chandra Patra

Pages 732-755 | Received 29 Jul 2022, Accepted 04 Oct 2022, Published online: 11 Oct 2022

Cite this article https://doi.org/10.1080/25740881.2022.2133616 Check for updates

ABSTRACT

Chemical Engineering and Processing - Process Intensification

Volume 165, August 2021, 108439

Green synthesis of sub 10nm silver nanoparticles in gram scale using free impinging jet reactor

Kshetramohan Sahoo, Sanjeev Kumar

https://doi.org/10.1016/j.cep.2021.108439

Highlights

Inorganic Chemistry Communications

Volume 142, August 2022, 109670

Short communication

Chlorophyll-a functionalised Zn-Cd-S thin film fabricated by SILAR technique for dye sensitised solar cells

Mahesh Kumar Ghosh, Rabindra Kumar Send, Prasanta Kumar Mahapatra, Binod Bihari Panda

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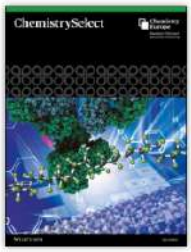

Volume 7,
October 1
e2022011

Research Article

Design Aspects of a Continuous Flow Photocatalytic Reactor and its Application to Degrade Methylene Blue and Textile Wastewater

Dr. Chittaranjan Sahoo, Dr. Binod Bihari Panda, Dr. Ashok Kumar Gupta

First published: 13 October 2022 | https://doi.org/10.1002/slct.202201179 | Citations: 2

Graphical Abstract

Photocatalysis is becoming the curative technologies in current decades for wastewater treatment. The presented work is based on the study of the photocatalytic degradation of MB & textile wastewater collected from Kolkata using Ag doped micro TiO2 in a stepped continuous flow reactor designed as CSTRs in series. The experimental data simulated well with the

Coordination Chemistry Reviews

Volume 466, 1 September 2022, 214583

Review

Lanthanide based inorganic phosphates and biological nucleotides sensor

Jashobanta Sahoo [a], Chidharth Krishnaraj [b], Jiamin Sun [b], Binod Bihari Panda [c], Palani S. Subramanian [d e], Himanshu Sekhar Jena [b]

https://doi.org/10.1016/j.ccr.2022.214583

Computer Methods in Biomechanics and Biomedical Engineering: Imaging & Visualization ›
Volume 11, 2023 - Issue 3

Research Article

Automated segmentation of blood vessels in retinal images based on entropy weighted thresholding

Deepak Kumar Maharana, Pranati Das & **Ranjeet Kumar Rout**

Pages 542-553 | Received 28 Jul 2021, Accepted 26 May 2022, Published online: 06 Jun 2022

Cite this article https://doi.org/10.1080/21681163.2022.2083982 Check for updates

DOI: 10.48084/etasr.5050 • Corpus ID: 251452196

Controller Design for the Pitch Control of an Autonomous Underwater Vehicle

L. Priyadarshini, S. Kundu, +1 author B. Ganthia • Published in Engineering, Technology &amp... 1 August 2022 • Engineering, Environmental Science • Engineering, Technology & Applied Science Research

In recent years, the Autonomous Underwater Vehicle (AUV) has found its application in a large number of areas, especially in the ocean environment. But due to its highly non-linear nature with six degrees of freedom and the presence of hydrodynamic forces, the equations for AUV control become complex and difficult to design. Hence, in order to overcome this complexity and non-linearity, a reduced-order subsystem is derived for controlling the pitch. Linear Quadratic Regulator (LQR) and... Expand

RESEARCH-ARTICLE

Delay-discretization-based sliding mode H_∞ load frequency control scheme considering actuator saturation of wind-integrated power system

Authors: Subrat Kumar Pradhan, Dushmanta Kumar Das Authors Info & Claims

The Journal of Supercomputing, Volume 78, Issue 12 • Pages 13942 - 13987 • https://doi.org/10.1007/s11227-022-04397-4

Published: 01 August 2022 Publication History

International Journal of
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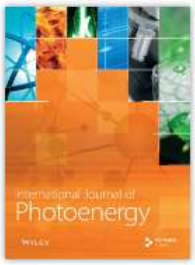

Research Article | Open Access

Design and Implementation of a Floating PV Model to Analyse the Power Generation

Mohamad Reda A. Refaai, Lavanya Dhanesh, Bibhu Prasad Ganthia, Monalisa Mohanty, Ram Subbiah, Endalkachew Mergia Anbese

First published: 20 May 2022 | https://doi.org/10.1155/2022/3891881 | Citations: 9

Academic Editor: V. Mohanavel

Abstract

The floating photovoltaic (FPV) system is a revolutionary power production technology that has gotten a lot of interest because of its many benefits. Aside from generating electricity, the technology can also prevent the evaporation of water. The electrical and mechanical structures of FPV power stations must be studied to develop them. Much research on FPV technologies has already been undertaken, and these systems have been evaluated from many perspectives. Many problems, including environmental degradation and electricity generation, fertile soils, and water management, are currently limiting societal growth. Floating photovoltaic (PV) devices save a great of land and water resources and have a greater energy conversion efficiency than standard ground power systems. A performance investigation of photovoltaic (PV) installations set on a moving platform is carried out. The paper presents and discusses various design alternatives for

materialstoday: PROCEEDINGS

Volume 56, Part 6, 2022, Pages 3355-3365

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

ELSEVIER

Annals of Nuclear Energy

Volume 165, January 2022, 108675

Internal model control based proportional-integral controller with class topper optimization for power control of molten salt breeder reactor core

Subrat Kumar Pradhan, Debasis Acharya, Dushmanta Kumar Das

https://doi.org/10.1016/j.anucene.2021.108675

Computers and Electrical Engineering

Volume 99, April 2022, 107838

Modular unmanned aerial vehicle platform design: Multi-objective evolutionary system method ☆

Wenyi Zheng [a], Abolfazl Mehbodniya [b], Rahul Neware [c], Surindar Gopalrao Wawale [d], Bibhu Prasad Ganthia [e], Mohammad Shabaz [f]

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https://doi.org/10.1016/j.compeleceng.2022.107838

International Journal of
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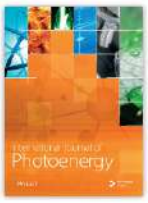
Forward Series



Research Article | Open Access

Simulation Model of PV System Function in Stand-Alone Mode for Grid Blackout Area

Bibhu Prasad Ganthia, R. Dharmaprakash, Tushar Choudhary, T. Vijay Muni, Essam A. Al-Ammar, A. H. Seikh, M. H. Siddique, Abdi Diriba

First published: 20 May 2022 | https://doi.org/10.1155/2022/6202802 | Citations: 4

Academic Editor: V. Mohanavel

Abstract

PV systems are frequently used in a stand-alone configuration. In a solar PV-based energy-producing system, power fluctuation is a natural occurrence. Alternative sources of energy, including such hybrid grid-tied or energy storage systems, could be discovered when solar PV systems run off-grid to satisfy regional power demands for reliable power supply. This research uses an unusual PV system that can function in both grid-connected and stand-alone states to propose an efficient approach for the power generation challenge in the residential segment. A block of storage battery with sufficient dimensions is included in the system to make sure the constant power supply of such a residential building with an average electricity demand of 10 kWh. An atypical 3.2 kWp PV system and a 19.2 kWh storage battery brick was determined to be capable of meeting the house's whole daily energy requirements, as well as the defined electrical shutdown

ECS Transactions

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 Ganthia[1], Subrat Kumar Barik[1] and Byamakesh Nayak[1]

ECS Transactions, Volume 107, Number 1

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

DOI 10.1149/10701.5663ecst

Article and author information

Abstract

ELSEVIER

Renewable Energy Focus

Volume 41, June 2022, Pages 104-117

Research Paper (blue)

Strategic integration of photovoltaic, battery energy storage and switchable capacitor for multi-objective optimization of low voltage electricity grid: Assessing grid benefits

Kumari Kasturi [a], Chinmay Kumar Nayak [b], Samarjit Patnaik [c], Manas Ranjan Nayak [c]

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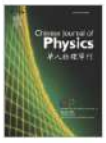
Article

ELSEVIER

Chinese Journal of Physics

Volume 85, October 2023, Pages 277-284



Rip behaviour in Brans–Dicke theory

Sasmita K. Pradhan [a] [b] ✉, Z. Naik [a] ✉, S.K. Tripathy [c] ✉

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https://doi.org/10.1016/j.cjph.2023.06.015 Get rights and content

Highlights

Articles

A kinetic model and parameters estimate for the synthesis of 2-phenyloctane: a starting material of bio-degradable surfactant

Sudip Banerjee, Md Aurangzeb & Amit Kumar

Pages 1-13 | Published online: 01 May 2022

Cite this article | https://doi.org/10.1080/00194506.2022.2068077 | Check for updates

SCIENTIFIC VOYAGE
ISSN: 2395-5546

Vol 2 No 3 (2021)

Accelerating universe and anisotropic dark energy models

ARTICLES

Published October 21, 2021

S.K. Tripathy[+], A. Anand[+], Asmita Parida[+], B. Mishra[+], Saibal Ray[+]

RESEARCH ARTICLE

Fortschritte der Physik
Progress of Physics

www.fp-journal.org

Bouncing Cosmology in Extended Gravity and Its Reconstruction as Dark Energy Model

A. S. Agrawal, Francisco Tello-Ortiz, B. Mishra, and S.K. Tripathy*

In this paper, we have presented a bouncing cosmological model of the Universe in an extended theory of gravity. The dynamical behaviour of the model obtained from the flat FLRW space-time along with the violation of null energy condition have been shown. The geometrical parameters show singularity behaviour at the bouncing epoch. The parameters involved in the scale factor play a major role in the bouncing behaviour. In addition, the coupling parameter that resulted in the minimal matter-geometry coupling in the extended gravity has significant role to avoid the singularity of equation of state parameter at the bouncing epoch. Using a linear homogeneous perturbation calculation, we show the dynamical stability of the model.

1. Introduction

The standard cosmological model suffers from issues like initial singularity, the horizon problem, flatness problem and baryon asymmetry, though it has been successful in explaining the early Universe. The inflationary theory has been successful in solving some of these issues of early Universe, but it still suffers from the singularity problem and the trans-Planckian problem in terms

As usual the singularity occurs before the onset of inflation and therefore the inflationary scenario fails to recreate the complete past history of the universe. As a possible solution to the inflationary scenario problem, the matter bounce scenario has been suggested.[1,2] According to the matter bounce scenario, it is believed that the Universe had a contracting phase and is capable of expanding without encountering any initial singularity. That is, the Universe undergoes an initial matter-dominated contraction phase followed by a non-singular bounce and then there is a causal generation for fluctuation. The cosmological models replace big bang cosmological singularity with a big bounce scenario, which is a smooth transition from contraction to expansion phase.[3,4] But, one important observation is that in a flat Universe, the presence of non-singular bounce may lead to the violation of null energy condition. In fact the violation of null energy condition can be experienced in generalised Galileon theories that supports the possibil-

ity of a non-singular cosmology.[5] Another issue in the bouncing

Physica Scripta

PAPER

Cosmological model with time varying deceleration parameter in *F(R, G)* gravity

Santosh V Lohakare[1], S K Tripathy[2] and B Mishra[3,1]

Published 16 December 2021 • © 2021 IOP Publishing Ltd

Physica Scripta, Volume 96, Number 12

Citation Santosh V Lohakare *et al* 2021 *Phys. Scr.* **96** 125039

DOI 10.1088/1402-4896/ac40d6

References Open science

Article and author information

Abstract

In this paper, we study the dynamical behaviour of the Universe in the *F(R, G)* theory of gravity,

International Journal of Geometric Methods in Modern Physics | Vol. 19, No. 04, 2250060 (2022)

| Research Article

No Access

Viscous fluid accelerating model in modified gravity

Sankarsan Tarai, Pratik P. Ray, B. Mishra, and S. K. Tripathy

https://doi.org/10.1142/S0219887822500608 | Cited by: 4 (Source: Crossref)

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Abstract

In the framework of extended theory of gravity, an accelerating cosmological model

Polymer Bulletin (2023) 80:3949–3980
https://doi.org/10.1007/s00289-022-04246-7

ORIGINAL PAPER

Development of chitosan-based hybrid membrane modified with ionic-liquid and carbon nanotubes for direct methanol fuel cell operating at moderate temperature

Rabiranjan Murmu[1,2] · Debashis Roy[1] · Subhasmita Jena[2] · Harekrushna Sutar[2]

Received: 7 February 2022 / Revised: 2 April 2022 / Accepted: 15 April 2022 /
Published online: 4 May 2022

Abstract

Remarkable progress has been made to develop proton exchange membrane for direct methanol fuel cell to achieve higher power density. However, the higher methanol cross-over and poor water management are the two major obstacles of fuel cell which significantly reduces its performance. In this work, we have developed a highly performance Ionic Liquid (IL) modified chitosan based composite membrane and characterized by different experimental technique. The incorporation of IL in the chitosan composite introduces cationic acid which increases the ion exchange capacity and proton conductivity. Although the hydrophilic base of IL enhances water uptake capacity of the composite, the water is strongly attached with the polymer chain via hydrogen bonding thereby reducing free water content. The incorporation of Carbon Nanotubes (CNT) and bulky pendant group of IL in the chitosan composite reduces methanol cross-over and the methanol cross-over reported for CPCN@IL-4 composite (5.58×10^{-8} cm^2sec^{-1}) is significantly lower than the commercial N117 membrane (2.74×10^{-6} cm^2sec^{-1}). The IL modified composite membrane provides higher proton conductivity and membrane selectivity which is desirable for fuel cell design. At 70 °C, the maximum proton conductivity was achieved in CPCN@IL-3 composite (21.52×10^{-4} Scm^{-1}) and the proton transport was controlled by bound water regulated Grotthus mechanism. The polarization curve obtained for CPCN@IL-3 composite at 70 °C and 2 M methanol feed in a single cell of fuel cell provides the maximum power density of 82 mW/cm^2 at a current density of 370 mA/cm^2. The modification of chitosan based composite membrane with CNT and IL significantly reduces the methanol cross-over and provides higher membrane selectivity which will attracted a possible candidate for DMFC application.

Keywords Methanol cross-over · Ionic liquid · Multiwall carbon nanotubes · Membrane selectivity · Polarization curve · DMFC

Extended author information available on the last page of the article

J Mater Sci: Mater Electron (2022) 33:24559–24570

Band gap tailoring and photosensitivity study of Al-doped SnO_2 nanocrystallites prepared by sol–gel technique

Binod Bihari Panda[1,*], Debakanta Tripathy[1], and Niladri Maity[1,*]

[1] *Department of Chemistry, Indira Gandhi Institute of Technology, Sarang, Dhenkanal, Odisha 759146, India*

Received: 2 March 2022
Accepted: 18 September 2022
Published online: 30 September 2022

ABSTRACT

Electrical, optical and photosensitivity of aluminium-doped tin oxide (Al-SnO_2) nanocrystallites prepared by sol–gel technique and annealed at 400 °C and 500 °C are studied. The synthesized nanocrystallites are characterized using spectroscopic techniques such as powder X-ray diffraction (PXRD), scanning electron microscopy (SEM), Fourier transform infrared (FTIR) spectroscopy, energy-dispersive X-ray spectroscopy (EDX) and UV–VIS-DRS spectroscopy. The PXRD data confirm the development of polycrystalline nanocrystallites having crystal size ≈ 6.8 nm at 400 °C which increases to ≈ 8.7 nm on annealing at 500 °C. SEM images illustrate the formation of nanoclusters. Broad characteristics bands of FTIR spectra demonstrate the presence of physical interaction between SnO_2 and Al_2O_3. EDX spectra illustrate the presence of aluminium, tin and oxygen in the particles annealed at 400 °C and 500 °C with composition $Sn_{0.726}Al_{0.274}O_2$ and $Sn_{0.809}Al_{0.191}O_2$, respectively. UV–VIS-DRS spectroscopy illustrates that the band gap energy of 400 °C and 500 °C annealed materials are 3.42 and 3.35 eV, respectively. First time, the electrical properties and photosensitivity of the Al-SnO_2 nanocrystallites annealed at two different temperatures are studied by making the particles into thin films of thickness 103μ (400 °C) and 106μ (500 °C) on glass substrate.

1 Introduction

Nowadays metal oxide nanocrystallites are creating immense interest among researchers because of their unique characteristics, wide range of applications and stability. They are key materials for optoelectronic devices [1–5]. Among the oxides, SnO_2 is a significant n-type semiconducting material and is useful in fabrication of solid-state gas sensors [6], transparent conducting electrodes [7], rechargeable Li-batteries [8] optical and electronic devices [9], catalyst for photo-degradation & organic conversion [10], photo-electrodes of photovoltaic cells for solar energy conversion and antistatic coating [11–14]. Researchers have reported that the optoelectronics

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https://doi.org/10.1007/s10854-022-09167-9

A New Approach of Image Denoising Based on Adaptive Multi-Resolution Technique

L. M. Satapathy[1], P. Das[2]

[1]Department of Electrical and Electronics Engineering, Siksha 'O'Anusandhan deemed to be University, Bhubaneswar, Odisha, India.
[2]Department of Electrical Engineering, Indira Gandhi Institute of Technology, Sarang, Odisha, India.

ABSTRACT: Medical imaging and diagnostic techniques have become popular over the last two decades with the advancement of data science, data analysis, data storage, and the internet. The impact of this evolution can be seen in the fields of telemedicine and medical sciences, which allow more effective detection and treatment of various diseases. Like any other form of imaging technique, medical images are sensitive to noise and artifacts. The images become unclear with the presence of noise, and the diseases cannot be identified properly. Therefore, image denoising plays a vital role in the field of biomedical image processing. As a result, work must be done to minimize noise without sacrificing image quality. Various methods for reducing noise have already been proposed in the literature. Each method has its own set of benefits and drawbacks. In this paper, we introduce a bi-dimensional empirical mode decomposition (BEMD)-based image de-noising approach. The principal purpose of this research is to decompose noisy images depending on frequency and create a hybrid algorithm that incorporates existing de-noising approaches. The proposed algorithm is an image-dependent technique that decomposes the noisy image into several IMFs with residue, then considering the individual attributes of the IMFs, they are separately filtered. Furthermore equalization is applied to the residue for preserving the edge information. A comprehensive study is conducted over the experimental results of the benchmark test images using different performance measure matrices to quantify the effectiveness of the presented approach. In terms of subjective and objective evaluation, the reconstructed image is found to be more accurate and visually pleasing. It also outperforms the state-of-the-art image-denoising methods, especially in terms of PSNR, RMSE, correlation, and structural similarity.

KEYWORDS: Image de-noising, Adaptive multi-resolution, BEMD, PSNR, RMSE, SSIM.

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I. INTRODUCTION

One of the fundamental challenges in the field of medical imaging is the radiation-sensitive property. Due to this property, various noises are encountered during the image acquisition process. The emergence of noise is random in nature and is intimately linked to image quality assessment. In the presence of these undesirable elements, image processing operations are similarly hampered. As denoising plays an important role in the application areas of image processing, such as video tracking, image analysis, restoration, registration, segmentation, and classification, where visually pleasing images are essential, a special focus is required on it (Gonzalez and Woods 2007).

Removing noise from the noisy image is still a challenging problem for researchers. Over the previous few decades, a number of authors have presented many algorithms, each with its own set of benefits and drawbacks. Some of the publications focused on the classification of noises based on their behaviour. The noises discussed in the preceding articles are either additive or multiplicative. Classical filters like as mean filters, median filters, Gaussian filters, and others are employed for spatial domain denoising (Mallat, 2008). But these classical filters not only smooth the image. However, these classical filters not only smooth the image but also blur the edges of the information. In due course, to overcome the above limitations, transformation-based filters were introduced. The Fourier Transform (FT) is one of the transformation and decomposition methods used in image processing. Later on, wavelet transformation became popular as it has a low resolution and provides simultaneous localization in the time and frequency domains.

The Wavelet transform (WT) (Gupta and Ahmad 2018; Ellinas et al. 2004) has shown its efficiency in various signal processing applications. The beauty of this method is that the decomposed signal contains the different space-frequency components. At this stage, many authors have applied some mathematical operation such as thresholding to suppress the noise (Ellinas et al. 2004; Zhang 2016; Fedak and Nakonechnyy 2015; Kimlyk and Umnyashkin 2018). Then the denoised image is reconstructed by reversing the wavelet coefficients into the spatial domain. The whole process is known as the wavelet-based denoising technique (Fedak and Nakonechnyy 2015; Kimlyk and Umnyashkin 2018; Bnou et al. 2020; Sagheer and George 2020). As per image quality, this denoising method gives a better result in terms of PSNR.

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ORIGINAL CONTRIBUTION

Fault Analysis of PI and Fuzzy-Logic-Controlled DFIG-based Grid-Connected Wind Energy Conversion System

Bibhu Prasad Ganthia[1] · **Subrat Kumar Barik**[1]

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Abstract This research is based on the design of modified version of Type-III wind turbine system using DFIG (Double-Fed Induction Generator). The control technique associated with Type-III wind turbine system is Modified Type-I Fuzzy Logic Controller. Using this advanced form of controller, four different models are designed to control the active and reactive power during the transients and unwanted faults cause voltage sags. Mechanical Drive Train-modified Type-III DFIG-based wind turbine system during various fault conditions like voltage dip conditions, swell conditions with respect to variation in wind speed is explained in MATLAB model with control action of PI controller and Fuzzy Logic Controller (FLC) with grid integration. The research highlights implementations of four types of Fuzzy structures with different modes of operations that are modeled, and comparisons were made between all the structures with PI control structure for both steady state and dynamic state. The model is assembled to the lattice of grid, and the control of the model mechanisms using PI and FLC is studied to estimate the fast response of settling time after the removal of faults. The simulation is done to find the effective controller with respect to cost and economic point of view. The model is based on transient responses to calculate the settling time with application of various fault conditions. In this paper, DFIG, i.e., Double-Fed Induction Generator, is operated through variable speed and variable pitch angle control scheme which is now mostly implemented in power generation and distribution industries. In this paper, DFIG in wind turbine model is assembled to a constant frequency and constant voltage source and tied into a grid which is modeled using MATLAB and to the corresponding generator for operation and control action on active and reactive power are highlighted. The steady state operation and transient characteristics of the whole wind energy conversion system is explained with detail study with respect to the transients due to sudden change in wind speeds.

Keywords DFIG · WECS · GSC · RSC · FLC · PAC

Introduction

The study depicts wind energy system is now the most efficient, ecofriendly and economical source of energy among renewable sources, i.e., solar power, wind and tidal. Wind energy is most abundant, available with no operational cost, and it is away from the releasing any gases which cause harm to our environment at any form. The wind energy system has the high conversion efficiency, and overall environmental harmless makes it most favorable choice as a supply of renewable strength to utilize for the source of energy for humanity [1]. Wind generators are much sensitive to the grid disturbances like faulty condition and voltage dips, etc. During fault conditions, over currents reflect to the RSC through stator and rotor. To protect the system during this condition, crowbar protection is used on the rotor windings to disable the RSC temporarily. Whenever there is a fault occurred, the high magnitude fault current is diverted by the crowbar resistance; thus, the rotor-side converter (RSC) is protected. But

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RESEARCH ARTICLE-ELECTRICAL ENGINEERING

H_∞ Performance-Based Sliding Mode Control Approach for Load Frequency Control of Interconnected Power System with Time Delay

Subrat Kumar Pradhan[1] · Dushmanta Kumar Das[1]

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Abstract
This paper proposes a sliding mode control (SMC) approach to design H_∞ performance-based load frequency controller for interconnected power system (IPS) with time delay. Incorporating an artificial delay, a sliding surface function is designed to enhance dynamic performance of the power system. Linear matrix inequality-based stabilization criterion is derived using Lyapunov–Krasovskii functional for multi-area power system. A novel SMC law is designed with artificial delay to drive the system trajectory into the predefined sliding surface. The applicability of the proposed controller is proved by considering a two-area time-delay IPS. Performance of the controller is verified from the simulation study of the time-delay IPS with proposed controller in MATLAB/Simulink. Then, the controller performance is verified in real time by using OPAL-RT OP4510 digital simulator.

Keywords H_∞ performance · Interconnected power system (IPS) · Sliding mode control (SMC) · Load frequency control (LFC) · Time delay

1 Introduction

Stability in frequency is most important for stable power system operation, because it balances the active power flow from supply to demand. Fluctuation in frequency always makes the operation of power system unsafe, i.e. generators and other power devices deviate from their operating conditions in the entire power system network [1,2]. Thus, frequency regulation is not ignored in power system operation and control. Load disturbance is the primary cause for frequency and voltage oscillation. Therefore, load frequency control (LFC) is very much necessary for safe and stable power system operation [3–5]. To meet high power demand, simple single area power systems are connected with each other via tie lines and create a complex multi-area interconnected power system (IPS) [6,7]. During normal operation of IPS, scheduled amount of power sharing is done among different control areas. But, the aim of a well-designed IPS is to maintain both frequency and voltage within permissible limits during abnormal period of power system operation, i.e. sudden change in load demand [8].

Many research results have been obtained for solving LFC problem in power system over last few decades. Proportional–integral (PI) controller [9] is designed to solve the LFC problem for single as well as multi-area power system. Kharitonov's theorem-based decentralized robust PI controller [10] and Riccati-equation-based robust controller [11] are designed for interconnected power system with parametric uncertainty. Some other control schemes such as active disturbance rejection control approach [12], adaptive control approach with variation in system parameter [13] and variable structure control using pole placement scheme [14] are proposed for IPS. Besides the traditional control techniques, some intelligent control techniques based on fuzzy logic [15], genetic algorithm [16], neural network [17] and bat inspired algorithm [18] are used to design hybrid controllers for LFC of multi-area power system.

A finite time is always required for measurement of control signals, computation of control action and actuation process in a system. This is termed as time lag or time delay in a closed-loop system. This delay affects negatively on the system stability, because of its destabilizing property [19,20].

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ORIGINAL CONTRIBUTION

Improvement in Fault Tolerant Capability of ST-DTC for Five-Phase Induction Motor using Neural Network

Umakanta Mahanta[1] · **Anup Kumar Panda**[2] · **Bibhu Prasad Panigrahi**[1]

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Abstract The performance of switching table-based Direct Torque Control (ST-DTC) depends on number and type of switching states. If there are greater number of switching states and are distributed uniformly in the space, then DTC can handle not only different types of loads but also it can be operated in smoother way during high and low speed operation. When DTC is considered for fault tolerant drive, there are uneven distributions of switching states. In this context, higher level inverter can be preferable as it gives greater number of switching states which are distributed nearly uniformly in the space. The artificial neural network (ANN)-based DTC has the capability to handle such situation in better way if the training data are properly prepared. In this paper, the improvement of fault tolerant capability of ST-DTC with three-level inverter (3-LI) and ANN-based DTC for a five-phase induction motor (5PIM) with one phase open (phase 'a') are compared. The result shows that the use of ANN for fault tolerant DTC reduces the torque and current ripple by 3% and 3.36% respectively. The 5PIM 3-LI gives an opportunity to use five-level torque comparator to handle transient and steady-state load separately. Moreover, with ANN-based DTC, the torque and current ripples are further reduced.

Keywords Three-level inverter · Fault tolerant capability · Five-phase induction motor · Open phase winding · ST-DTC · ANN-based DTC

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Introduction

Generally, the induction motor is controlled through an inverter whose legs and level can be increased. Because of this, the researchers are trying to exploit the advantage of multiphase induction motor like reduction in per phase current, reduction in torque ripple and fault tolerant capability, etc., to improve the overall system reliability as compared to its three-phase counterpart [1–4]. In case of three-phase induction motor (3PIM), if one of the phases is isolated due to fault, it is difficult to apply DTC. However, with multi-phase induction motor (more than three-phase), DTC can be implemented with reduced load. When ST-DTC is implemented to a five-phase induction motor with two-level inverter (5PIM-2LI) with one phase open, there are only 16 numbers of switching states which are not uniformly distributed in space. With use of five-phase three-level inverter to a faulty five-phase induction machine with one phase open, the switching states are increased to 81 and are distributed nearly uniformly in space [5–7]. This gives added advantage for selection of five-level torque comparator to handle the transient and steady-state loading separately.

In recent time, researchers are taking more interest on fault tolerant drive of multiphase machines (more than 3-phase) to improve the system reliability [3, 8, 9]. A fault tolerant DTC of a 5PIM applying virtual vector concept by setting the dwell time of the vectors of a particular sector for two-level inverter is explained in [10–12]. Model-based predictive current control technique also used to handle the fault tolerant drive [13]. The 5PIM is also capable to run with 3-phase operation mode by V/f control [14]. A six-phase induction generator can be operated with three open phases [15]. For reduction in torque ripple and to improve the dynamic response, different intelligent techniques such

JAYA Algorithm-Optimized Load Frequency Control of a Four-Area Interconnected Power System Tuning Using PID Controller

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Abstract-This study examined the design of a Load Frequency Control (LFC) component in a four-area interconnected power system. LFC maintains the frequency of a power system within a prescribed limit. Various controllers for the LFC of a power system have been proposed. The PID controller is a classical approach to LFC. A PID controller that uses a filter in the derivative part amplifies and smooths out the high-frequency noise. The selection of the appropriate optimization method to tune controller gains plays a vital role for LFC. In this work, the PID controller was optimized using the Particle Swarm Optimization (PSO) and the JAYA optimization methods and was simulated in Matlab-Simulink. After studying and comparing the results, it was concluded that the PID controller using the JAYA algorithm provided better LFC in terms of system settling time, overshoot, undershoot, and performance index compared to other optimization methods.

Keywords-load frequency control; AGC; tie line; PIDN; PSO; JAYA

I. INTRODUCTION

An electric power system is a sequential arrangement of components to generate, transmit, distribute, and utilize power while continuously protecting it [1]. A power system has two important parameters that need to be constantly monitored and corrected: voltage and frequency. A generator generates power at some voltage and frequency, and these parameters should be controlled when there is a mismatch between active or reactive power generation and demand [2]. There are basically two methods to perform such control. When the active power demand is not equal to the active power generation, the frequency should be controlled, and when the reactive power demand is not equal to the reactive power generation, the voltage should be controlled [3]. Control of voltage and frequency can be performed in two ways, which are the primary and secondary control mechanisms. The primary control mechanism examines the aspects of generation, as generation remains constant most of the time while demand varies [5]. In the primary control mechanism, the Automatic Generation Control (AGC) has to match the demand by varying the generation. But in emergency conditions, where it is not possible to control generations, the load should be controlled, which is known as the load side management [6]. AGC can control voltage as well as frequency, i.e. load frequency control plus excitation control [7]. In AGC, there is a generator that generates active power P_g and reactive power Q_g. The generator gets input power from a turbine, and the turbine gets input power from the boiler [8]. While the steam comes from the boiler, there is a governor valve placed in the boiler to control the steam. When the active power is delivered to the bus, there is a comparator that receives and senses the frequency f_g coming from the generator [9]. The comparator has a reference frequency f_{ref}, which has to be maintained, and if there is any difference between f_g and f_{ref}, there will be an error f_e which will be operated by the generator valve. This whole closed loop is the LFC [10].

II. INTERCONNECTED SYSTEM

The operation of more than one interconnected areas is known as an interconnected system or power pool or pool operation [12]. Under normal operating conditions, each control area carries its own load and each control area adopts beneficial regulating and control strategies. These are two basic operating principles of a multi-control area system [11]. Unlike a small system, where a sudden change in load causes a large

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Monitoring Nonlinearities and Power Smoothing in Modified Mathematical Modeled Type-III Wind Turbine System using Artificial Neural Network

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Abstract

For feasible wind power generation the speed of the rotor should be maintained balanced with respect to the production of generator power. This research introduces a sliding mode controller to manage wind speed and preserve system stability. It is useful to reduce the nonlinearities using an Artificial Neural Network based Radial Basis Function Neural Network (RBFN). The tip speed ratio technique is utilized in this paper to harvest the most power from wind energy. To optimize this Tip Speed Ratio (TSR) approach, a Proportional-Integral PI-RBFN tuned sliding mode controller was employed to obtain maximum power while minimizing active power losses. Nonlinearities in the pitch angle due to variable wind speed can be solved using this proposed technique. Hence in this paper the robustness of the modified Type-III wind turbine system is studied using MATLAB Simulink. The Simulink results are compared with the existing technique of Double Fed Induction Generator (DFIG) based modified Type-III wind turbines.

Keywords

Wind energy, Type III Wind Turbine, Wind Speed, Pitch Angle Control, RBFN, Sliding Mode Control, Power Smoothing.

1.Introduction

Wind energy, being a renewable source of energy, is now in high demand across all power sectors due to its clean and abundant nature. It could be critical in balancing power demand and increasing energy efficiency for business and residential utilities [1]. The best part about this type of energy is that it does not pollute the environment by generating toxic gases. As a result, it is employed to meet our energy needs as a useful source of energy. To attain high output, a balanced and dependable power system with complete control is essential [2]. Renewable energy sources are becoming increasingly crucial in the huge Generation, Transmission and Distribution system's balancing [3]. We now produce 15 to 20 million Megawatt of power from renewable sources, with wind being the most cost-effective [4]. This can be utilized in both independent and grid-integrated modes to balance out power needs. For complete control over power generation, transmission and distribution, a technical wind turbine system requires both mechanical and electrical components. We started with double fed induction generators, which have no control mechanism and generate losses owing to abrupt variations in wind speed because they are designed for fixed speed operation [1] [16]. Later on we developed the type-III wind turbine system which uses DFIGs with full control over speed and power generation. These are designed with Rotor side and grid side converter based with Maximum power point tracking abilities. Then type-IV PMSG based but the cost is so high, these mechanisms are less used in the world. In our country India type –III DFIGs are maximum used and play efficient power generations in both standalone and grid connected mode. But the controller to the rotor side and grid side should be more precise and faster responsive techniques should be implemented. Many researchers are using adaptive techniques like genetic algorithms, Artificial intelligence and meta-heuristic controllers for fault analysis during transients [1][2]. Fuzzy logic controllers are another example of a control approach that can be used to provide a quicker response to transients. Because the wind energy system requires a steady wind speed for reliable power generation, the wind speed should be balanced between low and high speeds. Wind flow might be unpredictable, causing harm to the system, so the controllers for the rotor and grid should be thoroughly evaluated and implemented [2] [3].

2.Literature Survey

The Lyapunov-based sliding mode control (SMC) approach has a number of advantages over previous approaches. For many practical systems, it has been recognized as one of the most effective design methodologies [1][4]. It may be used to tackle issues that are both linear and nonlinear. It may be used for both continuous-time and discrete-time systems, and it has long been regarded as a reliable control system approach due to its simple design procedure and robustness to system uncertainties and external disturbances. SMC's purpose is to transfer a system route's state to an appropriate area in a finite period of time and keep it there. After that, the problem region is labeled as a sliding surface or switching, implying that the system state variables are related. [3][5] It is completely defined by a differential equation that defines the dynamics of the system. Dynamic sliding mode describes the system's behavior as it moves across the sliding surface. Chattering, a type of high-frequency oscillation that can cause system instability and damage, is one of the most common and major undesirable phenomena that SMCs experience. SMC was used in this work to control and regulate nonlinearities in order to get the most power out of it [6][13][15]. The adaptive

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ORIGINAL ARTICLE

Nonlinear dynamic measurement method of software reliability based on data mining

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Abstract Developing high-quality software is the ultimate goal of any software development organization. But the major challenge is to achieve good quality. It can usually only be measured after delivery, and reliability is the primary measure of software quality. During development, there are many attempts to assess software quality. To solve the reliability problem of evaluating software, the data mining model of BP neural network is proposed to predict the reliability of software. Firstly, data mining is carried out on the number of faults of the software, and data such as the cumulative execution time and the corresponding observed cumulative number of faults in the testing process of the software within a set of specific times are collected. Secondly, the training model of BP neural network is built according to the failure data samples, and the software is trained and learned according to the historical data, it is used to test the cumulative execution time of the future stage, calculate the corresponding predicted cumulative failure number of the software, and then verify the reliability of the target software. The example proves that the BP neural network is more accurate in predicting the 17th, 18th, and 19th groups of cumulative failure times compared with the traditional nonlinear modes, Jelinski-Moranda model, Goel-Okumoto model and Yamada S-shaped model, the number of faults predicted is more the prediction accuracy is higher, and it is more suitable for application and reliability evaluation of software.

Keywords Data mining · Software reliability · Nonlinear measurement · BP neural network · Jelinski-Moranda model (JM) · Goel-Okumoto model (GO)

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1 Introduction

Developing high-quality software is the ultimate goal of any software development organization, but one of the most challenging aspects of quality, it can usually only be measured after delivery, and reliability is the primary measure of software quality. During development, there are many attempts to assess software quality. Such estimates are likely to aid the engineering of high-quality software by providing useful insights to project managers. Data mining is the use of various heuristic methods or tools to collect a large set of data, which is stored in a database or data warehouse for analysis, the goal is to discover hidden patterns and relationships in the data set and summarize the data in a form that decision makers can understand, that is to realize "data, information, knowledge, value"

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ORIGINAL ARTICLE

Positional Identification Based Whale Optimization Algorithm for Dynamic Thermal–Wind–PV Economic Emission Dispatch Problem

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Abstract
Global warming is the latest important discussion, and that is due to byproducts such as SO_x, CO_2, and NO_x, and all countries have started the initiation to minimize the emission level. For environmental concern and the welfare of society, the emissions have to be minimized. Every electrical power generation company also needs to minimize the cost of operation for better use. This paper uses different constraints to reduce both the generation cost and emissions. Because the thermally operated power plants are non-convex and non-linear in nature, the emissions produced during generation are a complex mathematical problem. To improvise the issues, we introduced renewable energy sources (RES) generation such as wind and solar power along with the thermal power plant to analyze the Dynamic Economic Emission Dispatch (DEED). From an environmental point of view, RES is used to reduce the level of environmental emissions. A position-based Whale Optimization Algorithm (PWOA) is projected as the extension of WOA to upgrade the performance by accelerating the rate of convergence and improving its capability. To verify the reliability and accuracy of the PWOA and solve the DEED problem, we utilized the IEEE-30 bus 6 thermal unit and IEEE-57 bus 7 thermal unit testing systems, considering both the conditions with and without RES generation. The outcome obtained from the simulation using PWOA shows the accuracy and efficiency of the method for the reduction of operational cost and obtained emissions.

Keywords Dynamic economic emission dispatch · Position-based whale optimization · Wind power · PV power · Hourly generation

Introduction

Thermal power plants, as we know, are the base load plants that generate the majority of the electrical power. Its primary fuel is fossil fuel, and after burning to generate heat, the emissions are released into the environment. This emission consists of SO_x, CO_2, NO_x, etc., which are very harmful to the environment. India uses thermal power plants to satisfy the major portion of its electric power demand and cause harmful emissions. For the safety of our environment, it is necessary to diminish the emission level. For sustainable development, emissions have to be minimized, but on the other hand, the growth of the population and technological advancement require more and more generation of power. Due to this, demand for base and peak load increases. Normally, thermal power plants are used for base load demand. To reduce the generating cost and emission level to a minimum value, non-conventional power sources may be used. But these types of plants depend on environmental conditions and vary from time to time.

Problems associated with DEED are considered as a multi-objective optimization issue used for minimizing the fuel cost and environmental emission level by dispatching generating power subject to different constraints within the power system. Solving these two different objectives within a single model is a difficult task. So, to reduce the complexity of two objectives, it is required to reduce them into a single objective problem. To improve the ED problem in practice, the model was modified to a dynamic system of demanding loads over a single day (a 24 h span). As development is linked to renewable sources, technology is rapidly increasing, incorporating the inclusion of RES to reduce harmful emissions, i.e., wind power sources and

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VMD BASED IMAGE QUALITY ENHANCEMENT USING MULTI TECHNOLOGY FUSION

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Curvelet transform
Dual-tree
CWT
MSVD
CS-MCA
NSST.

ABSTRACT

Despite the success of various enhancement techniques used in many bio-medical applications, edge-preservation-based image enhancement remains a limiting factor for image quality and thus the usefulness of these techniques. In this paper, a new enhancement technique combining the variational mode decomposition (VMD) with the Sobel gradient and equalization technique is proposed. The proposed algorithm first decomposes the image into various sub-modes based on their frequency. The low-frequency components are equalized using the conventional equalization technique, whereas the high-frequency components use a traditional filter. Finally, the edge of the original image is added to the processed image for quality assurance. The proposed algorithm has two advantages over the existing approaches by enhancing only the low-frequency components to extract the hidden artefacts and specifically de-noising the high-frequency component. This process not only enhances the contrast, but also preserves the brightness of the image. A comprehensive study was conducted on the experimental results of benchmark test images using different performance measure matrices to quantify the effectiveness of the approach. In terms of both subjective and objective evaluation, the reconstructed image is found to be more accurate and visually pleasing. It also outperforms the state-of-the-art image-fusion methods, especially in terms of PSNR, RMSE, mutual information, and structural similarity.

Contribution/Originality: This method combines the advantages of variational mode decomposition with a multi-technology fusion to preserve some source image features while improving the image clarity, removing blurring and noise, and increasing contrast.

1. INTRODUCTION

Proper diagnosis requires a good visual quality image with the hidden information present, as nowadays, medical images are playing a vital role in clinical assessment [1]. But practically, finding a suitable image and imaging system is very difficult because the image collected by the electron microscope or different medical image acquisition equipment is not up to standard. So post-processing must be deployed for better results and perception. Contrast enhancement is one of the popular image and video signal processing techniques used to improve image quality in various applications where human perception and recognition play a vital role. In some cases, it is also critical to highlight the essential image domain features for automatic pattern recognition and machine learning. As per the view of different researchers, finding the right balance of brightness and contrast is necessary for a good quality image [1]. Based on this principle, image enhancement is an important preprocessing technique for better

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REGULAR PAPER

Micro Cylindrical Ultrasonic Motor with Improvised Power and Efficiency

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Abstract
This paper presents a micrometer scale of a bar-type traveling wave ultrasonic motor. The proposed work is based on the cylindrical micro ultrasonic motor which consists of an 8 piezoelectric bar, is very small in size, and has been designed through a Micro-meter scale. It produces a high power/weight ratio, and efficiency is independent of the size of the motor. The different parameters of such motors are studied and analyzed. The motor produces an output power of 5.7 pW. The output torque is 0.28 nN. The produced rotation per minute is 2620 RPM with a preload of 0.98 μN. There is a great demand for high drive power for micro loads in many fields as per their requirement or field of application, such as micro-robots, microsurgery equipment, and MEMS applications.

Keywords Ultrasonic motor · Piezoelectric · MEMS · Actuator

1 Introduction

Nowadays piezoelectric ultrasonic motor is widely used in many fields, such as in medical microsurgery equipment and ultrasound [22], 18. On the other hand, ultrasonic motors are used in micro-robots [8] and micro cameras for autofocusing purposes [1]. Due to non-electromagnetic operation [12], the demand for ultrasonic motors is increasing rapidly. Besides this, the geometry and fabrication of ultrasonic motors are very accessible [11]. Piezoelectric material has the property of converse piezoelectric effect for which the external electric field is applied to a piezo material [5], it produces mechanical deformation on it. In the case of the ultrasonic motor sinusoidal wave with ultrasonic range, frequency is applied to piezo material to produce mechanical changes named bending modes [4]. According to geometry, design, and operational principles [9, 16, 24] the piezoelectric ultrasonic motor is divided into some types [7]. The proposed ultrasonic motor is named a cylindrical bar-type traveling wave micro ultrasonic motor. Ultrasonic motors are very renowned for their high torque output at low speeds.

Several works on cylindrical traveling wave ultrasonic motors are going on Kanda et al. describes the high output power generated in cylindrical bar-type stators [10]. According to operational principles, the performance is described by Tian et al. [21]. In the count of advancement in this work, the size of the cylindrical traveling wave type ultrasonic motor is minimized by using scaling of the piezoelectric ultrasonic motor by Mashimo [13]. All the motor outputs like torque etc. are retained and calculated in this study. In addition, frictional material is avoided, and preloading for purpose of rotor stabilization is minimized [2], 20. Considering these many physical things into account the study is progressed and the required data for the miniaturized motor has been studied. To discuss the application field of the proposed motor, it can be utilized in the medical field and others where electromagnetic motors are restricted piezoelectric motors take the advantage of it [14]. Piezoelectric motors can produce high torque as compared to electromagnetic motors when the small-scale design is considered [27].

In this article, a Microscale cylindrical ultrasonic motor has been designed and various parameters were analysed. Design of the proposed structure along with the FEM and numerical analysis is carried out in Sect. 2. The section is also divided in to four parts such as the design of the structure, operating principle, FEM analysis, and numerical analysis. In Sect. 3, the results obtained from FEM and

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TECHNICAL PAPER

A proposal for testing kit of corona viruses using 3D photonic structure

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Abstract
Design of corona virus testing kit is proposed in this paper using silicon based 3D photonic structure through zirconium quantum dot solution at the signal of 412 nm. The principle of measurement depends on the computation of reflectance, absorbance and transmittance of virus based quantum dot solution. In this paper, the reflectance is studied through the analysis of photonic band gap and absorbance is made through its numerical treatment. Further, the numerical investigation shows that the transmitted energy through photonic structure would determine the type of corona virus. For example; if the transmitted energy lies within the visible spectrum the sample would be normal corona virus. However, the sample could be IBV (SARS COV-2) if the transmitted energy would be Infrared.

1 Introduction

A novel corona virus is a new damage that has not been previously identified in humans. However, it is originated in the Wuhan city of China in December 2019. The disease infects the people and the rate of infection grows exponentially among the people. The corona virus has large family of viruses, which cause the illness ranging from severe diseases (MERS and SARS) (Cui et al. 2019; Forni et al. 2017). However, all common colds do not belong to the novel corona viruses. There are different corona viruses such as N5H1, N5H2, H9N2, H4N6, FAdV, and IBV (Ahmed et al. 2018). The infectious bronchitis viruses (IBV) have different characteristics with respect to the others. Moreover, the properties of the IBV are similar to the present novel corona viruses (Crossley et al. 2012; Editorial Commentary 2020). So, SARS COV-2 or novel corona virus or COVID-19 belongs to the family of IBV. It is caused by sever acute respiratory syndrome. Basically, such viruses spread through the close contact via talking, coughing, sneezing and through the touching of contaminated surface. Moreover, the common symptoms of these diseases are fever, tiredness, breathing problem, and the loss of smell aside cough and sneeze. The time of exposure of such diseases is about 5–6 days. However, currently the time range of 2 to 14 days are considered as the time of exposure. However, it is extended to 21 days in some cases. Since medicines are not available for such disease, hydrochloride based medicine and plasma therapy are applied on a hit and trial basis. However, it is important to increase the immune system of the patients to keep away such diseases. Though no real medicine have been used for the same so far, some preventive measures including covering mouth while coughing and sneezing, frequently hand washing with soap, wearing a face mask in public places, maintaining distances and self isolation for minimum 14 days, have been advised and recommended now a days. As far as diagnosis of this disease is concerned, reverse transcription polymerase chain reaction (RTPCR) of infected secretion or CT imaging of the chest are used to know the status of the disease (CT provides best diagnosis for COVID-19 2020; Ai et al. 2020). Ribonucleic acid (RNA) testing of respiratory is used as standard test for SARA CoV-2. Recently various laboratories and companies are designing serolaboratories (Coronavirus disease (COVID-19) technical guidance: Laboratory testing for 2019-nCoV in humans, World Health Organization 2020), which will diagnose the antibody of the same. However the accuracy is the matter of concerned here. Imaging features of the chest radiograph and computer tomography are used for symptomatic nature (Vogel (2020). Further comparing

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ORIGINAL CONTRIBUTION

A Novel Study of Synthesis, Characterization and Erosion Wear Analysis of Glass–Jute Polyester Hybrid Composite

Abhilash Purohit[1] · Janaki Dehury[2] · Laxmi Narayan Rout[2] · Satyaranjan Pal[2]

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Abstract In this study, an attempt has been taken to fabricate a new class of hybrid composite consisting of polyester as a matrix material with glass and jute fibers for reinforcement. Twelve composite specimens have been fabricated by varying the fiber loading and orientation; further, the effect of fiber content and orientation on different physical criteria (density, void content and water absorption behavior), mechanical criteria (tensile and flexural strength) and erosion wear property of the prepared samples are investigated. Experimental design of Taguchi is implemented to study the effect of various control factors such as standoff distance, impact velocity, composite composition, fiber orientation and impingement angle on erosion wear rate of the composites. Scanning electron microscopic analysis is done on the fractured surface of the composites to study the mode of failure under tensile and flexural loading conditions. From the experimental results, it is found that inclusion of fiber decreases the density of the composites, whereas the void and mechanical properties increase with fiber loading. From the Experimental design of Taguchi, it is found that composite composition is the most influencing control factor affecting the wear rate of the composites.

Keywords Polyester · Hybrid composites · Surface morphology · Physical properties · Mechanical properties · Erosion wear behavior

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Introduction

Both Natural and synthetic fiber-reinforced composites are gaining attention due to their number of advantages such as low density [1, 2], improvement in mechanical properties [3, 4], environmental friendly [5–7] and low cost [8]. These fibrous composites replace many traditional materials for different applications like transportation, automobiles, aerospace, construction, sports equipment, military usage, packaging, home appliances, etc. However, poor compatibility and moisture absorption are the major drawbacks of fiber-reinforced composites [9]. The rate of water absorption is high in natural fiber composite due to the existence of hydroxide and other polar groups in several constituents of natural fiber. Therefore, to overcome these problems, the most important criterion is to confer hydrophobic nature to the fibers by treating them with suitable chemicals [10–12]. The compatibility can be enhanced by improvement in fiber's surface roughness, which can be obtained by alkali treatment of fibers [13–15].

Incorporation of Jute fiber furnished an increase in the mechanical properties of the natural fiber for reinforced polymer composites [16, 17]. It was reported that, with the alkali treatment, tensile and bending strength of the jute fiber-based polymer composites increased by 30% and 50%, respectively [18]. The effect of fiber loading on mechanical characteristics of sisal/jute, glass–jute epoxy composites was studied by Srivastav et al. [19, 20]. Goriparthi et al. [21] analyzed the tensile strength and water absorption properties of polylactide-jute fiber composites in hygro-thermal environment. Bledzki et al. [22] studied that jute fiber-reinforced polypropylene composites have better mechanical properties than those of kenaf fiber-based composites. A similar report published by Gowda et al. [23] showed that polyester matrix filled with jute fiber composites has better mechanical

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THE EUROPEAN PHYSICAL JOURNAL C

Regular Article - Theoretical Physics

Dynamical stability analysis of accelerating $f(T)$ gravity models

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Abstract In this paper, we have emphasized the stability analysis of the accelerating cosmological models obtained in $f(T)$ gravity theory. The behaviour of the models based on the evolution of the equation of state parameter shows phantom-like behaviour at the present epoch. The scalar perturbation technique is used to create the perturbed evolution equations, and the stability of the models has been demonstrated. Also, we have performed the dynamical system analysis for both the models. In the two specific $f(T)$ gravity models, three critical points are obtained in each model. In each model, at least one critical point has been observed to be stable.

1 Introduction

The theoretical studies and cosmological observations of the Universe suggest that at early times Universe has passed through the inflationary stage and at late times in the accelerated phase. Theoretically, it can be achieved in two ways. In the first approach, the Universe content is to be altered with the introduction of additional fields, phantom scalar, canonical scalar, vector fields and so on [1–3]. The second approach is to modify the gravitational sector [4]. Usually, the modified gravitational theories are formulated by extending the Einstein-Hilbert action, which is curvature-based; however, another class of gravitational modification can be done by extending the action of equivalent torsional formulation of General Relativity (GR) e.g., the teleparallel equivalent of GR (TEGR) [5–9]. The framing of the modified theory of gravity that leads to second-order equations in the four-dimensional space-time can be started from TEGR. In GR, the Levi-Civita connection means curvature, but no torsion has been used whereas in teleparallelism, the Weitzenböck connection means torsion, but no curvature has been used [10]. In this framework, the dynamical objects are the four linearly independent tetrad fields that forms the orthogonal bases for the tangent space at each point of space-time. Also, the torsion tensor has been formed from the products of the first derivative of the tetrad. The $f(R)$ gravity is the simplest modification of GR and so also the $f(T)$ gravity, which is a simple modification of TEGR. It is well known that the action of general teleparallel gravity fails to satisfy local Lorentz invariance [11]. In the formulation of $f(T)$ gravity [12–14], one begins with pure tetrad teleparallel gravity and the spin connection is considered to vanish identically. So, the torsion tensor is effectively replaced by coefficients of the governing parameters, which are not tensor under local Lorentz transformations. The violation of local Lorentz symmetry has been ignored in TEGR as it does not affect the field equations, but this is an issue in $f(T)$ gravity. It is noteworthy to mention that the teleparallel gravity utilizes the teleparallel connection $\Gamma^{\rho}{}_{\mu\nu}$ [15,16], which has the torsion but vanishing curvature. Whereas in curvature based geometries, the Levi-Civita connection, $\tilde{\Gamma}^{\rho}{}_{\mu\nu}$ of the metric is used, which has non-vanishing curvature of space time. Both the connections are metric compatible.

The problems related to expanding Universe and late time acceleration are studied in $f(T)$ gravity [12–14,17,18]. In this gravity, Wu and Yu [19] have performed the dynamical system analysis in the power-law model. They have shown the stable de Sitter phase and unstable matter and radiation dominated phase. Hohmann et al. [20] have shown that there are no trajectories, which would start from an initial accelerating period, then decelerates and finally transition back to the accelerating de Sitter phase. Bamba et al. [21,22] have shown the finite time future singularity. Another important study in $f(T)$ gravity is the Noether symmetry approach to find the exact solution to the given Lagrangian [23,24]. Zheng and Huang [25] have compared their model framed through the power-law with the observational prediction of

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BRIEF COMMUNICATION

A New Perspective on the Green Strategy of Close Cycle Dissociation of H_2S

Bachcha Lal[2] · Dan Bahadur Pal[3] · Chandradhwaj Nayak[4] · Amit Kumar Gupta[5] · Arvind Singh[1]

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Abstract Extremely toxic H_2S gas is produced in huge quantities across the world as a byproduct of the desulfurization of hydrocarbon fuels. This H_2S gas is further converted into sulfur in sulfur recovery units. However, the valuable hydrogen content is lost as water vapour. It emphasizes the importance of proper exploitation of this resource. A continuous two-steps cyclic process for producing H_2 and sulfur simultaneously has been derived in this study. The first well-studied photocatalytic step generates hydrogen by water splitting in the presence of sulfide (S^{2-}) and sulfite (SO_3^{2-}), the sacrificial agents. Here, these sacrificial agents are converted into thiosulfate ($S_2O_3^{2-}$). In the second step, this $S_2O_3^{2-}$ reacts with hydrogen sulfide (HS^-) to form elemental sulfur, along with generation of S^{2-} and SO_3^{2-}, which are again reused in the first step. The kinetics of the reaction involved in the second step ($HS^- + S_2O_3^{2-} + OH^- \rightarrow S + S^{2-} + SO_3^{2-} + H_2O$) were studied in the present work. The reaction was found to be non-elementary with a rate law of $k[HS^-]^{1/2}[S_2O_3^{2-}]^{3/2}$. The observed rate law is of the order of 1.5 with respect to thiosulfate and 0.5 with respect to HS^- ions. A reaction mechanism for the second step consistent with the kinetics was also proposed. The rate constant was observed to be $1.075 \times 10^{10} e^{-62280/RT}/M/s$. This new proposed close cycle may simultaneously achieve green and renewable H_2 production along with H_2S removal.

Keywords H_2S · Dissociation · Sulfur · Kinetics

Introduction

Hydrogen sulfide (H_2S) is a very poisonous and corrosive gas with a rotten egg stench [1]. H_2S is often produced by natural processes such as microbial metabolism in the absence of oxygen or volcanic eruptions. However, in current civilization, the major sources of H_2S are ascribed to human need based industries such as crude oil refineries (desulfurization), coal industries, and natural gas production. A quantity of H_2S in the air exceeding 320 ppm might cause pulmonary edema and mortality [2]. Therefore, H_2S must be properly eliminated from these industries and associated human activities. H_2S is made up of two hydrogen atoms. As a future energy carrier, H_2 may play a pivotal role [3]. The Claus process, which produces sulfur and water via a high-temperature oxidation phase followed by a low-temperature reduction step, is the standard and well-known technique for H_2S removal (Eqs. 1, 2) [4, 5].

$$2H_2S + 3O_2 \rightarrow 2SO_2 + 2H_2O \quad (1)$$

$$2SO_2 + 4H_2S \rightarrow 6S \downarrow + 4H_2O \quad (2)$$

Due to the requirement of higher temperature, the energy consumption of this process is rather significant.

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Indian Chemical Engineer ›
Latest Articles

Research Article

Performance investigation of MISO soft sensors in predicting AQI: a comparative analysis

Md Aurangzeb, **Sudip Banerjee**, Dipa Das & Prabir Ghosh

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ABSTRACT

The present investigation proposes a Bayesian Regularized Artificial Neural Network (BRANN) based multi input single output (MISO) soft sensor. It predicts the value of air quality index (AQI) by receiving measured inlet concentration of different air pollutants such as particulate matter-2.5 ($PM_{2.5}$), particulate matter-10 (PM_{10}), SO_2, NO_2, O_3, and CO. The performance of BRANN is also evaluated comparing with other two soft sensors namely, scaled conjugate gradient trained artificial neural network (SCGANN) and

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Applicability of the Teetered Bed Separator for Beneficiating Indian Iron Ore Fines: An Experimental Study

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Abstract

Higher alumina and lower iron content in Indian iron ore fines is a major problem for its effective utilization in the iron-making process. India is the second largest steel producer in the world with an annual production of 200 million tons in the year 2020, whereas iron ore beneficiation of this country is highly derisory. Only 52 concentrators are required to produce 220 MTPA of iron ore. Most of the concentrator's benefits are limited to sizing and washing. In recent years, the Teetered Bed Separator (TBS) has gained significant importance and appeared as a viable option for beneficiating a variety of fine minerals. So, a systematic study has been carried out to verify the suitability of the TBS to reduce the alumina content and improve the iron grade in Indian iron ore fines. As the performance of gravity separation processes strongly depends on the feed particle size, a size-by-size beneficiation study was carried out to delineate the role of particle size on the performance of the TBS. Based on this study, the TBS is established to be a possible alternative to the other conventional equipment used for the beneficiation of iron ore fines.

Keywords: *Beneficiation, Iron Ore Fines, Partition Coefficient, Separation Efficiency, Teetered Bed Separator*

1.0 Introduction

India has a substantial amount of iron ore capital of about 31,213 million tons, of which about 34% is of magnetite and 66% of hematite type[1]. The physical and mineralogical properties of an ore play a vital role in the extraction of metal in a profitable process. High hematite content and low energy requirement for crushing are two prominent features. Indian iron ore is generally softer with high clay content with fines (-10 mm size) during the preparation of the ore. The use of these fines is restricted due to its lower quality. These fines were rejected into the tailing dam. Indian iron ore which makes it a potential economic source of iron. As per the Steel Policy 2017-18, around 450 MTPA (million tons per annum) of high-grade iron ore resources are required to meet the steel demand of 300 MTPA in 2030[2]. However, as it is of lateritic origin with goethite abundance, a huge number of fines (-10 mm size) are produced in the size reduction step. The generated fines are characterized by aluminium gangue mineral (3-6 %) in addition to low iron percentage[3]. The low iron content of these fines prevents them from being processed in blast furnaces for iron extraction and chart their path to the tailing ponds used for the waste. Further, it has been documented that, a -100 mesh fraction in the sinter feed can be used up to 40%, by micro-balling of the sinter mix before sintering. The scarcity of high-grade iron ores and environmental concern in using new mines

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Performance of Bioremediation Strategy in Waste Lubricating Oil Pollutants: A Review

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ABSTRACT

The rapid growth of industrialization commences the utilization of lubrication oil in various machinery and automobile sectors. Waste Lubricating Oil (WLO) is the used oil which is released by industries and vehicles as a waste product. The toxicity of WLO is due to the lubricants of the machine associated with asphaltene content, residual carbons, heavy metals, and other dirt materials. The elemental content of WLO is calcium, magnesium, lead, iron, and chromium, containing 1020, 367, 16, 36, and 180 ppm, respectively. These oils are usually generated from motor garages, accidents, cement industry, textile industry, and food industry, mining industry, etc. Disposal of WLO directly into the environment, especially rivers, seas, and lakes, causes serious problems. WLO containing heavy metals and toxic hydrocarbon pollutants has various impacts on the soil by reducing water holding capacity, moisture content, activities of microorganisms etc. As a result, it has a negative effect on human health by triggering disorders in a wide range of human organs. When these metallic wastes come into touch with the skin, it both irritates and sensitizes it. It has also several impacts on aquatic life, such as a decrease in fertility rate and growth of aquatic animals. Physicochemical methods can't recommend the treatment of WLO due to the involvement of secondary pollutants allied with these processes. Bioremediation can be effectively applied to the management of waste lubricating oil pollutants by utilizing natural or enhanced microbial activity to degrade and transform the contaminants present in the oil. In order to address the issues with traditional approaches, this review concentrated on the origins and key pollutants of WLO, its effects on humans and the environment, and the need of a sustainable bioremediation plan.

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KEYWORDS
Bioremediation; heavy metals; hydrocarbons; waste lubricating oil

Introduction

Lubricating oils are very important in industries, including friction reduction on machinery parts, engine and gear lubrication, and driving hydraulic winches, cranes, and other heavy machines. Further, the common use of lubricating oil includes friction reduction in vehicles Releases are facilitated by riverine and atmospheric movement, storm water, and calamities. Pollutants such as Plastics and microplastics get aggregated, and sink in surface waters where they are consumed by creatures and dispersed by currents. The final location is anticipated to be in ocean sediments. The quality of lubricating oil deteriorates due to oxidation, contamination with moisture, contamination with ethylene glycol, and metal corrosion. Over time, the tribological and rheological properties of the oil undergo a gradual deterioration, ultimately resulting in its transformation into waste oil. The deteriorated lubricating oil or waste lubricating oil (WLO) contains toxic substances, heavy metals, carbon residue, asphaltene, aromatic, aliphatics, diversified organics and inorganics, water, and other dirt materials. For this reason, the WLO exhibits detrimental impacts on both the environment and human populations (Mishra et al. 2021). Improper dumping of hydrocarbon pollutants may cause death to plants and animals (Mohanta et al. 2023; Behera et al. 2021; 2022; Hentati et al. 2013; Sammarco et al. 2016). The heavy metals in lubricating oil must be pretreated before releasing into the environment. Major heavy metals present in WLO are Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Mercury (Hg), and Lead (Pb) (Adesodun and Mbagwu 2008). The types of metal found in WLO depend on the process of lubricating oil. The metals found in WLO are not necessarily the same as those found in unused lubricating oil. In the year 2019, lubricating oil's global consumption reached 48 million tons (Yang et al. 2021). An annual utilization rate of 60% for oil-based lubricants, the global scale emission of 70 million liters of deleterious lubricant oil can be inferred. According to a statistical investigation of algae potentiality in bio sorption, it absorbs about 15.3–84.6%, which is higher than other bacterial bio sorbents (Kuanar et al. 2022). Heavy metals pollution is one of the most pervasive forms of pollution, since it is produced in large amounts by both the industrial and

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REVIEW ARTICLE

Impact and Remediation of Petroleum Hydrocarbon Pollutants on Agricultural Land: A Review

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ABSTRACT

Petroleum hydrocarbons, which are organic molecules consisting of carbon and hydrogen, are found in crude oil. Due to human activities like oil spills, leaking storage tanks, and transportation accidents, they are pervasive environmental toxins. This contamination can have negative consequences on the ecosystem, including soil, water, and air pollution, and agricultural land is not immune. There are several variables that can affect how petroleum hydrocarbons affect agricultural land, including the particular hydrocarbon, the properties of the soil, and the current climatic circumstances. The porosity, permeability, and water-holding capacity of soil have been influenced by petroleum hydrocarbons. This might result in soil compaction, decreased infiltration, and higher runoff, affecting agricultural land production. Hydrocarbons can also impair soil aeration, resulting in anaerobic conditions that can harm the soil microbiome and hinder plant development. Petroleum hydrocarbons can change soil's pH and nutrient availability, which can affect its chemical characteristics. Through modifications to microbial activity, diversity, and composition, petroleum hydrocarbons can affect the soil's biological characteristics. Reduced soil fertility and production may result from this. The kind of hydrocarbon, the properties of the soil, and the type of crop are only a few of the factors that affect how petroleum hydrocarbon pollution affects agricultural productivity. Some crops are significantly more susceptible to hydrocarbon contamination than others, which can impact their yield. To limit the spread of petroleum hydrocarbon contamination, a number of physicochemical strategies have been used to the contaminated areas, but this has resulted in significant chemical consumption, high treatment costs, and the production of secondary pollutants that harm the environment. The biological remediation method, on the other hand, makes use of microorganisms or plants to break down or remove toxins from the soil. This review articles focus on the effects of petroleum hydrocarbon pollution on agricultural land and elaborates the remediation methods that may be applied to lessen these effects.

ARTICLE HISTORY
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KEYWORDS
Agricultural land; bioremediation; crude oil; petroleum hydrocarbons; poly aromatic hydrocarbons

Introduction

Organic substances called petroleum hydrocarbons, produced from crude oil, are extensively employed in many sectors. However, the unintentional release or improper disposal of petroleum products can contaminate soil and water, seriously negatively affecting the well-being of human populations and the ecosystem (Behera et al. 2021; 2022; Mishra et al. 2021; Siddiqi et al. 2022). Over the past century, there has been a tenfold increase in the use of hydrocarbons, such as petroleum and its byproducts, in industry and daily life, leading to hydrocarbon contamination of both land and water. Oil spills and leaks threaten aquatic or marine species all over the globe, and some 35 million barrels of oil are carried across the seas every year, putting the aquatic environment at risk (Banerjee et al. 2016). Another significant issue is the contamination of soil by oil spills, which poses a substantial and sometimes fatal risk to human health and causes groundwater pollution, environmental issues, and decreased agricultural land production (Saeki et al. 2009). Such instances of water and soil contamination have increased in frequency recently.

Given that many hydrocarbon compounds have poisonous properties, these have adverse short-term and long-term effects. These contaminants linger in soil and water for years on end, frequently. In the Year 2021, Federal documents show that the operator neglected to make the necessary repairs, which led to the burst of a highly corroded pipeline and the spilling of more than 300,000 gallons of diesel fuel just outside of New Orleans; a similar incident occurred in Bangladesh's Sunderbans in 2014 when 350 tonnes of oil were spilt into the river Sela over a 70 sqr km area, endangering the mangrove forest there as well as the various species of flora and fauna. Petroleum oil is transported across a huge pipeline network in India (Khan et al. 2004). Oil spills caused by pipeline leakage; leaking oil or tanker accidents are frequent yet incredibly harmful to the environment. In addition to petroleum, diesel also contains mixes of

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Microfiber pollution and its microbial mitigation: A review on current trends and future prospects

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Sustainability

ABSTRACT

Background: Synthetic Microfiber pollution poses a significant rising threat to the environment and human health. During manufacturing, use, and disposal at the end of their useful lives, textiles release microfibers into the environment. Microfiber pollution poses a potentially significant and rising risk to the environment, necessitating safeguards and sustainable growth in the textile and fashion sectors.

Methods: Annually, around 9 million tonnes of microfibres are produced, with 60% being synthetic and 25% being non-synthetic or natural. During the washing of synthetic clothes these microfibres fleece are released and discharged into municipal water streams and end up in rivers and marine ecosystem. These emerging pollutants are being underestimated during environmental impact assessments various aquatic ecosystems, leading to potential widespread of damaging contaminant. Microfiber waste management through biological and chemical approaches has been evaluated for the treatment of these pollutant. The present biological approaches focus upon microbial degradation of synthetic pollutants in the natural environment.

Significant findings: In this review, we deliberated the recent advances on microfiber pollution and its microbial mitigation and elaborately describes the sources of microfibers in aquatic, the harmful effects of microfiber pollution on environment and human health. Moreover, the manuscript the mechanism of microbial remediation of microfiber pollutants, the factors affecting the bioremediation process, novel strategies for microfiber waste treatment and conclusively discussed different approaches of sustainable microfiber waste management.

1. Introduction

Tiny synthetic fibre particles, which are releasing into the environment by textiles during manufacture, usage and disposal are called Synthetic Microfibers (SMFs). Microfibers are the most wide-ranging particulate contaminants, detected in all ecosystems [1–3]. They are mostly considered as microfibers but comprise natural as well as synthetic textile fibres. Synthetic fibres are small plastic threads of different textiles comprising clothes, fishing net, ropes, tyres, tie, and lace, *etc.* [4]. Along with several other anthropogenic pollutants microfibers are largely spread over the terrestrial and aquatic ecosystem [5–7]. According to current knowledge about microfibers pollutants, both the global society and scientists are delegating more importance for these pollutants. It is also a serious environmental problem for aquatic ecosystems [8,9]. Synthetic fibre such as nylon, polyester, acrylic, and Polypropylene liberated during domestic laundering, textile industries, domestic drainage, direct dumping off garments are presumed to be enormous source of microfiber in the environment [10–13].

Approximately 5 milion metric tons of the synthetic enter and natural microfibers enter the environment annually. The number of synthetic microfibers presently contaminating the environment is estimated to exceed 6 million metric tons [2,14]. As per the report by [15], an average domestic and commercial laundry machine releases approximately 1. 05 MMT of synthetic microfibers annually. The synthetic microfibers from other sources such as textile manufacturing including dyeing, printing, finishing, and other textile applications released up to 4.20 MMT globally. Apart from textile industries, other potential sources of microfibers are single-use million surgical face masks, cigarette butts,

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Applicability of the Teetered Bed Separator for Beneficiating Indian Iron Ore Fines: An Experimental Study

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Abstract

Higher alumina and lower iron content in Indian iron ore fines is a major problem for its effective utilization in the iron-making process. India is the second largest steel producer in the world with an annual production of 200 million tons in the year 2020, whereas iron ore beneficiation of this country is highly derisory. Only 52 concentrators are required to produce 220 MTPA of iron ore. Most of the concentrator's benefits are limited to sizing and washing. In recent years, the Teetered Bed Separator (TBS) has gained significant importance and appeared as a viable option for beneficiating a variety of fine minerals. So, a systematic study has been carried out to verify the suitability of the TBS to reduce the alumina content and improve the iron grade in Indian iron ore fines. As the performance of gravity separation processes strongly depends on the feed particle size, a size-by-size beneficiation study was carried out to delineate the role of particle size on the performance of the TBS. Based on this study, the TBS is established to be a possible alternative to the other conventional equipment used for the beneficiation of iron ore fines.

Keywords: *Beneficiation, Iron Ore Fines, Partition Coefficient, Separation Efficiency, Teetered Bed Separator*

1.0 Introduction

India has a substantial amount of iron ore capital of about 31,213 million tons, of which about 34% is of magnetite and 66% of hematite type[1]. The physical and mineralogical properties of an ore play a vital role in the extraction of metal in a profitable process. High hematite content and low energy requirement for crushing are two prominent features. Indian iron ore is generally softer with high clay content with fines (-10 mm size) during the preparation of the ore. The use of these fines is restricted due to its lower quality. These fines were rejected into the tailing dam. Indian iron ore which makes it a potential economic source of iron. As per the Steel Policy 2017-18, around 450 MTPA (million tons per annum) of high-grade iron ore resources are required to meet the steel demand of 300 MTPA in 2030[2]. However, as it is of lateritic origin with goethite abundance, a huge number of fines (-10 mm size) are produced in the size reduction step. The generated fines are characterized by aluminium gangue mineral (3-6 %) in addition to low iron percentage[3]. The low iron content of these fines prevents them from being processed in blast furnaces for iron extraction and chart their path to the tailing ponds used for the waste. Further, it has been documented that, a -100 mesh fraction in the sinter feed can be used up to 40%, by micro-balling of the sinter mix before sintering. The scarcity of high-grade iron ores and environmental concern in using new mines

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Effect of C/N ratio, temperature, and *p*H on the removal of ammonia-nitrogen from wastewater using inverse fluidized bed biofilm reactor

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Experiments have been carried out in an inverse fluidized bed biofilm reactor (IFBBR) to study the effects of carbon to nitrogen (C/N) ratio, temperature (T), and *p*H on the removal of ammonia-nitrogen (NH_4^+-N) from wastewater using mixed microbial-culture. IFBBR is operated at settled bed volume to reactor volume ratio (V_b/V_r) of 0.380, superficial gas velocity (U_g) of 0.0085 m/s, and liquid recirculation velocity (U_l) of 0.0021 m/s. Three initial NH_4^+-N concentrations (40, 100, and 200 mg/L) are considered here. Effects of different parameters are studied for wastewater treatment by varying C/N ratio from 0.0 to 2.5, T from 26 to 34°C, and *p*H from 7.5 to 9.0. Maximum NH_4^+-N removal is observed at C/N ratio of 0.0, T of 30°C, and *p*H of 8.3. NH_4^+-N removal is found to decrease with increase in C/N ratio. Both NO_3^--N formation and nitrification percentage are found to decrease with increase in C/N ratio and initial NH_4^+-N concentration. Fractional Factorial Design analysis is used to predict the NH_4^+-N removal. Average absolute percent deviation is found to be 11.75 implying the proposed correlation is in good agreement with experimental values. Kinetic constants are found to be higher than the values reported in literatures.

Keywords: Ammonia-nitrogen, Carbon to nitrogen ratio, Fractional factorial design, Inverse fluidization, Nitrification, Wastewater treatment

Beyond regulated limits, aquatic systems contaminated with NH_4^+-N causes eutrophication, deteriorates taste and odour, reduces dissolved oxygen (DO) level, complicates the chlorination process, damages human nervous system[1], and is toxic to aquatic organisms[2]. This pollutant can be removed physically, chemically, physico-chemically, or biologically[3]. Use of biological treatment of wastewater containing NH_4^+-N is advantageous due to ease of operation, no addition of chemicals, less volume of regenerated sludge, low operational expenses, and high efficiency[1,4]. The two-step biological conversion of NH_4^+-N first to unstable nitrite-nitrogen (NO_2^--N) by *Nitrosomonas* and then to less harmful nitrate-nitrogen (NO_3^--N) by *Nitrobacter* is known as nitrification[3,5]. The stability of nitrification depends on several factors such as T; *p*H; DO level; salinity; presence of toxicants, heavy metals, and organic substrate[6]; and concentrations of NH_4^+-N, NO_2^--N, and NO_3^--N[4].

The nitrifying bacteria become more active and reproduce rapidly at increasing temperatures between 5 and 40°C with zero nitrification rates being observed above 40°C and below 5°C[7]. Autotrophic aerobic ammonia-oxidizing bacteria responsible for nitrification are mesophilic in nature which grow well in this temperature range. Nitrification rate was reported to be maximum in the temperature range between 30 and 35°C[8]. Devi and Setty have studied the removal of NH_4^+-N in the temperature range between 24 and 39°C and observed the maximum NH_4^+-N removal to be occurring at 30°C[3]. Nitrification process is *p*H sensitive. Autotrophic aerobic ammonia-oxidizing bacteria responsible for nitrification are neutrophilic in nature which has higher growth rates in the *p*H range of 7.5 to 8.5[9] and can remain active in the range of 5 to 8.5. But for laboratory work, the optimum *p*H range was reported to be 8.1 to 8.5[7]. As the *p*H of wastewater is dependent on alkalinity, substances such as sodium bicarbonate or magnesium hydroxide are used to maintain the required *p*H ranges. Initial alkalinity and initial concentration of NH_4^+-N decide the amount of alkaline substances to be used[10].

Autotrophic microorganisms under aerobic conditions derive energy from inorganic carbon rather than organic carbon sources for their growth[11]. In biofilm systems, the presence of organic carbon affects

Capturing Pseudocritical Property change of Steam in a Spiral Steam Pipe of a Boiler Through Numerical Technique

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Abstract

Heat transfer characteristics of fluids is rather peculiar when the bulk fluid temperature approaches pseudocritical point. In the present paper, computational fluid dynamics (CFD) methodology has been used to predict the attainment of pseudocritical temperature of steam in a typical spiral pipe. Abrupt changes in fluid properties near pseudocritical point are captured using commercially available CFD tool Ansys Fluent. The CFD methodology is first validated with experimental results available in literature for the specific type of problems. Then attainment of pseudocritical point in a steam pipe of an industrial boiler is predicted. For a specific mass velocity and heat flux condition, the axial location is identified where bulk fluid temperature attains pseudocritical point. Density, dynamic viscosity, and thermal conductivity of steam take sudden dips when bulk fluid temperature attains a value of 382.9 °C. Isobaric specific heat of steam attains its peak at the same bulk temperature. The attainment of pseudocritical point by steam in spiral tube is captured accurately with the numerical model.

Keywords: *Industrial boilers*; *pseudocritical temperature; spiral pipe; large specific heat; bulk fluid temperature.*

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Experimental investigation and optimization of the FDM process using PLA

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ABSTRACT

The 3D model of the PLA (Polylatic acid) fabricated specimens were developed using solid works and were manufactured by Fused Deposition Modelling process which is one of the Additive Manufacturing processes. The current research work discusses the consequence of three process variables such as layer thickness, infill percentage, and print speed and their effect on the hardness and strength of PLA fabricated specimens. For each process variable, three levels were taken to decrease the number of experiments. Taguchi L9 orthogonal array has been considered and the obtained results were analysed by the analysis of variance method optimization techniques. The present research work states that the layer thickness and infill percent have a foremost influence on the mechanical properties of FDM structures. The functional relationship between process of factors and the mechanical properties of the component have been discussed in the present study. The present analysis discusses the results to increase the strength of a fabricated part with the help of FDM technology.

Selection and peer-review under responsibility of the scientific committee of the 3rd International Conference on Recent Advances in Mechanical Engineering Research and Development (ICRAMERD-22).

1. Introduction

The process of joining the material (usually layer upon layer) with the help of the 3D data is known as an Additive manufacturing (AM). The different additive manufacturing techniques are (i) Selective laser melting (SLM) (ii) laminated object manufacturing (LOM), (iii) Selective laser sintering (SLS) and (iv) Fused deposition modelling (FDM) (v) plastic sheet lamination (PSL). FDM is one of the commonly used method due to the small cost of printer device and variety of cheap filaments. Additive manufacturing (AM) has a large range of application in aerospace industries, automotive industry, machinery and medical implants. Lower prototyping cost, faster and less expensive small production run and fewer on-hand inventory are some of the advantages of AM process while slow build rate, high production costs, limited component size are some of the disadvantages.

Many researchers [1–5] have carried out their research work in the field of additive manufacturing a few of which has been discussed here. Panes et al. [6] made a comparison between two thermoplastics such as PLA and ABS taking into account their mechanical behaviour. They considered three factors such as layer height, infill density and layer orientation for their study. PLA showed better results than ABS with strong bonds between the layers. Sood et al. [7] improved the design accuracy of ABSP 400 (acrylonitrile-butadine-styrene) part manufactured by FDM technique is based on grey Taguchi method. The process factors considered were layer thickness, part orientation, raster angle, air gap and raster width. Trimurthulu et al. [8] attempted to increase the surface finish and reduce part deposition time of ABS by using adaptive slicing method. They optimized the deposition orientation of the fused deposition modelling process and evaluated the average part roughness and build time. Gong et al. [9] compared the tensile strength and hardness of FDM and SLM manufactured ultra-fuse 316L steel. It was found that the use of ultra-fuse 316L steel filament is one of the cost effective approaches for manufacturing metal parts. Hafsa et al. [10] made a comparison between

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Coal and its Beneficiation Techniques: A Review

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Abstract

Crushing run-of-mine coal alters the proportion of particles in a given density class because of the coal's naturally occurring diversity in particle size and specific gravity. Because of this, the gravity-based coal washing process loses some of its effectiveness in terms of producing clean coal and maintaining high quality coal during the separation phase. The amount of 'near-gravity material' (material with a specific gravity within the range of 0.1) present in a normal coal at a given specific gravity makes washing the coal more challenging. Here, we employ two numerical indices—the 'near-gravity material index' and the 'index of washability'—to quantify the distribution of near-gravity material across density classes and to assess the degree of difficulty involved in the washing process. In order to remain competitive in the global coal market, India's coal businesses rely heavily on the process of beneficiating lower-grade coal, which presents significant obstacles.

Keywords

Coal beneficiation, wet and dry coal beneficiation, washability curve, near-gravity material, index of washability.

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An Appropriate Numerical Model to Capture Pseudocritical Property Change of Steam Flowing Inside Straight Tube

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Abstract:

The use of supercritical fluids in industries is becoming more and more common due to various reasons such as reduced environmental effects and improved efficiency. Because of the huge cost involved, experimentally investigating heat transfer to supercritical fluids is a difficult affair. Therefore, numerical simulation is an effective tool to investigate heat transfer to supercritical fluids. However, simulating heat transfer to supercritical fluid is a challenging task, mainly because of the abrupt property change near pseudocritical point. In this study, different combinations of CFD solvers, RANS turbulence models and material libraries are evaluated to assess the accuracy of predicting pseudocritical properties of steam flowing inside straight tube. It is found that the combination ofAnsys CFX solver, k-ϵ turbulence model and IAPWS IF-97 material library grossly over-predicts the tube wall temperature. Similarly, the combination of Ansys CFX solver, k-ω turbulence model and IAPWS IF-97 material library accurately predicts the bulk fluid temperature and tube wall temperature only up to a point where pseudocritical point is attained by steam. Beyond that the predicted values start to deflect from experimental values continuously. The most accurate combination turns out to be the Ansys Fluent solver along with NIST REFPROP material library and SST k- ω turbulence model. Both the bulk fluid temperature and tube wall temperature are predicted accurately with this model. Further the wall HTC is also predicted quite accurately with this combination. The percentage deviation in predicting the bulk fluid temperature, tube wall temperature and wall HTC from experimental values are 0.2, 0.5 and 1.07 respectively.

Keywords: CFD; supercritical; HTC; IAPWS; material library

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ORIGINAL ARTICLE

Optimization of process parameters by RSM-BBD for the removal of titan yellow dye from aqueous solution by acid-treated *Phyllanthus acidus* leaves

Chandradhwaj Nayak[1] · Babitha Babu[2] · V. Manoj[2] · Chelluboyana Vaishnava Raghunath[3] · M. Laxmi Deepak Bhatlu[4] · Poornima Pandey[3]

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Abstract

The elimination of titan yellow dye from the aqueous solution was carried out using acid-treated *Phyllanthus acidus* leaves as an efficient biosorbent. *Phyllanthus acidus* leaves are capable biosorbent for dye removal with eco-friendly and non-toxic nature. Response surface methodology Box–Behnken design was used to determine numerous operating parameters such as concentration, optimal dosage, time, and pH for the titan yellow dye adsorption. The spent biosorbent was characterized using FTIR, SEM, EDAX, XRD, and BET. The amorphous structure was identified by X-ray diffraction. FTIR analysis identified the presence of C-H, C = O, and O–H functional groups in the dye. A high removal efficiency of 99.55% was achieved for titan yellow dye by acid-treated *Phyllanthus acidus* leaves with 1.12 g dosage of biosorbent, 68 mg L^{-1} of initial dye concentration, and pH 7.73 for time 179 min. The adsorption data were estimated using several kinetic models and isotherms. The best fit for the equilibrium data is the Langmuir isotherm. The maximum adsorption capacity of acid-treated *Phyllanthus acidus* leaves for titan yellow dye has been found to be 237.61 mg g^{-1} from the Langmuir isotherm. It was observed from the kinetics that the best fit for the TY model is the pseudo-first-order model. Overall, using acid-treated *Phyllanthus acidus* leaves exhibits potential as an environmentally sustainable and cost-effective adsorbent for removing titan yellow dye from an aqueous solution.

Keywords Titan yellow (TY) dye · Acid-treated *Phyllanthus acidus* biosorbent · Adsorption · RSM-BBD · Equilibrium kinetics

Highlights
- A low-cost biosorbent was prepared from acid-treated *Phyllanthus acidus* leaves.
- The process variables were optimized using response surface methodology Box–Behnken design.
- The removal efficiency of titanium yellow dye up to 99.55% was observed.

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1 Introduction

The wastewater containing dye is one of the key contaminants in water resources. Recently, discharge of wastewater without including dyes from the industries like textile, paper, and leather has become a serious environmental issue. The limited resource of drinking water reminds the importance of wastewater treatment. Recent studies estimated that 12% of the input synthetic dyes were wasted yearly during their processing and production. Twenty to 35% of these waste dyes ended up in the environment as residual industrial wastewater effluents [1]. Highly soluble synthetic dyes are common pollutants in water bodies [2].

Dyes are carcinogenic and mutagenic in nature [3, 4], and people working in these industries have a high risk of breast cancer [5]. In humans, several colors cause allergies, discomfort, cancer, and even mutation [6]. There is huge damage to soil production efficiency after the discharge of dye

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Mathematical approach and experimental validation on criteria for instability of interface between liquid droplet and water

Amit Kumar Gupta, Arvind Singh, Rajen Kumar Nayak, Ravi Shankar Prasad, Chelluboyana Vaishnava Raghunath, Chandradhwaj Nayak and Amar Kumar

Abstract. The deformation and displacement phenomena of liquid droplets from solid substrates are important in sub-surface processes such as enhanced oil recovery, chemical processing, and others, where the velocity of the continuous fluid is a key parameter. In the present work, a pioneering mathematical model equation for the minimum fluid velocity at which perturbation development begins, termed the 'critical velocity of perturbation' that is associated with the elongated part of a droplet and water has been developed using viscous potential flow analysis. Furthermore, the deformation and detachment of large (2 mL and 4 mL) aniline droplets, small (120 μL) aniline droplet and small (5 μL and 40 μL) iso-quinoline droplets in close channels have been experimentally investigated in the verification of the proposed mathematical model equation. The developed model equation was successfully verified. Tails were formed, and the droplet partially detached when the continuous fluid velocity exceeded the critical velocity of perturbation. This study will aid in enhancing process efficiency and lowering operational costs in the field of liquid recovery and associated process industries.

Mathematics Subject Classification. 76E17, 76D45, 76-10.

Keywords. Droplet, Instability, Partial detachment, Mathematical modelling.

1. Introduction

The study of droplet development and detachment has gained a lot of interest in recent years, owing to its recurrence in a wide range of industries and households, as well as the fact that it is thought to be a basic phenomenon. Examples of applications include exchangers, cooling systems, chemical processing, emulsion preparation, beer brewing, and wastewater treatment [1–7]. Oil droplet removal from solid surfaces is also an important step in efficient oil production and environmental protection [8]. Furthermore, the creation, proliferation, and removal of liquid-water droplets from the gas diffusion layer along with channel interfaces in fuel cells are key phenomena that have created the curiosity of many researchers [9,10]. Various parameters affect the shape of droplet development and its detachment from the solid substrate. The droplet detachment phenomenon is governed by parameters such as interfacial tension, the relative velocity of the shearing fluid, contact angle, and viscosity of droplet of fluid [11–16]. The elimination of the perturbation phenomenon during droplet detachment is a key aspect of the process. If perturbation took place, it would affect the cost of the process and decrease the efficiency due to the partial detachment of droplets from the solid substrate [17–19]. To examine the attachment–detachment process of liquid droplets and the impacts of various factors, numerous experimental and numerical models have been established.

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Mineralogical investigation on preheating studies of high LOI iron ore pellet

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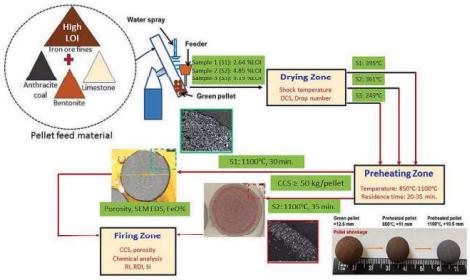
HIGHLIGHTS

- Iron ore pellet quality is dependent on mineralogy of ores.
- Goethitic-hematite ore have high goethite, gibbsite, and kaolinite, lead to high LOI.
- Incomplete removal of LOI in preheating zone affects pellet quality.
- Investigated effect of preheating temperature and residence time to acquire threshold CCS (50 kg/pellet).
- Morphological investigation to address inappropriate heating effect.

GRAPHICAL ABSTRACT



ARTICLE INFO

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Goethitic-hematite
Kaolinite
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ABSTRACT

Present pelletization practices are facing problems to handle high loss on ignition (LOI) concentrate generated from goethitic-hematite iron ore containing higher goethite, gibbsite, and kaolinite. These minerals need to completely release their LOI in the preheating zone of pellet induration process. If it is not, crack develops in the pellet, which reduces cold crushing strength (CCS) also deteriorates pellet quality. In this study, this issue has been addressed by taking variable preheating temperature (850 °C, 950 °C, 1000 °C, 1100 °C) and residence time (20, 25, 30, 35 min.). Pellets were prepared from three iron ores with LOI (2.64, 4.85, and 9.19%). Effect of ore mineralogy on the drying characteristics of the pellet has been established. Preheated pellet CCS, porosity and morphology have been investigated. The coordination between preheating temperature and residence time to acquire desired CCS (50 kg/pellet) varies ore to ore. A detailed morphological investigation has been performed to address the inappropriate heating effect by the use of stereomicroscopy, optical microscopy and scanning electron microscope study. The pellet properties are dependent on the presence of kaolinite and goethite percentage.

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Mathematical Modelling and Simulations of Active Direct Methanol Fuel Cell

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ABSTRACT

A one dimensional isothermal model is proposed by modelling the kinetics of methanol transport at anode flow channel (AFC), membrane and cathode catalyst layer of direct methanol fuel cell (DMFC). Analytical model is proposed to predict methanol cross-over rate through the electrolyte membrane and cell performance. The model presented in this paper considered methanol diffusion and electrochemical oxidation at the anode and cathode channels. The analytical solution of the proposed model was simulated in a MATLAB environment to obtain the polarization curve and leakage current. The effect of methanol concentration on cell voltage and leakage current is studied. The methanol cross-over has the significant impact on cell performance. The presented model predicts higher leakage current with the increase of methanol feed concentration. The cell performance was predicted at 70°C and various methanol feed concentration. The proposed model was validated with the experimental polarization curve of active DMFC.

KEYWORDS: *Analytical Model, 1-D Isothermal Model, Anode Flow Channel, Leakage Current, Methanol Cross-over Rate, Polarization Curve, Active DMFC.*

1. INTRODUCTION

Fuel cell is considered to be a potential candidate for portable and stationary applications. It becomes widely popular due to its higher fuel conversion efficiency, low pollutant emissions and high power density [1]. In near future, it has the potential to replace internal combustion (IC) engine in vehicles. The development of high performance fuel cell is crucial to replace IC engine. A significant

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The mechanical and thermal behaviour of unsaturated polyester matrix (UPM) composite filled with pistachio shell particles (PSP)

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ABSTRACT

This investigation focuses to study the effect of the content of micro scale natural pistachio shell particles on the mechanical and thermal properties of unsaturated polyester matrix composites. The composite of polyester resin reinforced with 10, 20, 30 and 40 wt% PSP was made by hand mixing followed by compression molding. Several mechanical properties viz. tensile strength, flexural strength, impact strength are examined to understand the behaviour of composite material. The thermo-gravimetric analysis of the prepared composites is conducted. The field emission scanning electron microscope is used to investigate the surface morphology of the fabricated composite. The end result from the observation discovers that, the properties of the composites are improved. The maximum tensile, flexural and impact strength is resulted at 40, 40 and 10 wt% respectively.

Selection and peer-review under responsibility of the scientific committee of the 3rd International Conference on Recent Advances in Mechanical Engineering Research and Development (ICRAMERD-22).

1. Introduction

The rapid growth of manufacturing industries calls for fabrication of new materials with high strength and stiffness. This demands the new material to be of low cost and better sustainability. According to scientific studies this can be achieved by composite materials which satisfactorily fulfill the required properties. It has been verified that the composite materials performs better than that of conventional material due to its improved properties [1]. In general, the composite materials have two phases, the continuous phase is called as matrix and the dispersed phase is terminated as reinforced material. Usually, the produced composite material enhances the load bearing capacity.

The recent studies show, composites with fiber as the reinforcing material is widely accepted. Scientists have preferred natural fiber in the place of synthetic fiber as reinforcing material. Natural fibers are obtained from plant, animal and from minerals. Fibers made from minerals are perilous to human health as they contain asbestos. While the fibers made from plant have excellent qualities viz. low cost, accessibility, biodegradable with high physical and mechanical properties. Pistachio shell is among the naturally available fiber material and it has about 42 % cellulose, 13.5 % lignin, 3.11 % cellulose lignin, 1.26 % ash and 0.18 % extractable [2]. Pistachio is renowned as a fruit. An overview of the production of Pistachio shell particles (PSP) worldwide is presented in Table 1. United States of America alone contributes 68 % of the total production. PSP bear high strength and modulus. So, PSP can be utilized as a filler or reinforcing material in a polymer and may be applicable for economical and environmental view. In addition to the natural materials, a polymer like unsaturated polyester resin has found extensive applications in engineering and structural purposes due to its good bonding capacity and solvent resistance. Literature reveals several applications of composites made from pistachio shells particles [3].

Ismail Ibrahim Marhoon [4] considered polyurethane as matrix and made a composite from pistachio shell particles with 2.5 to12.5 wt%. He did tensile, compressive, hardness, impact and water absorption tests and results are reported. He found that the tensile, compressive, hardness, impact and water absorption properties give best results at 5, 7.5, 12.5, 2.5 and 12.5 wt% respectively. A scientific article [5] reveals a research on the physical, chemical, microscopy, thermal behavior and gas absorption properties of pistachio Vera nutshellparticles. It is decided that pistachio Vera nut shell particles hold amicable structural and thermal properties. Nada N Kadhim et al [6] determined mechan-

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Effect of zinc oxide on the mechanical, thermal and physiochemical properties of chitosan-based hybrid membrane for DMFC application

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ABSTRACT

This work uses zinc oxide (ZnO) as a filler to prepare a chitosan-based hybrid membrane. The mechanical, thermal and physiochemical properties of the membranes were studied using different experimental techniques. The water uptake capacity and swelling degree of the composite membranes were increased whereas ion exchange capacity (IEC) decreases with the increase of ZnO content. The ZnO filler reduces the crystalline phase of the hybrid membranes. The hybrid membrane's proton conductivity was measured by EIS experiment and fitted into a comparable circuit model. The ZnO filler improves the membrane's proton conductivity, and the proton transport is controlled by the Grotthus mechanism.

Selection and peer-review under responsibility of the International Conference on Advances in Smart Materials, Chemical & Biochemical Engineering.

1. Introduction

For industrial, commercial, and household uses, societies use energy for transportation, production, illumination, air conditioning, heating, and communication. Various experiments have been carried out over the past several years to substitute the petroleum-based raw material. Future energy supplies must be ecologically acceptable, and energy efficiency must be greater than the currently available quantity. The need for energy sources based on petroleum is rising nowadays. As is well known that, it has finite resources, pollutes the environment, and is a non-renewable source of energy. Due to their high efficiency with low emissions, fuel cell technologies have gained considerable attention recently as a solution to the aforementioned problems with petroleum-based energy sources [1]. It is difficult to acquire and emits a lot of harmful gas [2]. A viable substitute for petroleum-based raw material is the fuel cell. Using two redox processes, fuel cells are the electrochemical device that transforms the chemical energy of a fuel (including hydrogen, methanol, etc.) and an oxidant into electrical energy (electricity) [3–6]. In 1839, Sir William Grove developed the first fuel cell [7]. PEMFC, often referred to as Polymer Electrolyte Membrane Fuel Cells, have a benefit over the rest since they can operate at low temperatures, do have a high energy density, are lightweight, and are simple to modify for a range of applications [8]. These membrane fuel cells can be made up of proton conductivity and platinum (Pt) based electrode as catalysts. The catalyst activates the hydrogen, which is then fed into the proton exchange membrane fuel cell to yield proton ions. Methanol performs better than hydrogen among various fuels. This gives a potential for the Direct Methanol Fuel Cell (DMFC) to be a practical option in the future [9]. The DMFC is an option for applications requiring portable power because it is low temp device that is environmentally safe and its fuel is transportable and reasonably priced [10,11].

The selection of a membrane for fuel cells, and specifically for DMFC, should take into account several factors, including price, chemical resistance, film-forming capability, degree of hydrophilicity, cross-linking efficiency, and water resistance. Additionally, it is possible to specify criteria like biodegradability, non-hazardousness, and renewability [12]. Nafion represents the most widely utilized polymeric barrier in these cells. Its widespread usage is a reflection of its outstanding mechanical and thermal characteristics, strong proton conductivity, and great electrochemical and chemical stability. However, Nafion has a high production cost of about 800 US dollars per square inch. The fundamental disadvantage of Nafion membranes is their quick dehydration at temperatures over 100 °C, and low humidity below 30% which causes a rapid decline in proton conductivity [11,13]. Due to its inexpensive price and, more specifically, its excellent thermal and chemical stabilities, another membrane known as sulfonated poly (ether ketone) (SPEEK) also was employed. Moreover, compared to Nafion

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Effect of Sulfuric Acid on the Physiochemical Properties of Chitosan-PVA Blend for Direct Methanol Fuel Cell

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In this work, we have successfully cross-linked the different weight ratio of Chitosan-PVA blend with sulfuric acid. The effect of cross-linker on the properties of blends are studied by using different experimental technique. The cross-linked membrane provides higher ion exchange capacity due to the procurement of extra ionic hooping sites in the membrane. The compatibility of the blends are confirmed from the FTIR and DSC analysis. The crosslinking reaction fastening the phase transition behavior of the blends which reduces the glass transition temperature. The highly compatiblized cross-linked blend provides higher tensile strength and lower modulus at moderate temperature. The significant reduction of weight loss was observed in a cross-linked membrane which enhances thermal stability of the blend. The group which are responsible for higher methanol cross-over are consumed by the cross-linking reaction and a drastic reduction of methanol cross-over was observed. The proton conductivity of the blends are obtained by performing experiment in a four probe impedance analyzer and fitting the EIS data in an equivalent circuit model. At moderate temperature, the cross-linked membrane provides higher proton conductivity than the pure membrane and the proton transport was controlled by Grotthus mechanism. The cross-linked membrane provides higher proton conductivity and membrane selectivity which is beneficial for DMFC design.

KEYWORDS: *Cross-linked Membrane, Storage Modulus, Methanol Cross-over, Proton Conductivity, Membrane Selectivity, DMFC.*

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RESEARCH ARTICLE

Development of the highly performed chitosan based thin film towards the sustainability of direct methanol fuel cell

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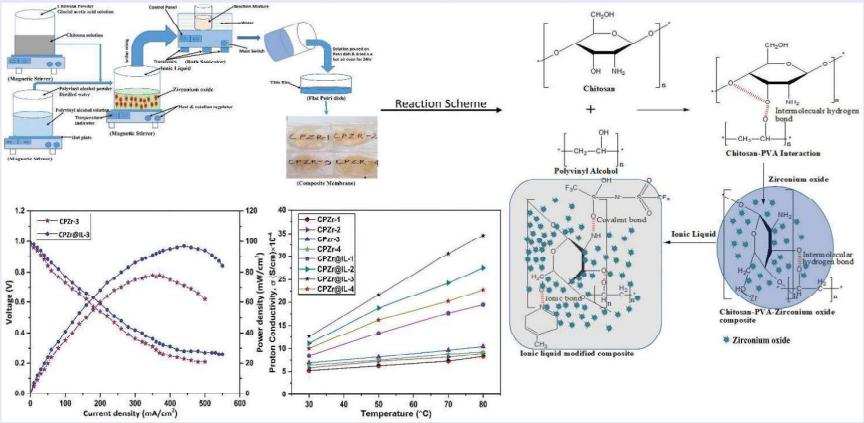
ABSTRACT

We used a new strategy to develop a hybrid membrane by impregnating hygroscopic zirconia and ionic liquid in the chitosan-PVA blend. The effects of ionic liquids on the water uptake, IEC, phase transition behavior, methanol permeability, and proton conductivity of the hybrid membrane were studied. The ionic liquids have a synergetic effect on the chain flexibility and tensile strength of the thin film. The developed hybrid membrane has the lowest methanol permeability of 0.94×10^{-7} cm^2s^{-1}. The polarization curve obtained for a fuel cell operating at 70°C and 2 M methanol feed provides the maximum power density of 97 $mWcm^{-2}$.



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Ionic-Liquid; hygroscopic zirconium oxide; DMFC; methanol permeability; proton conductivity; power density

1. Introduction

In the past few years, numerous studies have been conducted to replace the petroleum based feedstock. The drawback of petroleum-based feed stock is its low availability and high toxic emission. The fuel cell is considered to be a potential alternative of petroleum-based feed stock.[1] Fuel cells are becoming widely attractive owing to its high power density and low pollutant emissions. A significant amount of effort has been put into developing high-performance fuel cells. The chemical energy of fuels such as hydrogen and methanol was efficiently converted to electrical energy by fuel cells.[2] The proton exchange membrane fuel cell has gained popularity due to its following advantages like low temperature operation, high power density, light weight, and adaptability of various application.[3–5] The direct methanol fuel cell (DMFC) gained more popularity due to its low temperature operation, high energy density of fuel, easily transferable fuel and comparatively cheaper.[6–8] The proton conducting membrane is the vital component of DMFC and should have the following features such as high proton conductivity, low methanol cross-over, good mechanical and thermal stability, biodegradability, easy to prepare and comparatively lower price.[8,9] The lots of work has been carried out to develop high-performance electrolyte membrane for DMFC application. However, it is challenging to develop the electrolyte membrane with

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inventions

MDPI

Article

Polypropylene and Graphene Nanocomposites: Effects of Selected 2D-Nanofiller's Plate Sizes on Fundamental Physicochemical Properties

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Abstract: The authors developed a nanocomposite using polypropylene (PP) and graphene nanoplatelets (GNPs) with a melt mixing method. Virgin PP was filled with three sets of GNPs with a fixed thickness (15 nm) and surface area (50–80 m^2/g). The selected H-type GNPs had three different sizes of 5, 15 and 25 µm. The nanocomposites were made by loading GNPs at 1, 2 and 3 wt.%. Mechanical analysis was carried out by performing tensile, flexural and impact strength tests. The crystalline, micro-structural, thermal and dynamic mechanical properties were assessed through XRD, FESEM, PLM, DSC, TGA and DMA tests. It was observed that all three types of GNPs boosted the mechanical strength of the polymer composite. Increasing the nanofiller size decreased the tensile strength and the tensile modulus, increased the flexural strength and flexural modulus, and increased the impact strength. Maximum tensile strength (≈41.18 MPa) resulted for the composite consisting 3 wt.% H5, whereas maximum flexural (≈50.931 MPa) and impact (≈42.88 J/m) strengths were observed for nanocomposite holding 3 wt.% H25. Graphene induced the PP's crystalline phases and structure. An improvement in thermal stability was seen based on the results of onset degradation (T_D) and melting (T_m) temperatures. Graphene increased the crystallization (T_c) temperatures, and acted like a nucleating agent. The experimental analysis indicated that the lateral size of graphene plays an important role for the nanocomposite's homogeneity. It was noted that the small-sized GNPs improved dispersion and decreased agglomeration. Thus overall, small-sized GNPs are preferable, and increasing the lateral size hardly establishes feasible characteristics in the nanocomposite.

Keywords: polypropylene; 2D graphene; melt mixing; nanocomposite; size effect

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1. Introduction

In the current scientific world, graphene has created a significant role. Graphene is derived from graphite, and exists in the form of single layer sheet. Graphene is a 2D (two-dimensional) material with sp^2 hybridization. It has a honeycomb structure of carbon atoms. Graphene nanoplatelets (GNPs) consist of several layers of graphene with thickness between 3 and 100 nm that are sustained due to van der Waals forces of attraction. Graphene has found extensive applications in engineering, science and technology as a favorable reinforcing material for different polymers [1–8]. Polypropylene (PP) is a widely accepted thermoplastic polymer among the polyolefin groups [9–11]. PP is widely available, relatively inexpensive, easy to handle and allows for recycling. It possesses good mechanical and physical properties [12–16]. Improving the properties of polypropylene has stimulated many researchers to use graphene as a reinforcing agent

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Preparation and Characterization of Red Mud Modified Chitosan-PVA Composite Membrane for Direct Methanol Fuel Cell

A novel cost-effective chitosan-polyvinyl alcohol (PVA)-red mud (RM) hybrid membranes are developed and their morphological and physiochemical properties are studied. The addition of RM enhanced IEC and bound water content in composite membranes. The hydroxyl groups are consumed due to the interaction with silica oxides and depleted the crystalline phase of the composites. The tensile strength and modulus of the composite membranes were reduced. The addition of RM improves the thermal stability of the composite membrane and shifts the degradation process to a higher temperature. The RM nanoparticles depleted the hooping sites for methanol transport in the composite membrane and the permeability value reported in the modified membrane was one order lower than the Nafion (N117) membrane. The proton conductivity of the composite membranes is obtained by fitting the EIS data in an equivalent circuit model. The composite membrane provides higher proton conductivity at reduced relative humidity conditions and the proton transport was governed by Grotthus mechanism. The modified membrane provides the maximum power density of 44 mW/cm^2 at a current density of 140 mA/cm^2. The durability test was conducted at a current density of 0.15 A/cm^2 and 70 °C for 144 h to evaluate fuel cell performance and voltage decay. The durability study confirms that the modified membrane provides higher cell stability with marginal drop in cell voltage (1.76%). The reduction of methanol cross-over and the enhancement of membrane selectivity increases power density of the direct methanol fuel cell. [DOI: 10.1115/1.4055693]

Keywords: novel materials, red mud, bound water (%), methanol permeability, polarization curve, batteries, fuel cells

1 Introduction

The depletion of petroleum-based feedstock and their high toxic emission forced us to search for a potential alternative. Fuel cell is considered as a potential alternative to petroleum-based feedstock due to their high energy efficiency and low toxic emission [1]. There is lot of effort has been made to develop cost-effective and energy-efficient fuel cell. Recently, proton exchange membrane fuel cell received greater attention for portable and stationary applications and it is also considered as a next generation's power source. It has numerous advantages like low temperature operation, high power density, lightweight, and easy adaptability for a variety of applications. In proton exchange membrane fuel cells, polymer membrane is used as an electrolyte for proton transport and platinum (Pt)-based materials are used as a catalyst [2–4]. Proton exchange membrane fuel cells are categorized into two types: (1) hydrogen fuel cell and (2) direct methanol fuel cell. Although hydrogen fuel cell has high energy density but due to the lack of distribution of hydrogen fuel, difficulty in storage and transportation, and high cost forced us to search for potential alternative. The methanol is considered to be a potential alternative of hydrogen fuel due to its low cost, high energy density, and availability. In direct methanol fuel cell (DMFC), methanol is used as a fuel whereas polymer membrane is used as an electrolyte. The DMFC has an opportunity to power stationary and portable devices due to its low temperature application, high power density, low toxic emission, relatively cheaper price of fuel, and simplicity of operation [5]. The polymer electrolyte membrane used for DMFC application must have the following characteristics properties like low cost, high proton conductivity, low methanol permeability, high mechanical, and thermal stability. The material selected for the fabrication of electrolyte membrane for DMFC application must have the following characteristic features like cost, chemical stability, film forming ability, extent of hydrophilicity, cross-linking feasibility, and permeability for water. The material used for the fabrication of membrane must have the following additional features like biodegradable, nonhazardous, and environmentally benign.

Nafion is considered as a conventional electrolyte membrane due to its high proton conductivity, excellent mechanical, and thermal stability along with its high chemical and electrochemical stability [6–8]. Although the proton conductivity of the Nafion membrane is not reduced between 80 and 100 °C due to non-breakage of H-bond water which maintained water content but fuel cross-over and cost are the major concern which restricted it for potential application in DMFC. The increase of methanol cross-over across the membrane decreases voltage and power density in the polarization curve [9–12]. Sulfonated poly (ether ether ketone) (SPEEK) membrane is considered as a potential alternative to Nafion membrane due to its low cost, good proton conductivity, and good thermal and chemical stabilities [13–16]. However, the proton conductivity of SPEEK and SPEEK-based membranes are comparatively lower than the Nafion membrane [17–20]. Recent study reveals that a significant work has been carried out on the development of highly performed graphene oxide (GO) membrane for fuel cell application. The proton transport in GO membrane was dominated by in plane ionic transport which reduces fuel cell performance. The through plane ion transport should be enhanced to improve the fuel cell performance. The structurally modulated GO membrane improves

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The Development of Superhydrophobic PVA Sponge, Using HDTMS and HMDS, for the Separation of an Oil–Water Mixture with a Very High Separation Efficiency

Anup Kumar Bairagi · Soumya Sanjeeb Mohapatra · Abanti Sahoo

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Abstract The marine natural ecosystem suffers substantial damage from industrial oily wastes. Various mechanisms such as adsorption, aeration, sedimentation, screening, disinfection, and chemical oxidation have been proposed in the literature to treat oily waste water. The suggested approach to the aforementioned treatment comes at a significant expense. Therefore, in this work, a low-cost, recyclable sponge that is kind to the environment and has a high level of super hydrophobicity and oleophilic properties was designed to extract oil from wastewater. Titanium dioxide, carbon soot, and hexadecytrimethoxysilane (HDTMS) were employed as the coating materials to create superhydrophobic surfaces. For the post-coating analysis, the contact angle of oil and water, FTIR of coatings, and SEM of different coated PVA sponges were studied. The oil absorption capacity and changes in the contact angles between oil and water droplets over time were both examined in order to assess the coatings' effectiveness. With a 151° water contact angle, HDTMS-coated sponge proven to be more effective at separating oil from water. According to the impact mapping results, a hydrophobic surface initially achieves no slip condition before slip condition is recognized. The relationship between viscous forcc and capillary forcc (V_F/C_F) is sccn as the defining factors for super-hydrophobic properties, according to the examination of droplet dynamics. The V_F/C_F ratio must be lower than 2.9×10^{-4} in order to achieve superhydrophobicity features. Additionally, the HDTMS sponge's 99.9% oil absorption capacity was discovered. Moreover, the impact of oil characteristics on the capacity for absorption has been studied. The mechanism and thermal stability have also been covered in addition to the aforementioned.

Keywords Contact angle · Superhydrophobicity · Oil–water separation · Thermal stability

Nomenclature

Subscripts	M_f	Weights of the sponge after oil absorption
	M_i	Weights of the sponge before oil absorption
	Q	Absorption capacity gm/gm
	η	Oil–water separation efficiency
	C_F	Capillary force, N
	V_F	Viscous force, N
Acronyms	CS	Carbon soot
PVA		Polyvinyl alcohol
HDTMS		Hexadecyltrimethoxysilane
HMDS		Hexamethyldisilazane
FTIR		Fourier transform infrared spectroscopy
SEM		Scanning electron microscope

1 Introduction

Wastewater from chemical industries contains heavy metals, organic and inorganic materials, fertilizer,

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Innovating superparamagnetic chitosan hybrid nanoparticles for a high-efficiency separation of oil from oil–water emulsions

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ABSTRACT

In an era marked by rapid industrialization and heightened automobile usage, the demand for crude oil has surged, inducing ecological degradation and resource depletion. Effective management of intricate oily wastewater presents a formidable challenge. While diverse methods like gravity separation, centrifugation, and membrane techniques are employed for oil-water separation, gravity separation is the prevailing choice, yet limited to unstable emulsions. These methods often involve toxic substances harmful to marine life. Our research focuses on separating oil microemulsions in aqueous solutions. This study explores the application of superparamagnetic chitosan coagulants, revealing an optimal 10 ml dosage for peak efficiency. Aiming for rapid oil separation, we achieved a breakthrough with just 30 minutes, establishing a new benchmark. Rigorous VSM testing solidified the particles' magnetic capabilities, augmented through size reduction. Notably, at a 15% oil concentration, a remarkable 99.26% efficiency in oil separation was achieved, offering potential in microbiology, medicine, and drug delivery systems.

Key words: chitosan, coagulation, oil–water emulsion, superparamagnetic

HIGHLIGHTS

- Investigation of a superparamagnetic chitosan coagulant.
- An oil separation time study is performed, and the shortest time recorded for oil separation is investigated.
- Optimal coagulant dose is determined.
- Investigation of magnetic properties in superparamagnetic chitosan particles.
- A study of efficiency and particle size.

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Band gap tailoring and photosensitivity study of Al-doped SnO_2 nanocrystallites prepared by sol–gel technique

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ABSTRACT

Electrical, optical and photosensitivity of aluminium-doped tin oxide (Al-SnO_2) nanocrystallites prepared by sol–gel technique and annealed at 400 °C and 500 °C are studied. The synthesized nanocrystallites are characterized using spectroscopic techniques such as powder X-ray diffraction (PXRD), scanning electron microscopy (SEM), Fourier transform infrared (FTIR) spectroscopy, energy-dispersive X-ray spectroscopy (EDX) and UV–VIS-DRS spectroscopy. The PXRD data confirm the development of polycrystalline nanocrystallites having crystal size ≈ 6.8 nm at 400 °C which increases to ≈ 8.7 nm on annealing at 500 °C. SEM images illustrate the formation of nanoclusters. Broad characteristics bands of FTIR spectra demonstrate the presence of physical interaction between SnO_2 and Al_2O_3. EDX spectra illustrate the presence of aluminium, tin and oxygen in the particles annealed at 400 °C and 500 °C with composition $Sn_{0.726}Al_{0.274}O_2$ and $Sn_{0.809}Al_{0.191}O_2$, respectively. UV–VIS-DRS spectroscopy illustrates that the band gap energy of 400 °C and 500 °C annealed materials are 3.42 and 3.35 eV, respectively. First time, the electrical properties and photosensitivity of the Al-SnO_2 nanocrystallites annealed at two different temperatures are studied by making the particles into thin films of thickness 103μ (400 °C) and 106μ (500 °C) on glass substrate.

1 Introduction

Nowadays metal oxide nanocrystallites are creating immense interest among researchers because of their unique characteristics, wide range of applications and stability. They are key materials for optoelectronic devices [1–5]. Among the oxides, SnO_2 is a significant n-type semiconducting material and is useful in fabrication of solid-state gas sensors [6], transparent conducting electrodes [7], rechargeable Li-batteries [8] optical and electronic devices [9], catalyst for photo-degradation & organic conversion [10], photo-electrodes of photovoltaic cells for solar energy conversion and antistatic coating [11–14]. Researchers have reported that the optoelectronics

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Review

Lanthanide based inorganic phosphates and biological nucleotides sensor

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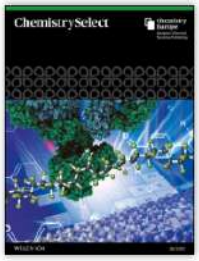

Research Article

Design Aspects of a Continuous Flow Photocatalytic Reactor and its Application to Degrade Methylene Blue and Textile Wastewater

Dr. Chittaranjan Sahoo, Dr. Binod Bihari Panda, Dr. Ashok Kumar Gupta

First published: 13 October 2022 | https://doi.org/10.1002/slct.202201179 | Citations: 2

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Graphical Abstract

Photocatalysis is becoming the curative technologies in current decades for wastewater treatment. The presented work is based on the study of the photocatalytic degradation of MB & textile wastewater collected from Kolkata using Ag doped micro TiO2 in a stepped continuous flow photocatalytic reactor designed as CSTRs in series. The experimental data simulated well with the model data calculated using the model equation. the experimental data and the design data are

References

Inorganic Chemistry Communications

Volume 142, August 2022, 109670

Short communication

Chlorophyll-a functionalised Zn-Cd-S thin film fabricated by SILAR technique for dye sensitised solar cells

Mahesh Kumar Ghosh, Rabindra Kumar Send, Prasanta Kumar Mahapatra, Binod Bihari Panda

https://doi.org/10.1016/j.inoche.2022.109670

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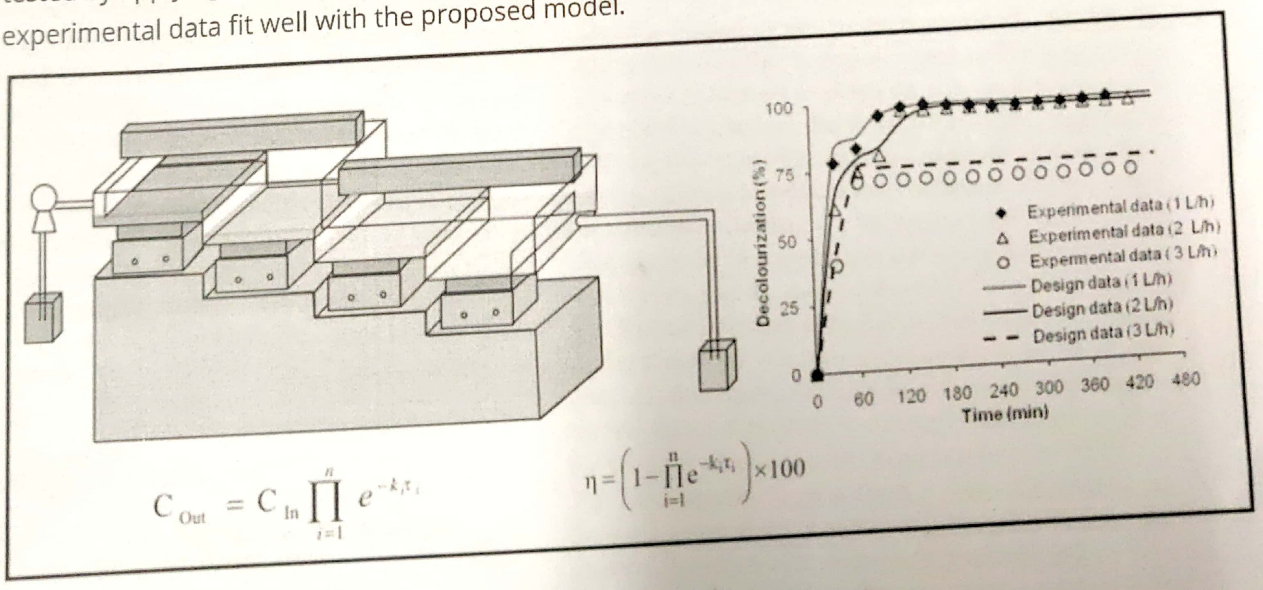

Abstract

A continuous flow photocatalytic reactor was developed by combining the reaction kinetics and mass balance concept. The concept of cascade aerator was also considered

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Short-term and long-term aging effect of the rejuvenation on RAP binder and mixes for sustainable pavement construction

Sujit Kumar Pradhan

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ABSTRACT

This investigation analyzes the usefulness of Mahua oil (M-oil) in reclaimed asphalt pavement (RAP) binder which simulates the short-term and long-term aging behavior of asphalt. As the inclusion of a higher amount of the RAP in the bituminous mix is susceptible to fatigue and thermal cracking, the use of a rejuvenator is a suitable option that can reinstitute the properties of the virgin binder. Different percentages of M-oil such as 1%, 2%, 3%, 4%, 5%, and 6% added to the short-term and long-term aged binder. Blended rejuvenated binders were evaluated through various physical properties. It was noticed that the inclusion of a rejuvenator increases the penetration, ductility, and flash point and reduces the softening point, and viscosity. Rheological properties conclude that rejuvenating short-term and long-term aged binder is feasible and can be considered an effective way to recycle the RAP binder. Further, rejuvenated (5% and 6% M-oil by weight of aged binder which is the optimum dosage) mixes were prepared with RAP mixture for short-term and long-term aging conditions to study the mechanical properties, i.e., moisture sensitivity and rutting. Finally, it was concluded that 5% M-oil successfully rejuvenated the RAP mixes in long-term aging conditions.

1. Introduction

These days, the rising consideration for ecological sustainability highlights the recycled asphalt pavement (RAP) materials. Increasing energy costs and the massive demand for natural petroleum have encouraged the utilization of high content RAP in hot mix asphalt (HMA). The utilization of RAP in HMA prompts various benefits such as saving natural resources, decreasing the use of asphalt obtained from crude oil, and providing the same or improving the pavement's performance. RAP in HMA causes saving raw materials such as virgin asphalt, and virgin aggregate and lessens energy utilization related to transporting and processing materials (Colbert and You, 2012, Goh and You, 2011).

Bituminous binders aged throughout their serviceable life. This is because of various cycles like oxidation and alternation in molecular components. There are predominately-two stages of aging of bituminous mixes, i.e., short-term aging that takes place throughout the blending and laying and long-term aging that takes place throughout the pavement serviceability. The aging process influences the mechanical performance adversely concerning cracking and fatigue resistances, and preferably decelerating the aging process is required. During the service period of the flexible pavement, the asphalt material experiences extreme aging and would produce substantial distresses due to overloading, temperature differential, rain, etc. Also, there is a requirement for pavement maintenance each year. So, a considerable quantity of RAP materials generated each year.

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Performance assessment and life cycle analysis of concrete containing ferrochrome slag and fly ash as replacement materials – A circular approach

Priyadarshini Das [a], Venkata Pavi Sankar Cheela [b], Abhijit Mistri [c], Sushanta Chakraborty [a], Brajesh Dubey [a], Sudhirkumar V. Barai [a d] ✉

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Highlights

- Circular pathway through use of FCS aggregate and fly ash in concrete was explored.
- An eco-efficient mix design method based on PPOT was adopted.
- Ten types of concrete mixes were prepared using PPOT and conventional mix design.
- The techno-environmental performance of all mixes were studied.
- FCSAC with 30% fly ash designed by PPOT was ranked as the most sustainable mix.

Abstract

Climate change mitigation and resource efficiency have emerged as crucial challenges for long-term sustainability of concrete. Implementing circular approach through waste valorisation in concrete production with eco-efficient mix design is an efficient mitigation pathway to combat natural resources depletion and environmental issues. This paper investigates techno-environmental sustainability of concrete utilizing 100% ferrochrome slag as alternate coarse aggregate and fly ash as partial cement substitute (0–40%) adopting particle packing optimization technique (PPOT) as a sustainable mix design method. Total of ten types of concrete mixtures were prepared using the alternate materials and mix design methods (PPOT and IS:10262(2009)). Natural aggregate concrete prepared by IS:10262(2009) mix design was considered as the reference mixture. Technical assessment of concrete was performed experimentally in terms of compressive strength and tensile strength. Environmental performance was investigated through life cycle assessment (LCA) as per ISO 14040-44 guidelines using cradle-to-gate system boundary and two functional units: 1 m^3 concrete and 1 MPa compressive strength. Results revealed that ferrochrome slag aggregate concrete (FCSAC) containing fly ash up to 30% prepared by PPOT has enhanced strength than reference concrete. Regardless of the functional units used, FCSAC with 30% fly ash designed by PPOT was ranked as the most sustainable mix with significant environmental savings (around 50–70%) without compromising desired requirements. Sensitivity analysis was performed by varying transportation distance, mode of transport and energy mix. Results showed that FCSAC with 30% fly ash is not sensitive to the scenarios investigated. The outcomes will be helpful for decision-makers to develop policy directives and frameworks on synergistic use of ferrochrome slag and fly ash towards concrete sustainability.

Previous

Next

Keywords

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Research Article

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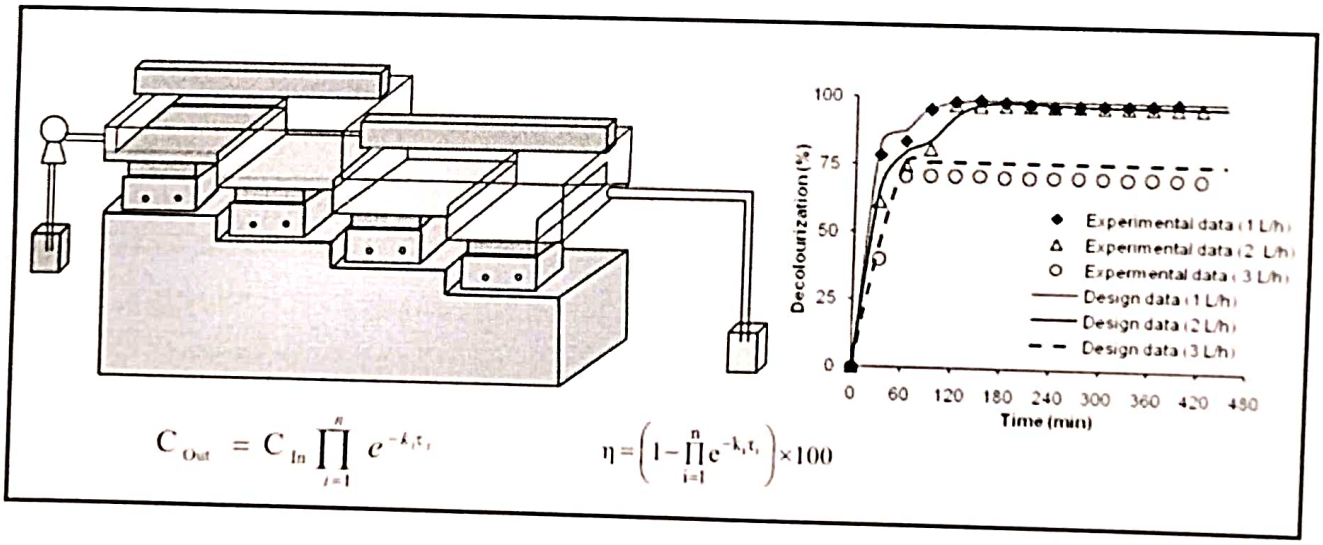

Abstract

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SURVEY PAPER

A survey on EEG-based neurophysiological research for emotion recognition

Jenamani Chandrakanta Badajena[1] · Srinivas Sethi[2] · Sanjit Kumar Dash[3] · Ramesh Kumar Sahoo[2]

Received: 14 November 2022 / Accepted: 13 March 2023

Abstract
Emotions play a significant part in a person's social connections, decision-making, and perception of the world. Elicited emotions cause a change in a person's physiological and psychological states. As Electroencephalography (EEG) facilitates a close study of brain activity, it is becoming a standard method among the research community for reliable recognition of human emotions. This work demonstrates various advancements in emotion recognition utilizing EEG signals and points out major changing trends by making a comparison of previously available research in this field. In addition to the survey a detailed explanation of the procedure for refining EEG for emotion recognition has been explained in this work. This aims to help researchers, especially beginners, have a thorough understanding of the developmental research in this field.

Keywords EEG · Human–computer interaction · Human brain · Emotion recognition

1 Introduction

Artificial intelligence is a field of research based on logical and mathematical intelligence. There have been several categories of research work in several fields that have tried to leverage the benefit of artificial intelligence for better results and insights. One such area of focus is emotion recognition which can be associated with various human-centric computational solutions. Machine learning applications can be helpful in improving computation involving human emotions. Understanding emotions is a crucial form of communication that involves several forms of human-gestures and can help make HCI (Human–Computer Interaction) more appreciable for human-centric applications. The sources of human recognition may include facial expressions, voice intonations, body language, and even subjective Self-Assessment Manikin (SAM reports). While these methods can be useful and have been used for years, researchers have concluded that they are unreliable for emotion recognition because subjects can easily hide their original emotion by manipulating various bodily expressions. Thus, the latest standard is to employ physiological signals for the purpose (Homan et al. 1987). The various forms of physiological signals for emotion recognition may include factors like heart rate (HR), electromyogram signal (EMG), respiratory volume (RV), skin conductance (SKC), skin temperature (SKT), blood volume pulse (BVP), etc. Studies have shown EEG signals to be one of the best choices for emotion classification given that they are non-invasive, rapid, and affordable (Wioleta 2013).

In this paper, the survey conducted by Alracao et al. (2017) has been extended and presented in the form of an in-depth analysis of the changing trends of several significant factors while carrying out the experiment to recognize emotion using EEG (Alarcao and Fonseca 2017). For this study, two queries were used with both IEEE Xplore and Google Scholar. The first one being "EEG + Emotions + Recognition" while the latter being "EEG + Emotions + Identification". From the output received from the search query, around 60 research papers were selected between the years 2017 and 2023 to carry out this survey. The work depicted in this paper has been organized in different sections. The Sect. 2 provides a brief background study to provide a more in-depth understanding of EEG and the physiological aspects of emotions in the human brain. It provides information

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Research

Data-driven approach to designing a BCI-integrated smart wheelchair through cost–benefit analysis

Jenamani Chandrakanta Badajena *, Srinivas Sethi, Ramesh Kumar Sahoo

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ABSTRACT

A smart wheelchair provides mobility assistance to persons with motor disabilities by processing sensory inputs from the person. This involves accurately collecting inputs from the user during various movement activities and using them to determine their intended motion. These smart wheelchairs work by collecting brain signals in the form of electroencephalography (EEG) signals and by processing them into a quantized format to provide movement assistance to people. Such systems can be referred to as brain–computer interface (BCI) systems that work with EEG signals. Acquiring data from human beings in the form of brain signals through EEG, along with processing of those signals and ensuring the correctness of actions instigated by those brain signals involve a huge amount of data. In this work, we carried out an experiment by taking 100 human subjects and recording their brain signals using a *NeuroMax* device. Typical wheelchairs are constrained by design as the motion of those is limited either by manual operation or controlled by haptic sensors and actuators. The main objective in this work was to design a wheelchair with better usability and control using machine learning-based knowledge, which is typically a data-driven approach. However, the proposed approach was designed to take inputs from human gestures and brain sensory activities to provide better usability to the wheelchair. The attention meditation cost–benefit analysis (AMCBA) proposed in this paper aims to reduce the risk of inappropriate results and improve performance by considering various cost–benefit parameters. The said classifier aims to improve the quality of emotion recognition by filtering features from EEG signals using methods of feature selection. The operation of the proposed method is described in two steps: in the first step, we assign weights to different channels for the extraction of spatial and temporal information from human behavior. The second step presents the cost–benefit model to improve the accuracy to help in decision-making. Moreover, we tried to assess the performance of the wheelchair for various assumptions and technical specifications. Finally, this study achieves improved performance in the most difficult circumstances to provide a better experience to persons with immobility.

1. Introduction

Information signals are useful for obtaining a thorough understanding of the complicated dynamics of interconnected neurons in the human brain. The human brain experiences varied states of activity, rest, and cognition. Investigating and classifying these phases is a difficult task that necessitates the use of a well-defined mechanism to assess brain activity. It is a well-observed fact that brain activity is proportional to cognitive load. Electroencephalography (EEG) [1] is a common neuroimaging method that is employed for observing and recording neural activity in the human brain. It is a technique that collects data from the surface of the scalp with the help of metal electrodes, thus providing important data about the brain's ongoing neural activity. This method is preferred over other neuroimaging [2] processes, as it is more cost-efficient [3] and facilitates the ease of mobility. Depending on our daily activities, our brain exists in varying states. Therefore, to learn more about the different states and classify the actual state, it is necessary to process the obtained data in order to extract relevant features that can be further utilized for classification [4]. Processing is also needed to determine the precision and efficiency of the wheelchair based on the obtained signal inputs from the human brain.

According to the studies conducted by the World Health Organization [5], nearly 650 million (and possibly more) people are physically handicapped, out of which roughly 70 million are estimated to be living in India alone. Several studies [4,6,7] have found that the incidence of impairment rises with age.

The customization of a wheelchair based on individual preference may be a challenging task, because the required data

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Enhancing Data Integrity In Mobile Crowdsensing Environment With Machine Learning And Cost-Benefit Analysis

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Abstract: Mobile Crowdsensing (MCS) is a major source of a vast dataset containing heterogeneous types of data collected from various sources and stored in the local or remote server. Proper analysis of MCS data helps in better decision-making. However, MCS data suffers from data integrity issues, such as validity, accuracy, and reliability, that affect decision-making. Therefore, ensuring data integrity in the MCS environment is essential as it is a major source of a huge dataset. The proposed work considers user review data collection and analysis using a mobile application developed for the purpose. To ensure the data integrity, identification of fake and invalid reviews in the dataset need to be determined. This work proposes two approaches to solve data integrity issues. The first approach is to detect and eliminate fake/ invalid reviews from the dataset. The second is to identify the sources of fake/ invalid reviews and block them to protect the dataset from future fake reviews. Machine learning (ML) models are proposed to solve these issues and to ensure data integrity by filtering out fake reviews from real-time data sets. The proposed model uses data fuzzification over a purely mathematical model that categorizes users or customers as honest, suspicious, or malicious and their reviews/ feedback as genuine or fake using ratings provided by the user in the MCS Environment. Using the developed mobile application, user can give feedback about the desired location through various devices, which is stored in a cloud platform. The dataset can be analyzed through a fuzzy logic-based mathematical model followed by an ML algorithm and cost-benefit analysis to detect genuine reviews for maintaining data integrity. Further accuracy of the proposed models is compared with popular ML algorithms such as Naive Bayes (NB), Bayes Net(BN), Support Vector Machine(SVM), Decision Tree(J48), and Random Forest(RF). Initially, it achieves 99.79% of accuracy using the Random Forest algorithm that has been enhanced to 100% using cost-benefit analysis in cross-validation mode.

Keywords: Data Integrity, Mobile Crowdsensing(MCS), Review classification, Machine Learning, Rating, Fuzzy Model, Cost Benefit Analysis.

1. INTRODUCTION

Data integrity is defined as maintenance, assurance of completeness, consistency, safety, and accuracy throughout its life cycle. It is essential for any database or cloud system that stores, processes, and analyzes data. It must be secured and cannot be modified maliciously so that obtained information from the dataset will be reliable at any time. Various standards and rules have been designed to ensure data integrity. Data integrity ensures that information retrieved from the dataset will be reliable, complete, and accurate. It is essential to identify and eliminate invalid and fake data and also identify users who wants to temper dataset through invalid and fake data maliciously to ensure data integrity. It can be applied and studied through different real-time applications such as fake review analysis considered in the proposed work. Feedback/Review provided by the user after getting an experience on a particular thing is called a review. It may be obtained from users in online and offline modes. It may be positive or negative as per the user's experience with a specific product, place, person, etc. Positive reviews can enhance popularity, whereas; negative reviews can reduce the popularity of certain products, places, people, etc. Therefore It plays an important role in a majority of sectors. A review may be genuine or fake as per the user's intention. Some malicious users consistently provide fake reviews on specific products, places, people, etc., to compromise their popularity by increasing or decreasing. In the current era, Reviews given by the user are considered correct, and they blindly believe the feedback or reviews provided by other customers or users. So it needs to be reliable, real, accurate, and complete, but a few malicious

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SURVEY PAPER

A survey on EEG-based neurophysiological research for emotion recognition

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OPTIMAL SOLUTIONS FOR RESOURCE ALLOCATION IN A CRAHN FOR ECO FRIENDLY ENVIRONMENT

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ABSTRACT:
Channel assignment in CRAHN (Cognitive Radio Ad Hoc Network) is defined as a critical issue during any kind of communication to be executable. It is a problem of determining an optimal mapping between the accessible licensed channels and the cognitive radio channels such that the performance of CRAHN is optimized. The objectives of the channel assignment in this concerned network are to assign the available channels to cognitive radio interfaces of cognitive nodes to achieve proficient spectrum utilization, to diminish the interference among cognitive or secondary nodes, and to curtail the interference to PUs (primary users). Thus, motivates the necessity for optimization during spectrum sensing in a cognitive radio system. This paper has narrowly focused on optimized spectrum allocation problems by developing new algorithms under a platform of Non-dominated Sorting-based Genetic algorithm (NSGA-II), Heuristic Harmony Search (HS), Cuckoo Search (CS), and Multi Objective Bat Algorithm (MOBA) by weighted sum method. The assessment of optimal solutions in terms of true pareto-fronts has been discussed towards ensuring eco-friendly environment in context with channel allocation.

Keywords- CRAHN, PU, Cognitive Radio, Spectrum Allocation

1.INTRODUCTION

To meet the recent challenges in the rapidly expanded service demands, it is mandatory to materialize the needs by means of integrating and merging fundamental wireless access network infrastructure like ad-hoc, cellular, and broadcasting schemes as well as optimizing the communication resource coordination towards various applications. In this context, to synchronize wireless network resources by integrating services for different applications under various spectrum regulations, it is inevitable to possess a cooperative, flexible, and reliable communication node. Hence, to provide ever-present and un-interrupted connectivity with integrated access and dynamic services, it is advisable to have a platform that is favorable for multi-band, multi-mode re-configurability being having operational environment around it. A hopeful explanation to such a problem in above scenario is CRAHN with its intellect ability required to realize the optimal performance that is to be projected under dynamic and random situations [1].

It is very much understood that CR (cognitive radio) is supported behind a concept of SUs (secondary users) might have sufficient transmission opportunity to assure their service quality due to the underutilized behaviour of channel by the primary system. Under such circumstances if SUs fails to find the means of increasing their transmission opportunity, then the quality of service (QoS) of the secondary network will be meticulously ruined. Thus, necessary action is to be taken up to increase the network throughput by creating additional transmission opportunity of CUs (cognitive users) without affecting primary service quality [2]. Analysis of various optimal techniques in the field wireless

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Better decision-making strategy with target seeking approach of humanoids using hybridized SOARANN-fuzzy technique

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ABSTRACT

The prediction and decision-making features of the artificial neural network have been applied to several robotic related research works. Humanoid robot navigation is a challenging task for the researchers with best decision making. Simple artificial neural network (ANN) is the connection models which are poor in multistep decision making with long term planning and logical reasoning. So, in this study artificial neural network is improved in long term cognitive planning by SOAR (State Operator and Result) with powerful feature prediction through ANN (SANN) and hybridized with Fuzzy system for generation effective turning angle value, which will guide the humanoids to reach target location with better decision target seeking ability. An intelligent data fusion model is embedded between SOAR and ANN for converting the logical sequence information of SOAR to probabilistic vectors in multilayer ANNs. The obstacle distances are the input parameters to the SANN model and turning angle (TA) is the output from SANN. The obstacle distances along with the TA obtained from SANN is fed to the fuzzy system as input value and effective turning angle (ETA) is obtained to guide the humanoids towards reaching target. The proposed novel technique and ANN is used by both single and multiple humanoids in both simulation and experimental platforms. The novelty of the research focuses on the development of the new SOAR-ANN technique with better decision strategy for effective turning angle value, to obtain global optimal path by avoiding trapping in local optima and dead ends. The simulation and experimental results in terms of path length travelled and time spent to reach target are obtained from both ANN and novel SANN-Fuzzy technique. When the developed novel technique is compared with standalone ANN method during single humanoid navigation then, a significant improvement of 2–5% and 14–15% is observed in related to trajectory path span and trajectory time spent respectively. Similarly, during multiple humanoid navigation percentage improvement of 5–9% and 14–18% is obtained for humanoids in terms of navigational parameters respectively. The results clearly shows the developed technique requires less time and travels less path to reach target as compared to ANN and the percentage of error is also quite low. Statistical analysis is performed from the results of both the techniques and reflects the effectiveness of the proposed technique in comparison to ANN. Further the developed technique is compared against another existing methodologies like Fuzzy-ANN and Boundary Node Approach and, significant enhancements of 5.64% and 9.72% is attained in terms of track span respectively.

1. Introduction

The navigation of robots has wide application in the area of military service, medical situations like COVID-19, mining and essential service like fire. The success of these services by the robots depends on the intelligence capability built in the robot. Navigation is an intelligent feature as robots to fulfill tasks with reaching target location without collision in the real environment. Among the robots now, humanoid robots have attracted the researchers for motion analysis investigation with reducing joint complexities of movement of humanoids. Mainly

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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 emrging technolgy 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

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Energy-efficient PEGASIS Clustering based multipath routing with Lion Swarm and Chicken swarm optimization (PEGA-LSCS) 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 (PEGA-LSCS) 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 results 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 optimising 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

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Towards stabilization and navigational analysis of humanoids in complex arena using a hybridized fuzzy embedded PID controller approach

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ABSTRACT

In this study, path planning and stabilization of humanoids are carried out in an uneven path and dynamic environment. The importance of the work focuses on avoiding local minima and trapping in dead-ends during navigation. The sole purposes of this research are to i) Stabilize the humanoid on an uneven surface. ii) Develop proper path planning for the humanoid so that it can adequately navigate through obstacle-rich terrain. For achieving the above said objectives, the robot's controller is designed by tuning the Proportional-integral-derivative (PID) controller with a fuzzy logic controller (FLC) for better performance. The PID controller does joint angle control and torque control respectively. In contrast, a complicated task like generating optimized turning angle (OTA) and adjusting feet angle during stepping upon an uneven path is done by FLC. Gait generation during stepping on and off an uneven surface for the humanoid robot is discussed and implementation of the inverted pendulum plus flywheel method (LIPFFM) is used for the analysis of the dynamics of motion and removing the height constraint (center of mass) where the upper body is considered as the mass of the pendulum. Petri net controller is used to navigate humanoids in an environment with multiple humanoids. To examine the proposed controller's performance, the controller undergoes testing in simulation and experimental set up, and the obtained results are compared with recently developed techniques. V-REP software is used for conducting the simulation with an arena-size of 240*160 dimensions to test the effectiveness of the developed controller. A less than 5 % deviation is found because of friction and signal delay is noticed between simulation and the experimental result obtained for navigation while comparing to the previously developed technique such as PIM. There is a significant improvement in path length by 10.49 % is noticed and a decrease of 2.98 % in computational time is noticed. When the navigation parameter of the FUZZY-PID controller is compared with Genetic Potential Field (GPF), Pseudo Bacterial Potential Field (PBPF), and Bacterial Potential Field (BPF), there is an improvement of 15.41 %, 12.51 %, and 8.56 % respectively are noticed. It has been seen that the FUZZY-PID controller minimizes the settling time and lower the peak overshoot. When the humanoid robot crosses the uneven path using the proposed FUZZY-PID controller, the graph obtained is smoother than the previously developed technique. It displays the body attitude angle falling between less than ±1.5 degrees compared to ±2 degrees by the previously developed method which justify the selection of the FUZZY-PID controller.

1. Introduction

A humanoid robot takes after a human in most aspects, like moving, walking etc. from source to any destination. Humanoid robots can potentially replace the human workforce soon. This research has two main objectives. They are i) To stabilize the humanoid on an uneven surface. ii) To develop proper path planning for the humanoid so that it can adequately navigate through obstacle-rich terrain. The biped robot's main challenge is to maintain the centre of mass (COM) in the support polygon. The idea of Zero Moment Point (ZMP) is introduced to improve the situation. Height is a constraint of COM, which can shift the COM from its desired position to deal with the situation. Here, we used the

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RESEARCH PAPER

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

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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 humanoids. 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 negotiate 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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Modified SVPWM technique for CMV reduction in asymmetrical dual three phase induction machine drive

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Due to its advantages, the asymmetrical dual three-phase induction motor drive is a strong choice in high-power applications. However, the common-mode voltage produced by the voltage source inverters affects the winding insulation and damages the bearings. Common-mode voltage is also responsible for electromagnetic interference and leakage currents. This paper, therefore, analyses the common-mode voltage produced by the inverter supplying a dual three-phase induction motor drive and proposes a novel modified space vector decomposition-based Space Vector Pulse Width Modulation (SVPWM) technique for common mode reduction. The vector space decomposition-based space vector modulation technique offers excellent flexibility as it reduces the common-mode voltage (CMV) by exploiting the additional degree of freedom in a dual three-phase system. The common-mode voltage (CMV) can be reduced to one-sixth of the DC link voltage compared to the highest CMV, i.e. half of the DC-link voltage produced in conventional space vector modulation. The proposed method is also validated experimentally to demonstrate the effectiveness of the proposed scheme in terms of the amplitude of CMV, pulsations, and total harmonic distortion(THD) in current.

List of symbols

λ_s	Stator flux linkage
λ_{rr}	Rotor self flux linkage
λ_{rs}	Rotor stator mutual flux linkage
λ_{sr}	Stator rotor mutual flux linkage
λ_{ss}	Stator self flux linkage
CMV	Common-mode voltage
$DTIM$	Dual three-phase induction machine
i_r	Rotor current
i_s	Stator current
i_{μ_1,μ_2}	Loss component in $\mu_1 - \mu_2$ plane
i_{dr}	d-axis rotor current
i_{ds}	d-axis stator current
i_{qr}	q-axis rotor current
i_{qs}	q-axis stator current
$i_{Z1,Z2}$	Zero sequence component in $Z_1 - Z_2$ loss plane
L_{ms}	Magnetising inductance
L_{sr}	Stator rotor mutual inductance
L_{ss}	Stator self inductance
$RCMV$	Reduced common-mode voltage
$SVPWM$	Space vector pulse width modulation
THD	Total harmonic distortion
v_r	Rotor voltage
v_s	Stator voltage
v_{ds}	d-axis stator voltage
v_{qs}	q-axis stator voltage
VSD	Vector space decomposition

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Research Article

Machine Learning Strategy to Achieve Maximum Energy Harvesting and Monitoring Method for Solar Photovoltaic Panel Applications

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The choice of the optimal orientation of the solar panels is by far one of the most important issues in the practical application of solar installations. The use of phase changing materials (PCMs) is an efficient approach of storing solar thermal energy. Because PCMs are isothermal in nature, they provide better density energy storage and the capacity to function across a wide temperature range. Unfortunately, this feature is very rare on various solar power panels; however, ignoring it can reduce the performance of the panels to unacceptable levels. The fact is that the angle of incidence of rays on the surface greatly affects the reflection coefficient and, consequently, the role of unacceptable solar energy. In this paper, a smart energy harvesting model was proposed. In the case of glass, when the angle of incidence varies vertically from its surface to 30, the reflection coefficient is practically unchanged and slightly less than 5%, i.e., more than 95% of the radiation goes inwards. Furthermore, the reflection increase is noticeable, and the area of the reflected radiation by 60 doubles to almost 10%. At an angle of incidence of 70, it reflects 20% of the radiation, and at 80, 40%. For most other objects, the dependence of the reflection magnitude on the angle of incidence is approximately the same.

1. Introduction

Even more important is the so-called effective group area, viz. The intersection of the radiation flow was thereby blocked. This is equal to the actual area of the panel multiplied by the sine of the angle between its plane and the direction of flow (or, equally, perpendicular to the panel and by the cosine of the angle between the direction of flow) [1].

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Occupancy Detection in a Building Using Hybrid Models

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Abstract – Buildings consume over 40% of the world's total energy supply, and their occupancy is increasingly recognized as a major performance indicator due to its effect on a building's energy costs and occupant satisfaction. In this paper, a hybrid model is created to estimate future loads of a building with high efficiency and accuracy. The proposed model is composed of two - connected in a cascade - artificial neural networks, where the outcomes of the first network are fed into the second one, which in its turn performs the load forecasts. A pre-existing dataset is used to verify the proposed model and to test a variety of training set sizes. Analysis of the results is executed by taking six pair of combinations separately for both open door and closed door fault cases. In this analysis, cascaded back propagation and Elman back propagation method - among the rest of the analyzed methods – is found to give the best accuracy, i.e, 97.2% - 97.9%, which indicates that the suggested hybrid technique is more accurate than the existing non-hybrid methods.

***Keywords*—** Occupancy detection; Prediction model; Hybrid neural network structure; Accuracy.

Abbreviations

ANN	Artificial neural network	OD	Open Door
NN	Neural network	CD	Closed Door
CFBP	cascaded forward back propagation	GA	Genetic algorithm
FF	Feed forward	SVM	Support vector machine
EBP	Elman back propagation	k-NN	K nearest neighbours
HVAC	Heating and ventilating air conditioning		

1. INTRODUCTION

The World Watch Institute reports that buildings use over 40% of global energy annually [1]. As a result, good building load management is critical for effective energy use and reduced energy consumption. Since the number of people in the space is a major consideration for managing the loads, occupancy sensors are installed. Because of this, occupancy rates have a big impact on how energy management is done.

Several studies and experts agree that accurate occupancy data is crucial to improving building energy staging and, hence, lowering energy consumption in buildings [2, 3]. In [4], the authors offer a heating and ventilating air conditioning (HVAC) system in which energy consumption is cut by 10-15% of manual switching control based on the number of people

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Artificial Neural Network Optimized Load Forecasting of Smartgrid using MATLAB

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Abstract— **The motivation behind the research is the requirement of error-free load prediction for the power industries in India to assist the planners in making important decisions on unit commitments, energy trading, system security & reliability, and optimal reserve capacity. The objective is to produce a desktop version of a personal computer-based complete expert system that can be used to forecast the future load of a smart grid. Using MATLAB, we can provide adequate user interfaces in graphical user interfaces. This paper devotes a study of load forecasting in smart grids, a detailed study of the architecture and configuration of Artificial Neural Network (ANN), Mathematical modeling and implementation of ANN using MATLAB, and a detailed study of load forecasting using the backpropagation algorithm.**

Keywords— ***Load Forecasting, Smart Grid, Expert System, ANN, Activation Function, Learning Mechanism***

I. INTRODUCTION

The two variables on which the economic prosperity of developing countries like India is constantly dependent are the reliability and quality of electric power supply [1]. Load forecast is a technique for predicting future loads for a power system. Power companies use this methodology to forecast the amount of power required to balance supply and demand. Demand forecasting is used to determine generating, transmission, and distribution capacity [2]-[4]. The type of generation proficiency required is determined by the energy prediction. In the design and operation of power systems, accuracy in electrical load forecasting is critical [5]. It can assist market participants in lowering operating costs and building a more reliable energy supply system. Long-term load forecasting is utilized in expansion planning, intertie tariff fixing, and long-term capital investment planning that spans one to ten years [6]-[7]. In order to schedule fuel supply for a few weeks, the medium-term load forecast is used. For unit commitment, maintenance & economic dispatch difficulties, a short-term load forecast is used [8]-[11].

II. LOAD FORECASTING IN SMART GRID

Prediction of electricity necessary to satisfy the short or medium-term & long-term load demand is known as "load forecasting." The forecasting methodology is used by utility companies to aid in the operations and management of their customers supplies [12]. Electricity load forecasting is an important procedure that helps electricity-generating and distributing businesses improve their efficiency and income [13]. It can be used to manage their capacity and operations so that they can reliably supply all of their customers with the energy they need. The smart grid is a combination of electrical and digital technology, as well as information and communication technology, that allows for the integration of business operations and the system to produce actual, measurable value across the power distribution chain [14]. Through a communication system, an intelligent future electrical system connects all supply grids and demand elements. The Smart grid uses two-way digital technology to transmit electricity to consumers, allowing for effective consumer management and grid use to notice and correct supply-demand imbalances. Load forecasting has an impact on fuel resource planning and strategic decisions to balance power supply and demand [15]. When the energy market underwent a revolution, load forecasting became increasingly important, spreading across other business areas such as energy trading, financial planning, and so on [16]. Exact load projections serve as the foundation for the system's spot price initiation in order to obtain the lowest possible power purchasing cost in the market. It is also advantageous for electricity customers to comprehend the relationship between demand and price, as well as to adjust their electricity usage patterns in response to the price. In the Smart Grid scenario, grid components are responsible for variations in the consumer's electricity demand at different intervals of time at the utility level [17]-[20].

III. EXPERT SYSTEM

It is a computer program shown in Fig. 1, which is used to simulate the abilities of a human expert to make decisions. It's a computer program that helps people solve problems by simulating human decision-making [21]. Typically, it accomplishes this by extracting knowledge from its knowledge base and applying reasoning and inference rules to the questions raised by the user. The first commercial system to utilize knowledge-based architecture was the Expert System. The knowledge base and the inference engine are two subsystems that make up a knowledge-based system

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Computation of maximum power point tracking of PV module using modified Newton Raphson technique

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ABSTRACT

The maximum power point tracking (MPPT) has been a popular terminology among those researchers who deal with one of the most available renewable energy resources called solar power. Many researchers have evolved and proposed a lot of techniques for tracking maximum power. But each technique has its pros and cons. Some techniques suffer from complexity as far as implementation is concerned, whereas other techniques lack accuracy. In current research work, it has been investigated the MPPT using Newton Raphson (NR) method, which has not yet received a good attention by researchers. After observing its limitation, this method is modified (i.e., abbreviated as modified Newton Raphson method (MNRM)) to make it suitable for extracting the maximum power from PV module. The feasibility and precision of this method depends upon accurate measurement of temperature and irradiation. By using MNRM, the presumption of initial value is close to the voltage corresponding to maximum power, so it leads faster converging to solution through a few rounds of iterations. In order to validate it, a MATLAB/Simulink model is developed and simulated. The proposed method is incorporated in PV module-fed buck converter so as to explore superior performance.

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1. INTRODUCTION

A photovoltaics PV cell is smallest unit of solar power generating unit and its basic characteristic (I~V) is mostly non-linear in nature. The connection of PV cells in series and parallel is known as PV module and the grouping PV modules in series and parallel is known as PV array. The modeling of PV cell is presented by Salmi *et al.* [1]. Since DC-DC converter is major component in solar power unit, so the comprehensive review of various DC-DC converters is detailed and analyzed [2]. The maximum power point tracking MPPT is common phenomenon among researchers in the field of solar technologies and the various techniques of MPPT are focused and compared [3]. In this literature, the comparison includes the positive aspects of each technique and its limitation. Also, it has been discussed about their performances and complexities about their implementation. Anand and Fernandes [4] have elaborated on implementation and

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Regular paper

LUS-TLBO Optimized Load Frequency Control for EV-Thermal-Hydro System Using Cascaded 3DOFPID-FOPID-FOPD-TID Controller

Journal of Electrical Systems

This study unveils the application of cascaded- three degree of freedom proportional integral derivative - fractional order proportional integral derivative- fractional order proportional derivative- tilted integral derivative (CC-3DOFPID-FOPID-FOPD-TID) controller optimized by local unimodal sampling –teaching learning based optimization (Lus-TLBO) algorithm for frequency stability. Conventional controller under reformed operating situations, are not giving reasonable performances as compared to cascaded controller in terms of robustness towards system non-linearities. Hence, a novel optimal 3DOFPID-FOPID-FOPD-TID controller is exploited for 4-area hydro thermal power systems considering system non lineraities. Further batteries of electric vehicles (EVs) are conformed here in the control areas to speedily incarcerated frequency oscillations following load demands to improve the stability of the system. Frequent simulations are directed to substantiate the robustness and superiority of EVs and the recommended control strategy over prevailing approaches. A hybrid Lus-TLBO algorithm is introduced here to optimize the controller parameters. The supremacy of dynamic performances of Lus-TLBO optimized controller is accomplished with teaching learning based optimization (TLBO) based for EV with system and without system through extensive simulations. Moreover the preeminence of cascade 3DOFPID-FOPID-FOPD-TID controller is executed in comparison with 3DOFPID-FOPID-TID, 3DOFPID-FOPID and 3DOFPID-TID controllers. Finally the robustness of this cascade is performed under random load fluctuation.

Keywords: Electric vehicle, area control error, fractional order controller, cost function, nonlinear constraints

1. *Introduction*

It is overbearing to sustain the power steadiness between the generation and demand for an immense and complex power system. Hence the foremost apprehension to deliver eminence power to the customer in contradiction of load variations, dispersion of renewable energy resources and large number of interconnected power system network. With the advancement of technology Now days, EV is the widely emerging research area due to lower noise pollution and greenhouse emissions. After the permeation of PHEV in the grid, rigorous work has been enumerated concerning LFC [1–4]. In [1, 2], exploitation of electric vehicle for deregulated power system using fractional order controller optimized by flower pollination algorithm (FPA) has discussed. In [3], the effect of electric vehicle for an interconnected thermal and hydro thermal power system using cascade fuzzy-fractional order integral derivative with filter (CF-FOIDF) controller has expounded. Robust frequency control for three area thermal systems incorporated with EV using 2DOF-PID controller has discussed in [4]. Primary control action by governor mechanism is not adequate to abolish the steady state error sharply which demands a secondary controller. Easiness execution of PID controller is frequently used in power system industries for last few periods. Different conventional controllers such as PID [5], degrees of freedom PID controller [6, 7] and fuzzy PID controller [8] are employed in different structures of LFC issues. However, these conventional controllers cannot give satisfactory performances

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Artificial Neural Network Optimized Load Forecasting of Smartgrid using MATLAB

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Abstract— **The motivation behind the research is the requirement of error-free load prediction for the power industries in India to assist the planners in making important decisions on unit commitments, energy trading, system security & reliability, and optimal reserve capacity. The objective is to produce a desktop version of a personal computer-based complete expert system that can be used to forecast the future load of a smart grid. Using MATLAB, we can provide adequate user interfaces in graphical user interfaces. This paper devotes a study of load forecasting in smart grids, a detailed study of the architecture and configuration of Artificial Neural Network (ANN), Mathematical modeling and implementation of ANN using MATLAB, and a detailed study of load forecasting using the backpropagation algorithm.**

Keywords*— *Load Forecasting, Smart Grid, Expert System, ANN, Activation Function, Learning Mechanism

I. INTRODUCTION

The two variables on which the economic prosperity of developing countries like India is constantly dependent are the reliability and quality of electric power supply [1]. Load forecast is a technique for predicting future loads for a power system. Power companies use this methodology to forecast the amount of power required to balance supply and demand. Demand forecasting is used to determine generating, transmission, and distribution capacity [2]-[4]. The type of generation proficiency required is determined by the energy prediction. In the design and operation of power systems, accuracy in electrical load forecasting is critical [5]. It can assist market participants in lowering operating costs and building a more reliable energy supply system. Long-term load forecasting is utilized in expansion planning, intertie tariff fixing, and long-term capital investment planning that spans one to ten years [6]-[7]. In order to schedule fuel supply for a few weeks, the medium-term load forecast is used. For unit commitment, maintenance & economic dispatch difficulties, a short-term load forecast is used [8]-[11].

II. LOAD FORECASTING IN SMART GRID

Prediction of electricity necessary to satisfy the short or medium-term & long-term load demand is known as "load forecasting." The forecasting methodology is used by utility companies to aid in the operations and management of their customers supplies [12]. Electricity load forecasting is an important procedure that helps electricity-generating and distributing businesses improve their efficiency and income [13]. It can be used to manage their capacity and operations so that they can reliably supply all of their customers with the energy they need. The smart grid is a combination of electrical and digital technology, as well as information and communication technology, that allows for the integration of business operations and the system to produce actual, measurable value across the power distribution chain [14]. Through a communication system, an intelligent future electrical system connects all supply grids and demand elements. The Smart grid uses two-way digital technology to transmit electricity to consumers, allowing for effective consumer management and grid use to notice and correct supply-demand imbalances. Load forecasting has an impact on fuel resource planning and strategic decisions to balance power supply and demand [15]. When the energy market underwent a revolution, load forecasting became increasingly important, spreading across other business areas such as energy trading, financial planning, and so on [16]. Exact load projections serve as the foundation for the system's spot price initiation in order to obtain the lowest possible power purchasing cost in the market. It is also advantageous for electricity customers to comprehend the relationship between demand and price, as well as to adjust their electricity usage patterns in response to the price. In the Smart Grid scenario, grid components are responsible for variations in the consumer's electricity demand at different intervals of time at the utility level [17]-[20].

III. EXPERT SYSTEM

It is a computer program shown in Fig. 1, which is used to simulate the abilities of a human expert to make decisions. It's a computer program that helps people solve problems by simulating human decision-making [21]. Typically, it accomplishes this by extracting knowledge from its knowledge base and applying reasoning and inference rules to the questions raised by the user. The first commercial system to utilize knowledge-based architecture was the Expert System. The knowledge base and the inference engine are two subsystems that make up a knowledge-based system

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Direct Torque Control Based Two Quadrant Analog Torque Controller for Squirrel Cage Induction Motor

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CONTENTS

Abstract—High performance variable speed drives have become indispensable for the modern age industry where the product quality and productivity are of utmost importance. Because of the many drawbacks of dc drives, research attention has been focused toward ac drives, mainly induction motor drives. The ac drives have evolved over the years with improved transient torque output response that closely matches the response obtained from dc drives. This paper presents a complete hardware based two quadrant analog torque controller for squirrel cage induction motor based on the Direct Torque Control (DTC) scheme. The proposed analog torque controller may find its own niche area of application, for example, in packaging industries where mostly small and medium sized drives are used. The two quadrant analog torque controller has been implemented as a simple hardware circuit based on the DTC scheme. The implementation is done using commonly available low-cost hardware components.

1. INTRODUCTION

The three-phase Squirrel Cage Induction Motor (SCIM) is the prime choice for industrial drives. Its robustness, simple construction and economic energy consumption at variable load has made it most popular among all the AC or DC motors. The Direct Torque Control method, postulated in 1980s, was simple in its implementation for providing fast torque control in the SCIM. Unlike the Field Oriented Control (FOC) Scheme, the DTC scheme could overcome the complexity of reference frame transformation [1, 2]. Almost all switching table-based DTC (ST-DTC) schemes [2–9] reported in literature use digital computing devices like personal computer (PC) or digital signal processor (DSP) for their implementation. One of the attractive alternatives for DSP or PC based implementation came out as complete hardware based analog implementation of the scheme without using any digital computing device. The advantage of this hardware control scheme is that it is faster compared to

Keywords: Analog DTC controller, two-level voltage source inverter (VSI), two quadrant forward and reverse motoring operation
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DE optimized IPIDF controller for management frequency in a networked power system with SMES and HVDC link

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A major concern is frequency change with load. So, Load Frequency Control (LFC) of an interconnected power system is proposed in this research using a unique integral plus proportional integral derivative controller with filter (IPIDF). The Differential Evolution (DE) algorithm is used to optimize the integral plus proportional integral derivative controller with filter controller parameters for a two-area power system. By contrasting the results of the proposed method with those of recently published optimization techniques for the same power system, such as the Particle Swarm Optimization (PSO), Genetic Algorithm (GA), Firefly Algorithm (FA), and Differential Evolution (DE) based Proportional integral derivative (PID) and PIDF controllers, the superiority of the integral plus proportional integral derivative controller with filter approach is made clear. It is possible to determine the system performance index like integral time multiplied the absolute error (ITAE) and the settling time (Ts). The power system with superconducting magnetic energy storage and an HVDC link is also included in the proposed work, and the values of the suggested integral plus proportional integral derivative controller with filter controllers are evaluated using the Differential Evolution method. By comparing the outcomes with the Differential Evolution tuned PIDF controller for the identical power systems, the suggested controller's superiority is demonstrated. To show the stability of the recommended Differential Evolution algorithm tuned integral plus proportional integral derivative controller with filter controller, the speed governor, turbine, synchronizing coefficient, and frequency bias parameters' time constants and operating load conditions are varied in the range of +25 to −25% from their nominal values, along with the magnitude and location of step load perturbation and pulse load perturbation, to perform sensitivity analysis. According to research, proposed integral plus proportional integral derivative controller with filter controllers offer greater dynamic response by minimizing time required to settle and undershoots than Proportional integral derivative controllers and PIDF controllers. MATLAB/Simulink is used to run the simulations.

KEYWORDS

load frequency control (LFC), differential evolution (DE) algorithm, proportional integral derivative (PID), integral plus proportional integral derivative controller with filter (IPIDF), superconducting magnetic energy storage system (SMES)

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Communications

Performance Evaluation of MIMO-OFDM-FSO with Modified Receiver

Chinmayee Panda & Urmila Bhanja

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Abstract

The performance of free space optical communication system using multi-input multi-output orthogonal frequency division multiplexing (MIMO-OFDM) with a modified receiver structure is evaluated in this paper referred to as MIMO-OFDM-FSO with the modified receiver (MIMO-OFDM-FSO-MR). Utilizing equal gain combining the analysis is done by taking closed-form expression of average bit error rate and throughput. The simulation is performed to estimate various performance parameters such as throughput and bit error rate (BER) for the proposed MIMO-OFDM-FSO-MR model under different turbulence and weather conditions. Simulation reveals that the proposed

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An Approach of Network Slicing in Next Generation Networking Environment

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ABSTRACT Network slicing known as NS is a key enabling technology used for 5G wireless network. It is a form of virtualization network that shares physical resources with multiple slices of virtual network It deploys on same physical network to serve specific application with better flexibility and efficiency. NS instances composed of VNF instances, commonly known as virtual network function, for point-to-point virtual slice network. Implementing VNF is an embedding problem in a wireless domain. 3GPP (Third Generation Partnership Project) introduced NS in Release 15. IoT (Internet-of-Things) can be one of the applications of Network Slicing which can allocate different network resources in the platform of physical things. Finally, it also analyses performance in terms of latency and data rates. In this paper, we have analysed data rates and latency of three different use cases by using diverse algorithm. We obtained various simulation result of use cases.

INDEX TERMS Network slice, Internet-of -Things (IoT), software-define network (SDN), Network function virtualization (NFV), eMBB, URLL, mMTC

I.INTRODUCTION The fifth-generation networks provide large spectrum with higher data rates in multi-gigabit-per-second (Gbps) for users. The connectivity of smart devices and appliances is increasing exponentially [1]. The main challenge for mobile operators is to connect more devices with high data rate, optimize bandwidth as well as latency [2]. Mobile operator developed solution to challenges. 5G NS is developed in 3GPP standard in Release 15 and 16[1][2]. It allows better internet speed and cost. It also improves capacity of network and enhances spectrum by connecting huge devices that is a well-organized technology for current facing problem such as interference which occurs during massive transmission [3].

5G wireless network provides multi-giga-bits of data rates, better reliability with less time required and less latency. It supports high users' mobility [4][2]. But it has certain drawback which prevent advancement in fulfilment of these characteristics [1]. Also, upgradation in hardware will be expensive and not feasible. To resolve these problems, new concept is used [5]. These are Software-Defined Networking (SDN) and Network Function Virtualisation (NFV) which can upgrade physical structure without upgrading hardware. It improves wireless network flexibility and network scalability. It can be used as the key components in the architecture of the 5G network, and using these SDN technology and NFV technology allows split

OPTIMAL SOLUTIONS FOR RESOURCE ALLOCATION IN A CRAHN FOR ECO FRIENDLY ENVIRONMENT

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ABSTRACT:
Channel assignment in CRAHN (Cognitive Radio Ad Hoc Network) is defined as a critical issue during any kind of communication to be executable. It is a problem of determining an optimal mapping between the accessible licensed channels and the cognitive radio channels such that the performance of CRAHN is optimized. The objectives of the channel assignment in this concerned network are to assign the available channels to cognitive radio interfaces of cognitive nodes to achieve proficient spectrum utilization, to diminish the interference among cognitive or secondary nodes, and to curtail the interference to PUs (primary users). Thus, motivates the necessity for optimization during spectrum sensing in a cognitive radio system. This paper has narrowly focused on optimized spectrum allocation problems by developing new algorithms under a platform of Non-dominated Sorting-based Genetic algorithm (NSGA-II), Heuristic Harmony Search (HS), Cuckoo Search (CS), and Multi Objective Bat Algorithm (MOBA) by weighted sum method. The assessment of optimal solutions in terms of true pareto-fronts has been discussed towards ensuring eco-friendly environment in context with channel allocation.

Keywords- CRAHN, PU, Cognitive Radio, Spectrum Allocation

1.INTRODUCTION

To meet the recent challenges in the rapidly expanded service demands, it is mandatory to materialize the needs by means of integrating and merging fundamental wireless access network infrastructure like ad-hoc, cellular, and broadcasting schemes as well as optimizing the communication resource coordination towards various applications. In this context, to synchronize wireless network resources by integrating services for different applications under various spectrum regulations, it is inevitable to possess a cooperative, flexible, and reliable communication node. Hence, to provide ever-present and un-interrupted connectivity with integrated access and dynamic services, it is advisable to have a platform that is favorable for multi-band, multi-mode re-configurability being having operational environment around it. A hopeful explanation to such a problem in above scenario is CRAHN with its intellect ability required to realize the optimal performance that is to be projected under dynamic and random situations [1].

It is very much understood that CR (cognitive radio) is supported behind a concept of SUs (secondary users) might have sufficient transmission opportunity to assure their service quality due to the underutilized behaviour of channel by the primary system. Under such circumstances if SUs fails to find the means of increasing their transmission opportunity, then the quality of service (QoS) of the secondary network will be meticulously ruined. Thus, necessary action is to be taken up to increase the network throughput by creating additional transmission opportunity of CUs (cognitive users) without affecting primary service quality [2]. Analysis of various optimal techniques in the field wireless

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A COMPARATIVE STUDY ON NETWORK SLICING USING META-HEURISTIC ALGORITHM IN A NETWORKING ENVIRONMENT

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Abstract: Network slicing (NS) is a main allowing technology used in cellular 5G wireless communication networks.NS is introduced by 3GPP (Third Generation Partnership Project) in releases 15 or 16. 5G network is standardized with more software implementation to provide better flexibility and support different services. Virtualization of network functions, commonly called VNF is a software-based technique to enable different function. The NS technique is mostly suitable for computing-distributed environments. Two different approaches are the random-access network function called as RAN and the core network function called as CN, which are used for fast network function deployment. Here, different algorithms are used for finding optimal solution with less complexity and time.

Index Terms - Network-slice, Core Network (CN), Software-Define-Network (SDN), Network-Function-Virtualization (NFV), Genetic Algorithm, Random Access Network (RAN)

I. INTRODUCTION The extensive increase in use of gadgets causes a surge in mobile traffic across the global network. Due to increase in demand and a higher bandwidth requirement, A fifth-generation network is implemented. 5G provides better network connections and services. 5G technology also provides better flexibility and scalability. Software-defined network (SDN) and network function virtualization (NFV) are the main apparatuses of the 5G cellular network, which can solve network issues with changing physical infrastructure.[1]. Network slice helps divide the network for each use case, such as ultra-reliable low latency (called as URLL), enhanced mobile broadband (eMBB), IoT, etc. Network slicing enhances performance through optimal utilization of resources. With the increase in the number of devices, the services are characterized based on the cost plane and user plane. Here, performance depends on bandwidth, number of users, data rates, reliability, throughput, and latency [2] [1]. Similarly, network functionalities depend on radio resource management, security, isolation, mobility, etc. Network build-on software is used in SDN technology, and virtualization is used in NFV technology.

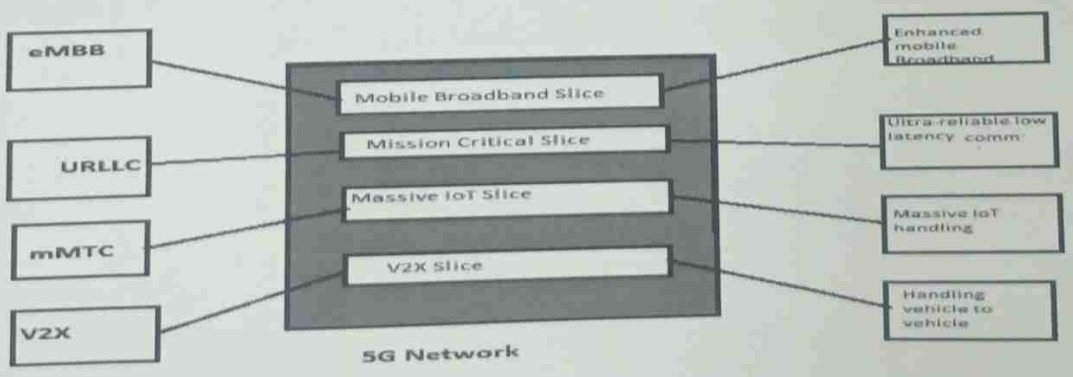

fig. 1: 5G network slicing architecture [4]

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Design of 256-bit Data Security Unit with the Analysis of Security Attacks

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ABSTRACT: The paper aims to provide a security solution for 256-bits digital data using Cryptography and Steganography techniques during its transmission over the digital network with data integraty test and the analysis of active & passive attacks. The Cryptography technique has been implemented using a newly developed data security algorithm having various operations on the data and the keys and the Steganography technique has been implemented using data cover technique. In order to check the integrity of the data, the data integrity check has been done so as to ensure that the data has not been modified by the attacker during its transmission. The proposed algorithm is found to be resistant towards various types of attacks such as Brute-force attack, timing attack, pattern attack etc. The maximum combinational path delay of proposed project is 14.426ns.

KEYWORDS: Cryptography; Steganography; Combinational Path Delay; Brute-force attack

I. INTRODUCTION

In order to maintain the privacy of the data, different researches are carried out so as to avoid the hacking of the information / data. The privacy can be achieved by using data security techniques. The technique may be A Cryptography Technique or Steganography Technique or the combination of both the techniques. The Cryptography technique uses the concept of encryption process to achieve data security and the the Steganography technique uses the concept of data cover / imge cover / audio cover / video cover to achieve the privacy of the information. In the Proposed algorithm, the data cover has been used to provide privacy to the 256-bits data. In the encryption algorithm, four keys are used to achieve the data security.

II. PROPOSED ALGORITHM

The algorithm used in the proposed work is given as follows:

Step 1: The 256-bits data and four keys having key sizes of 256, 512, 512, 256-bit are given to the 1st block of Cryptography unit which produces 256-bits coded data and the output of the 1st block with eight keys each having 64-bit are given to the input of the 2nd block of Cryptography unit which produces the 256-bit middle encrypted data.

Step 2: The output of the 2nd block of the Cryptography unit and the 256-bits covering data is given to the Steganography unit which produces 512-bits final encrypted data.

Step 3: The reverse operations are performed on the middle encrypted data, final encrypted data and the keys so as to produce the 256-bit data which is the exact repica of the 256-bit original input data.

Step 4: The data integrity test has been done in order to check the integrity of the data (i.e. change in the data (if any)).

Step 5: The analysis of the active and passive attacks has been done with respect to the proposed data security algorithm.

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Performance Evaluation of MIMO-OFDM-FSO with Modified Receiver

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Static stability analysis of tapered Timoshenko sandwich beam resting on Pasternak foundation with thermal gradient

Niraj Singh, Madhusmita Pradhan, Pusparaj Dash, Dipesh K. Nayak

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Abstract

The static stability investigation of a Timoshenko sandwich beam with varying thickness and supported on a Pasternak foundation with varying spring stiffness with axial loading at the ends is performed considering thermal gradient. The complete mathematical modelling of the non-uniform Timoshenko sandwich beam is expressed with the help of energy principle given by Hamilton. The static stability analysis of the system is analysed for pinned-pinned (P-P) boundary condition. The plots presenting the static stability of the Timoshenko sandwich beam are achieved and analysed for various values of system and geometric parameters using MATLAB and are illustrated over a series of figures. The system static stability is improved due to shear parameter, the ratio of shear layer thickness to beam length and the ratio of modulus of rigidity of supporting shear layer and modulus of elasticity of top layer. An increment in the taper parameter and thermal gradient parameter degrades the static stability.

Keywords

Timoshenko sandwich beam; Variable Pasternak foundation; Taper parameter; Static stability

1. Introduction

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Mechanochemical synthesis of $CaTiO_3$ powders: Microstructure and surface morphology

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ABSTRACT

Calcium titanate (CT) is a material that is similar to hydroxyapatite in biological properties. In this report, CT powders was prepared by using high energy planetary ball mill and to determine their phases distribution, microstructure and surface morphology as an effect of milling duration was characterized by XRD, SEM, and BET analysis. As results, XRD, SEM and BET analysis indicate that all the peaks were the $CaTiO_3$ powders in regular shape and uniformly distributed size of 2 μm in 32 h. Finally, it can be concluded that with increasing the milling time has significantly influenced and reduced $CaTiO_3$ crystalline powders after calcinations.

Selection and Peer-review under responsibility of the scientific committee of the Global Conference on Recent Advances in Sustainable Materials 2021

1. Introduction

Calcium titanate ($CaTiO_3$) is a family of Perovskite which was discovered in the Ural Mountains of Russia by Gustav Rose in 1839 and named after Russian mineralogist, L. A. Perovski (1792–1856). $CaTiO_3$ is a parent compound of the perovskite family and is used to immobilize nuclear waste [1,2]. This compound is widely used in electronic ceramic materials. Over the past decade, there has been some interest in the structural transformations of $CaTiO_3$ [3–6]. The perovskites have attracted considerable attention because of their technological applications, often associated with the phase transition, and their importance in the earth science [7]. In the recent years, $CaTiO_3$ has been proven to have better biocompatibility [8], increased osteoblast cell adhesion [9] and enhanced osteointegration [10] as compared to hydroxyapatite. In order to understand better biological and functional applications, an understanding of structural and physical properties with a cost effective process of $CaTiO_3$ is unimportant.

Recently, calcium titanate was introduced as a biomaterial that is similar to hydroxyapatite (HA) in biological properties. Several special methods are known for the synthesis of $CaTiO_3$ nanomaterials such as sol–gel [11], precipitation [12], polymeric precursor [13], organic–inorganic solution [14], and combustion [11] etc. $CaTiO_3$ is one of the materials that were initially synthesized via the mechanochemical route from the varying mixture of $CaCO_3$, CaO and TiO_2. The mechanochemical synthesis process is carried out in planetary mills at different milling condition such ball to weight ratio, milling time and milling speed. The size reduction process and the microstructural evolution of the $CaTiO_3$ during milling process is mainly influenced by the type of impulsive stress applied by the grinding media and other parameters such as atmosphere composition and the presence of different liquid media inside the grinding mill. The major drawbacks of this process are contamination and energy consumption. However, the study on mechanochemical effect on fine particles has created much interest among researchers because of its several advantages to downstream processes like reducing the annealing and sintering temperature, reducing the phase transformation temperature, decreasing the thermal decomposition temperature, and increasing the particle reactivity [5,7,8].

The main purpose of this report is to understand the influence of milling conditions on the mechanochemical synthesis of CaTiO powders and their microstructure and surface morphology usin BET analysis, XRD and SEM analysis.

2. Experimental procedure

2.1. Materials and methods

The starting materials from different precursors such as, C (98% purity, Nice) and rutile TiO_2 (98% purity, Nice) was mixed

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Evolutionary Intelligence
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RESEARCH PAPER

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

Manoj Kumar Muni[1] · Pragyan Kumar Pradhan[1] · Prasant Ranjan Dhal[1] · Saroj Kumar[2] · Rabinarayan Sethi[1] · Sanjay Kumar Patra[3]

Received: 11 May 2022 / Accepted: 31 December 2022

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 humanoids. 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 negotiate 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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Anomaly detection in rotating machinery using autoencoders based on bidirectional LSTM and GRU neural networks

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Abstract: A time series anomaly is a form of anomalous subsequence that indicates future faults will occur. The development of novel techniques for detecting this type of anomaly is significant for real-time system monitoring. Several algorithms have been used to classify anomalies successfully. However, the time series anomaly detection algorithm was not studied well. We use a new bidirectional LSTM and GRU neural networks-based hybrid autoencoder to detect if a machine is operating normally in this research. An autoencoder is trained on a set of 12 features taken from healthy operating data gathered promptly after a planned maintenance period using vibration sensors. The features taken from new data are then reconstructed using the trained model. If the model accurately reconstructs the features, the machine is in good working order. If the reconstruction exceeds a certain error threshold, the machine is functioning strangely and needs to be serviced.

Key words: Autoencoders, anomaly detection, deep learning, predictive maintenance

1. Introduction

Anomaly detection in time series is a critical subject in the fields of computer science and data mining [1–4]. It was widely used in a variety of practical uses, including signal processing, pattern identification [5], mathematical finance, forecasting the weather [6], and control engineering [7]. It has become a requirement in the industrial sector, as faults that go undetected can result in a catastrophic tragedy [8]. Industrial systems are subjected to a great deal of stress daily and are failure-prone, thus detection of anomalies can help to improve system availability and performance. This has a direct impact on productivity and lowers operating and maintenance expenses [9]. As a result, several studies in this field may be found in a variety of industries, including automotive [10], manufacturing [11], energy [12], Sensing networks in the industry [13], or even medicine, which uses a variety of pictures [14].

A time-series anomaly is described as an out of the ordinary pattern that deviates from predicted behaviour. There have been three types of categories of time series anomalies: a single point, a context, and a group [3]. Individual samples that exceed the usual range are referred to as point anomalies and can be discovered using an ultralimit alert. When the sequences' context shifts, contextual anomalies develop, which is always tightly tied to the temporal element. Multiple occurrences of data may constitute an anomaly as a sequential sequence, however, the individuals in this series may be irrelevant. As a result, it is difficult for models in detecting anomalies to efficiently capture distinct properties of several abnormalities in a time series.

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Intelligent Systems pp 621–629

Optimization of Operating Parameters for Improve the Combustion in Single Cylinder Four Stroke DICI VCR Engine Using Grey Relation Analysis

Krushnashree Sushree Sangita Sahoo, Anand Gupta & Amritam Mohapatra

Conference paper | First Online: 04 May 2022

Part of the Lecture Notes in Networks and Systems book series (LNNS,volume 431)

Abstract

This paper aims to present a novel method for the optimization of operating parameters of a four stroke variable compression ratio direct injection compression ignition engine with multi objective-based orthogonal design with grey relation analysis. Testing is conducted on the test engine. Combustion testes are carried out on the test engine using pure commercial diesel fuel under atmospheric conditions. In the present work, operating parameters such as compression ratio,

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Mechanochemical synthesis of $CaTiO_3$ powders: Microstructure and surface morphology

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Abstract

Calcium titanate (CT) is a material that is similar to hydroxyapatite in biological properties. In this report, CT powders was prepared by using high energy planetary ball mill and to determine their phases distribution, microstructure and surface morphology as an effect of milling duration was characterized by XRD, SEM, and BET analysis. As results, XRD, SEM and BET analysis indicate that all the peaks were the $CaTiO_3$ powders in regular shape and uniformly distributed size of 2 μm in 32 h. Finally, it can be concluded that with increasing the milling time has significantly influenced and reduced $CaTiO_3$ crystalline powders after calcinations.

Previous

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Keywords

Mechanochemical synthesis; $CaTiO_3$; Thermal analysis; Microstructure; Morphology

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Research Article

Optimization of process parameter in AI7075 turning using grey relational, desirability function and metaheuristics

Dillip Kumar Mohanta ✉, Bidyadhar Sahoo & Ardhendu Mouli Mohanty

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ABSTRACT

Even though metal may be effectively shaped by a variety of other manufacturing techniques, machining continues to play a significant role in industries. Turning is a conventional chip-forming operation that removes undesirable or surplus material from a cylindrical workpiece. The major objective of process optimization in turning operation research is focusing on the development of statistical modeling and optimization techniques for boosting production rate, lowering costs, and reducing product rejection. The current work aims to improve the CNC turning process of Al

7075 using coated carbide inserts. This investigation uses grey relational analysis, desirability function analysis, Multi-objective Genetic Algorithm (MOGA) and Multi-

ORIGINAL RESEARCH ARTICLE

Tailoring the Processing Route to Optimize the Strength–Toughness Combination of Pearlitic Steel

SWARNALATA BEHERA, RAKESH KUMAR BARIK, SK.MD. HASAN, RAHUL MITRA, and DEBALAY CHAKRABARTI

The present study fine tunes the processing route of a eutectoid steel to shape an optimum strength–toughness combination through appropriate microstructural design. A fully lamellar coarse pearlite microstructure leads to poor strength and toughness. Hot deformation prior to the isothermal treatment breaks down the lamellar pearlite to a spheroidized structure. Moreover, reducing the hot deformation temperature not only refines the pearlite nodule size but also increases the spheroidized pearlite fraction, which thereby improves the toughness of the steel. However, no proportionate increase in yield strength was obtained due to insignificant change in the interlamellar spacing. Remarkable refinement in lamellar spacing and increase in the spheroidization amount was ensured when the hot deformation was carried out just below the eutectoid temperature, owing to the strain-induced pearlite transformation. The presence of a mixed microstructure of fine lamellar pearlite along with spheroidized pearlite constituents simultaneously improves both the yield strength and toughness of the steel. Optimum strength–toughness combination was attained when the hot deformation strain (just below the eutectoid temperature) was increased up to 45 pct. Subsequent increase in strain creates deformation bands and traces of strain-induced bainite in the microstructure, which again deteriorates the tensile elongation of the steel.

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I. INTRODUCTION

SIMULTANEOUS improvement of strength and toughness through the concept of effective grain refinement is the most convenient route for escalating the performance of low-to-medium carbon steels containing ferrite, ferrite + pearlite, martensite, or bainite microstructures.[1–6] In those steels, the boundaries separating the adjacent grains act as obstacles to dislocation motion (determining strength) as well as to the cleavage crack propagation (deciding toughness). In other words, the same microstructural unit can control both the strength and the toughness. However, in case of high carbon steels with lamellar pearlite as the major phase constituent, there is no such unique microstructural parameter that governs both the strength and toughness simultaneously. For instance, the hard and brittle cementite lamellae in the pearlite act as obstacles to dislocation slip,[7–10] but these are ineffective for restricting the crack growth.[11] Therefore, refinement of the interlamellar spacing between the cementite lamellae can unambiguously improve the strength, but it cannot guarantee any proportionate increment in toughness. The toughness of the pearlitic steels is believed to be improved by refining the size of pearlite nodules, and more significantly by spheroidizing the lamellar structure of pearlite.[12–15] Moreover, the steels with fully spheroidized pearlite are reported to possess a very high ductility, but it is achieved at the expense of loss in tensile strength.[15,16] In addition, spheroidized pearlite also suffers from poor work hardenability due to its high yield strength (YS)-to-ultimate tensile strength (UTS) ratio in excess of 0.85 (as reviewed by Zheng *et al.*[17]). It is therefore desirable to fine tune a mixed microstructure of lamellar and spheroidized pearlite to get an optimum level of high strength and high toughness without impairing the work hardenability much.

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Article

Development of Improved Flexural and Impact Performance of Kevlar/Carbon/Glass Fibers Reinforced Polymer Hybrid Composites

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Abstract: The present investigation focuses on developing cost-effective Carbon/Glass/Kevlar fiber-reinforced polymer hybrid composite laminates for achieving its synergistic effect on flexural and impact performance. It investigates the effect of stacking sequence induced by the use of different fiber types (Kevlar = K, glass = G, and carbon = C) on the flexural and impact performance of the composites. Five hybrid composites (labelled as A = [$G_2K_3G_2$], B = [KG_2CG_2K], C = [CKGCGKC], D = [CGKCKGC], E = [CK_2CK_2C]) and three plain (i.e., non-hybrid) composites (F = $[K]_7$, G = $[G]_7$, H = $[C]_7$) have been fabricated through manual pre-preg lay-up manufacturing techniques. The flexural strength and modulus, hardness, and Izod impact strength have been evaluated for the fabricated composites and compared. The results showed that the D-type hybrid composite achieves the maximum positive hybrid effect as compared to other hybrid composites, possesses a hardness of 59 BHN, a flexural strength of 380 MPa, and modulus of 36 GPa, and impact strength of 80 KJ/m^2. The fracture surfaces of the hybrid composite specimen have been analysed using scanning electron microscopy, and compared against the properties achieved for enabling correlations. Furthermore, the cost-efficiency of the hybridization in terms of flexural strength/cost, modulus/cost, and impact strength/cost ratio were evaluated for potential engineering and design applications.

Keywords: carbon/glass/kevlar hybrid composites; flexural; Izod impact; FRP laminates; stacking sequence

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1. Introduction

Industries such as railway, automotive, aerospace, space, and windmill require lightweight materials, which are satisfied by fiber-reinforced polymer composites due to their high strength-to-weight ratio, good fatigue life, and corrosion resistance compared to traditional engineering metallic materials. Carbon fiber-reinforced polymer composites possesses high strength to weight ratio. It satisfies the requirement in structural engineering components in ships, aircraft, and sports where other engineering materials cannot be replaced [1,2]. However, due to high material and manufacturing costs, it restricts essentially for common engineering materials in automotive and railway applications. Nevertheless, the carbon fibers are inherently brittle, and a minor impact load can cause severe damage to the structure of the composites [3–5]. Different researchers have adopted various strategies to overcome the weakness of carbon fiber in structural applications. One of the methods is toughening the thermosetting matrix by mixing different organic (carbon nanotubes) and inorganic nanofillers (Al_2O_3, SiO_2, and TiO_2) [6]. The other method is to do hybridization with ductile fibers such as woven glass fibers [7]. Woven Kevlar fibers can also improve the fracture toughness of the hybrid composites [8]. Therefore, the hybridization of ductile fibers with high-strength carbon fibers may achieve the desired mechanical properties for

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An advanced mean field dislocation density reliant physical model to predict the creep deformation of 304HCu austenitic stainless steel

Pankhuri Mehrotra [a], Nilesh Kumar [a], Alphy George [b], Kanhu Charan Sahoo [b], Vaidyanathan Ganesan [b], Mohammad Reza Ahmadi [c], Shivam Trivedi [a], Surya D. Yadav [a]

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Highlights

- A new physical based model to address the creep deformation of 304HCu SS.
- Internal variables: mobile and forest dislocation densities, and mean free path.
- Theoretical creep curves are validated with experimental curves.
- The evolution of dislocation densities, dislocation mobility, velocity of dislocations, internal stress, effective stress and damage parameters is tracked and discussed all together thoroughly.

Abstract

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1059-9495/$19.00

TECHNICAL ARTICLE

Multiaxial Creep Deformation and Influence of Different Precipitates on Creep Cavitation Failure of 304HCu SS

Kanhu Charan Sahoo, Parameswaran Padmanabhan, and Kinkar Laha

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Influences of multiaxial creep deformation and rupture behavior on 304HCu austenitic stainless steel have been investigated on carrying out creep rupture test on both smooth and notch specimens at 1023 K over a wide range of stress (100-200 MPa). Creep rupture strength exhibited an increasing trend with increase in notch sharpness (that is, notch strengthening effect) leading to a saturation and was associated with decrease in ductility. At relatively lower stresses, material possesses propensity to notch weakening which prevails for relatively sharper notches. Fractographic studies revealed that proportion of transgranular ductile dimple to intergranular creep cavitation is more pronounced for relatively shallow notches and at lower test temperature. With increase in test temperature and for sharper notches, the proportion of intergranular creep cavitation to transgranular ductile dimple becomes more prevalent. The influence of notch on creep rupture life and fracture behavior has been analyzed through different component of stationary state of stress distribution estimated by Finite Element Analysis (FEA). In addition to the different state of stress, the presence of different sub-microscopic precipitates ($M_{23}C_6$, NbC and Cu) also is found to play a vital role in creep deformation and fracture behavior. FEA of state of stress and strain across the precipitates have been assessed to estimate the influence of the precipitation on creep cavity nucleation at 923, 973 and 1023 K. The creep rupture life and ductility of the material having different notches have been predicted using different models of representative stress at the skeletal point. Further, a modified model has been proposed for the prediction of multiaxial ductility for any temperature which is found suitable for other steels as well.

Keywords AISI 304HCu SS, creep damage, creep life prediction, FE-analysis of strain distribution, modified ductility model, multiaxial creep, SEM characterization

1. Introduction

As per the recent announcement of Ministry of Science and Technology, India, Advanced Ultra Super Critical (AUSC) power plant has to be established in the upcoming years for better utilization of fuel to increase the efficiency thus reducing the CO_2 emission and decrease in fuel consumption (Ref 1). The efficiency can be improved on increasing working temperature, calling for higher temperature materials with better high temperature creep and corrosion/oxidation resistances (Ref 2). Austenitic stainless steels have better creep rupture strength than the ferritic steels and are preferred for the thin wall boiler tubes at higher application temperatures (Ref 3, 4). The conventional 18Cr-8Ni stainless steels have been modified with the additions of 3 wt.% Cu, niobium, nitrogen and traces of boron to enhance creep rupture strength and the steel is named as 304HCu SS (Ref 5). While Cu precipitates as nano-sized particles (due to low solubility in the austenite matrix), niobium combining with nitrogen and carbon forms Nb(C, N) sub-microscopic particles. Presence of these precipitates homogeneously throughout the matrix along with little addition of boron controls the nucleation of creep cavities during the creep process, thus improving the creep strength at higher temperatures (Ref 5, 6). The steel is specifically used in the super heater and reheater of the boiler over a temperature range of 873-948 K at about 30 MPa internal pressure (Ref 7).

In general, creep test is carried out on smooth specimen of material under uniaxial stress. However, there is a necessity to understand the creep behavior under multiaxial state of stress arises due to internal pressure in tube and the presence of weld joint, notch, hole and microstructural change in the specimen (Ref 8). The presence of these inhomogeneities not only affects the creep deformation but also the fracture behavior of the material (Ref 9). The 304HCu steel has been proposed to use in AUSC boiler tubes where such kind of problem is expected to arise (Ref 10). To understand the creep deformation behavior and rupture life of such component, it is necessary to conduct multiaxial creep test. In laboratory scale, multiaxial creep deformation and rupture studies are carried out on specimen having U-notches of different root radius under constant tensile load (Ref 11). Generally U-notches are preferred over V-notches as U-notches carry more volume of material below the notch to facilitate the study of creep cavitation (Ref 8, 11, 12).

The material's deformation characteristics as well as the notch profile and applied stress determine the notch strengthening or weakening effect (Ref 12). The state of stress developed across the notch will vary for different materials

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ORIGINAL RESEARCH ARTICLE

The Defining Role of Micro-fissures on the Mechanical Behavior of Laser-Welded Fully Austenitic Stainless Steel

ARNAB SARKAR, SOUDIP BASU, AMULYA BIHARI PATTNAIK, BALILA NAGAMANI JAYA, SHYAMPRASAD KARAGADDE, INDRADEV SAMAJDAR, HEMANT KUMAR, RAVI KUMAR, R. MYTHILI, CHANCHAL GHOSH, ARUP DASGUPTA, and SHAJU ALBERT

Laser-welded fully austenitic stainless steel (AISI 316LN) weldments revealed the presence of micro-fissures. They appeared at the grain boundaries, near the center of the welds. The grain boundaries, however, did not contain second phase or micro-segregation. The relative presence of micro-fissures decreased with increasing weld heat input. Spatial locations of the micro-fissures and their relative presence were associated with local misorientations and, in particular, with grain reference orientation deviation. Microstructural and microtextural studies indicated that solidification shrinkage was the origin of the micro-fissures in the laser welds. The use of sub-size tensile specimens (of 5- and 1-mm gauge length) with digital image correlation (DIC) related the presence of micro-fissures with mechanical property degradation by the appearance of strain localizations. This was further confirmed by analytical solutions and finite element analysis of critical flaw size and critical stress for fracture.

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I. INTRODUCTION

AUSTENITIC stainless steels, especially AISI316 and AISI304 grades, find wide applications as engineering and structural materials. Their fabrication often involves welding. Though austenitic stainless steel can be successfully welded, welding defects, especially solidification cracking, often provide serious impediment to the performance.[1,2] The nature and origin of solidification cracking has naturally captured extensive applied and scientific interests. Lundin *et al.*,[3] for example, reported potential for fissuring in the heat-affected zone (HAZ) of below 1 pct ferrite containing austenitic stainless steel fusion welds. This was attributed to the presence of low melting point compounds of Sulfur (S), Silicon (Si), Titanium (Ti), and Phosphorus (P) along the grain boundaries.[3–6] As shown by Yu *et al.*,[7] even in laser metal deposition which minimized HAZ, such compounds might form low melting phase(s) along the grain boundaries of the weldments. If the content of the detrimental elements (such as S, P, and Si) were kept low, hot cracking was not observed[7] even in the austenitic mode of solidification. The excellent review by Brooks and Thompson[8] showed the presence of centerline, transverse, and micro cracks in the welds of austenitic stainless steel. They attributed such intergranular cracks to the presence of low melting point grain boundary phases, and associated thermal and shrinkage stresses arising from the weld cooling.

The transverse and longitudinal shrinkage stresses, in laser welding, are generally believed to reduce when the weld mode changes from conduction to the keyhole mode.[9,10] This is characterized by considerable evaporation of the liquid melt.[11–13] The keyhole dynamics are primarily controlled by various parameters such as welding speed, heat input, recoil pressure, Marangoni shear stress, surface tension, *etc.*.[10,12] The significantly larger cooling rates and thermal gradients, compounded by the pulsing effects, are known to introduce much larger columnar grains, which are also prone to develop misorientations.[14] However, the instability of the weld pool, through keyhole oscillation and higher laser

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foundations

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Article

Big Rip Scenario in Brans-Dicke Theory

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Abstract: In this work, we present a Big Rip scenario within the framework of the generalized Brans-Dicke (GBD) theory. In the GBD theory, we consider an evolving BD parameter along with a self-interacting potential. An anisotropic background is considered to have a more general view of the cosmic expansion. The GBD theory with a cosmological constant is presented as an effective cosmic fluid within general relativity which favours a phantom field dominated phase. The model parameters are constrained so that the model provides reasonable estimates of the Hubble parameter and other recent observational aspects at the present epoch. The dynamical aspects of the BD parameter and the BD scalar field have been analysed. It is found that the present model witnesses a finite time doomsday at a time of $t_{BR} \simeq 16.14$ Gyr, and for this scenario, the model requires a large negative value of the Brans-Dicke parameter.

Keywords: cosmological constant; generalised Brans-Dicke theory; Big Rip

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1. Introduction

Late-time cosmic acceleration is one of the most bizarre and unsolved problems in modern cosmology. In scalar field cosmological models, the late-time cosmic acceleration issue is predominantly attributed to an exotic dark energy (DE) form that corresponds to a cosmic fluid having low energy density, as well as negative pressure. This is usually understood through a quantity dubbed as the equation of state (EoS) parameter $\omega_D = \frac{p}{\rho}$, where p represents the DE pressure and ρ symbolises the dark energy density. The dark energy with a negative pressure corresponds to a negative EoS parameter. Despite several attempts made by astronomers and cosmologists, the experimental determination of ω_D remains challenging. Its precise estimation at the present epoch along with the knowledge of its development over a long period may unravel the mystery of the dark energy whose nature and origin remains speculative so far. In the ΛCDM model, the cosmological constant Λ with $\omega_D = 1$ plays the role of dark energy. However, in canonical scalar field models, quintessence fields or phantom fields shoulder the burden for the late-time cosmic speed-up, while the EoS parameter for the quintessence field lies in the range $-\frac{2}{3} \leq \omega_D \leq -\frac{1}{3}$ [1–3], which for the phantom fields, becomes $\omega_D < -1$ [4]. However, the EoS parameter as constrained from recent observational data favours a phantom phase in the Universe with $\omega_D < -1$ [5], while constraints from the CMB data in the nine-year WMAP survey suggest that $\omega_D = -1.073^{+0.090}_{-0.089}$ [6], a combination of the CMB data with Supernova data, predicts $\omega_D = -1.084 \pm 0.063$ [7]. Other constraints on the EoS parameter include $\omega_D = -1.035^{+0.055}_{-0.059}$ from Supernova cosmology project [8], $\omega_D = -1.03 \pm 0.03$ from recent Planck 2018 results [9] and from Pantheon data $\omega_D = -1.006 \pm 0.04$ [10].

Superconductivity is a phenomenon in certain materials at extremely low temperatures, characterized by exactly zero electrical resistance. It is an important field in the low temperature physics. Study of anisotropy plays an important role for different superconducting materials. In view of this, Ginzburg-Landau (GL) theory is an important tool for understanding the high temperature superconductors.

In this book an attempt has been made to study the anisotropy arising in copper dopped titanium diselenide superconductor through Phenomenological GL-theory.

Anup Pattanaik
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Specific heat anisotropy in $CuTiSe_2$ superconductor

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Specific heat anisotropy in $CuTiSe_2$ superconductor

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Bouncing Cosmology in Modified Gravity with Higher-Order Gauss–Bonnet Curvature Term

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Abstract: In this paper, we studied the bouncing behavior of the cosmological models formulated in the background of the Hubble function in the $F(R, \mathcal{G})$ theory of gravity, where R and $\mathcal{G}$, respectively, denote the Ricci scalar and Gauss–Bonnet invariant. The actions of the bouncing cosmology are studied with a consideration of the different viable models that can resolve the difficulty of singularity in standard Big Bang cosmology. Both models show bouncing behavior and satisfy the bouncing cosmological properties. Models based on dynamical, deceleration, and energy conditions indicate the accelerating behavior at the late evolution time. The phantom at the bounce epoch is analogous to quintessence behavior. Finally, we formulate the perturbed evolution equations and investigate the stability of the two bouncing solutions.

Keywords: $F(R, \mathcal{G})$ gravity; bouncing cosmology; energy conditions; stability analysis

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1. Introduction

In recent astrophysics and cosmology research, instances of late-time cosmic acceleration supposedly witnessed by cosmological observations have compelled theoretical cosmologists and astrophysicists to think beyond general relativity (GR) . Cosmological observations such as those of high redshift supernovae [1], supernovae of type Ia [2,3], cosmic microwave background radiations (CMBRs) [4,5], baryon acoustic oscillations [6], and Planck collaboration [7] are sufficiently indicative of the accelerated expansion of the universe. Furthermore, the cause has been speculated to be the presence of some exotic dark energy (DE). The negative pressure indicates the violation of strong energy conditions as well as a limitation in GR. Accordingly, in the field equations of GR, the modification is thought to be in the geometrical part or matter part. The matter can be modified by replacing the dynamical parameters with the DE parameters that lead to the DE models. The modification in the geometrical part can be performed by including additional terms, known as geometrically extended gravity models. Some recent geometrical extended gravities are $F(R)$ gravity [8–10], $F(R, T)$ gravity [11], $F(\mathcal{T})$ gravity [12,13], $F(Q, T)$ gravity [14], etc. Another such extension is made by including the Gauss–Bonnet invariant, known as the $F(R, \mathcal{G})$ gravity [15]. The next section discusses $F(R, \mathcal{G})$ gravity in detail.

The standard model or Big Bang cosmology has been widely accepted as a cosmological model and has successfully defended many intriguing universe problems. However, regarding the issue of late-time cosmic acceleration, GR has difficulties in resolving some early universe issues such as an initial singularity, flatness, and cosmic horizon. The inflationary scenario could resolve the flatness and horizon issues, but not that of initial singularity. To date, the beginning of the universe before inflation is not known. This is because of the attractor nature of inflation. When the inflation started, the information on the initial singularity was lost as the initial spatial curvature was stretched away by the

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Observationally constrained accelerating cosmological model with higher power of non-metricity and squared trace

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ABSTRACT

In this paper, a cosmological model of the Universe is presented in $f(Q,T)$ gravity and the parameters are constrained by cosmological data sets. Initially, a generalised form of $f(Q,T)$ model is used as $f(Q,T) = -\lambda_1 Q^m - \lambda_2 T^2$, where λ_1, λ_2 and m are model parameters. With some algebraic manipulation, the Hubble parameter is obtained in terms of redshift. Then, using MCMC analysis, the model parameters are constrained using the most current Hubble and $Pantheon^{+}$ data. The model parameters are also verified through the BAO data set. The model shows an early deceleration transitioning to an accelerating phase of the Universe. The $Om(z)$ diagnostic indicates a positive slope, favouring the model to be in a phantom field dominated phase.

1. Introduction

The late time acceleration (Riess et al., 1998; Perlmutter et al., 1999; Tegmark et al., 2004; Abazajian et al., 2004; Spergel et al., 2003; Parkinson et al., 2012) is one of the most significant accomplishment in recent research on cosmology and gravitational physics. This finding compels to go outside the frame to explain the repulsive nature of gravity on large cosmic scales. It is not known regarding the source of creation of the repulsive gravity, however the reason might be the presence of dark energy. The presence of dark energy, a non-standard component of the Universe with negative pressure, or a large-scale infra-red modification of General Relativity (GR). Dark energy has major share in the mass-energy budget of the Universe and remains sub-dominant in prior epochs resulting difficulty in model building. The current dynamics of the Universe show the acceleration due to the dark energy component and the cosmological constant (Λ) may be the simplest candidate. This has been originated from early vacuum quantum fluctuations. At late time of the cosmic dynamics, the concordance flat ΛCDM paradigm has become most successful in explaining the observed phenomena. The equation of state (EoS) parameter of dark energy mediated through the cosmological constant enables to distinguish different phases of the cosmological models ($\omega_{DE} \approx -1$). The other two ideas are the quintessence and phantom field dominated phases, which can be respectively identified as, $-1 \leq \omega_{DE} < 0$ and $\omega_{DE} \leq -1$. However, the recent surveys ruled out the possibility of $\omega_{DE} \approx -1$, although ω_{DE} could be a bit less than -1 (Riess et al., 2004; Eisentein et al., 2005; Astier et al., 2006). Several corrections are suggested to ω_{DE}: CMB observations was limited to $\omega_{DE} = -1.073^{+0.0900}_{-0.089}$ by the 9-year WMAP survey (Hinshaw et al., 2013), $\omega_{DE} = -1.0840 \pm 0.063$ is suggested by a combination of CMB and Supernova data (Hinshaw et al., 2013). Kumar and Xu constrained it to $\omega_{DE} = -1.06^{+0.110}_{-0.13}$ based on a combined examination of the data sets of SNLS3, BAO, Planck, WMAP9, and WiggleZ (Kumar and Xu, 2014). Combining Planck data with additional astronomical data, including Type Ia supernovae, Ade et al. (2016) suggested $\omega_{DE} = -1.006 \pm 0.045$.

We shall discuss here some of the recent findings of the cosmological models with the observational data sets. Wei and Zhang (2007a) have used the $H(z)$ data set to capture the key aspects of ten cosmological models; six of them failed to sustain with the observational data sets, however the remaining four were compatible with the data sets. Further it has been extended to eleven interacting dark energy models with varying couplings to the observable $H(z)$ data (Wei and Zhang, 2007b). However, none of these models outperforms the simplest ΛCDM model. Seikel et al. (2012) have studied novel consistency tests for the ΛCDM model and the parameters are expressed explicitly in terms of $H(z)$. Magana et al. (2014) have investigated five different dark energy models with variable equations of state as a function of redshift.

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Rip behaviour in Brans–Dicke theory

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ABSTRACT

In this work, we present little rip and pseudo rip scenarios in the framework of the generalised Brans–Dicke (GBD) theory where an evolving BD parameter along with a self-interacting potential is considered. The GBD field equations are derived for an anisotropic space time to provide a more general approach to the cosmic expansion. The evolutionary behaviour of the Brans–Dicke (BD) scalar field, dynamical Brans–Dicke parameter and the self interacting potential are studied. It is not possible to separate out the dynamical Brans–Dicke parameter into distinct evolving and non-evolving part for the rip scenarios as is obtained for constant deceleration parameter. While the little rip behaviour requires a positive value for the GBD parameter, a small negative value around -1.33 favours a pseudo rip behaviour.

1. Introduction

The observation of late time cosmic acceleration compels to think of a non-standard cosmic fluid with negative pressure. An obvious incorporation of such exotic fluid into the field equations may cause a situation where the Universe enters into the quintessence or phantom phase in future [1]. The phantom phase dominated Universe requires the null energy condition and the strong energy condition to be violated. It may so happen that, the scenario leads to a kind of singularity in the Universe occurring at a finite time. A serious singularity situation is the Big Rip singularity where the curvature of the space time blows up at finite time along with the divergence of the scale factor and the energy density. Different singularities may occur depending upon the model and equation of state. Notable among them are the Big Rip singularity and the Sudden singularity [2]. Besides them two other singularities occur where either the density and pressure blow up for a finite scale factor or the onset of a situation involving the diverging behaviour of the Hubble parameter. The singularity occurring in the models dissolves the whole bound cosmic system within a finite time. The finite time future singularity leads to inconsistency [3–6] and has become the subject of major research concern. In order to avoid such situation, ad hoc and intermediate mechanisms such as the little rip and the pseudo rip scenarios have been developed [4,5]. In the little rip scenario, there occurs a monotonic increase of the energy density with the cosmic expansion which diverges while being pushed into a distant infinite future. On the other hand, the pseudo rip occurs as an intermediate situation in between the Big Rip and the little rip. Other possible mechanisms to delay the ripping behaviour include the dark energy–dark matter coupling and a possible gravity modification [5,7].

The concern of the ultimate fate of the Universe led to wide investigation of the rip cosmological models in different gravity theories such as in GR [8,9], in f(R) gravity [10], $f(T)$ gravity [11], extended gravity theory [6], extended symmetric teleparallel gravity [12] and in BD theory [13]. In the usual BD theory proposed initially, the BD parameter appears as a constant and can be constrained from observations including solar tests. A lot of controversy arise regarding its constrained value which varies from a

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Evolution of Generalized Brans–Dicke Parameter within a Superbounce Scenario

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Abstract: We studied a superbounce scenario in a set up of the Brans–Dicke (BD) theory. The BD parameter was considered to be time-dependent and was assumed to evolve with the Brans–Dicke scalar field. In the superbounce scenario, the model bounced at an epoch corresponding to a Big Crunch provided the ekpyrotic phase continued until that time. Within the given superbounce scenario, we investigated the evolution of the BD parameter for different equations of state. We chose an axially symmetric metric that has an axial symmetry along the x-axis. The metric was assumed to incorporate an anisotropic expansion effect. The effect of asymmetric expansion and the anisotropic parameter on the evolving and non-evolving parts of the BD parameter was investigated.

Keywords: generalized Brans–Dicke theory; superbounce scenario; BD parameter

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1. Introduction

The standard cosmological model is quite successful in describing the evolution of the Universe at different phases of time. The standard cosmology provides useful information at the early evolutionary epochs in particular. However, it suffers from issues such as the flatness, horizon, and initial singularity problems. The inflationary model, described through a scalar field, solved some of these problems, including the flatness and cosmological horizon problems, and provided a causal theory of structure formation [1,2]. However, the long-standing issue of initial singularity remains unsolved.

In modern cosmology, there remains a fundamental question: whether our Universe had a beginning, perhaps in the form of an initial singularity leading to a breakdown of the space–time description, or whether the presently expanding phase of the Universe was preceded by a contraction phase. This may also be conceived of as the Universe undergoing phases of alternate contraction and expansion, suggesting a cyclic cosmology. The proposal of matter bounce scenarios came as a possible solution to the initial singularity issue [3–5]. Novello and Perez Bergliaffa emphasized the significance of a singularity-free Universe [6]. As possible alternatives to the standard cosmology, Battefeld et al. discussed some bouncing cosmological models [7]. The consequences of initial singularity issues and matter bounce scenarios as possible explanations were reviewed in [8,9]. Within the purview of scalar field cosmology, the Universe starts to contract with an increase in the kinetic energy of the scalar field. As it dominates, the Universe collapses, leading to a classical singular event. This situation may be avoided if an expansion occurs prior to the sudden collapse. This is what is assumed in a bouncing scenario, wherein the Universe undergoes a contraction phase primarily dominated by its matter content, followed by a non-singular bounce.

In a flat Universe, the cosmic matter content needs to violate the null energy condition (NEC) in order to experience a bouncing phase. In other words, the sum of pressure p

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Bouncing Cosmological Models in a Functional form of $F(R)$ Gravity

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Abstract—We investigate some bouncing cosmological models in an isotropic and homogeneous space-time with in $F(R)$ theory of gravity. Two functional forms of $F(R)$ have are studied with a bouncing scale factor. The dynamical parameters are derived and analyzed along with cosmographic parameters. A violation of sthe trong energy conditions in both bouncing models is also shown. We show that both models exhibit stable behavior with respect to cosmic time.

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1. INTRODUCTION

The initial singularity is an important issue that General Relativity (GR) has encountered among other issues during the early Universe. Friedmann [1, 2] claimed that the occurrence of an initial singularity was at the beginning of the evolution of Universe. It is believed that a singularity occurred before inflation, because the inflationary scenario resolved certain key issues of early Universe [3–5]. One possible solution might be that the Universe did not attained a singularity during contraction, but expanded after experiencing a bounce. This concept is known as the big bounce. Recent discoveries [6–12] have revealed that our Universe is undergoing a late-time accelerated expansion, which is explained by dark energy (DE), time-independent vacuum energy (according to the ΛCDM model). The cosmological constant [13], scalar fields (including quintessence, phantom, quintom, tachyon, and others) [14–19] and holographic models [20] are possibilities for describing DE scenarios. Modified gravity theories have advantages over other models since they avoid expensive numerical computations and are consistent with current data for a late phase accelerating Universe and DE. So models with such theories are designed to modify the standard nature of GR by replacing the Ricci scalar R in Einstein-Hilbert action with, e.g., $f(R)$. Several such modified theories of gravity have been developed, such as $f(R)$ gravity [21–29], $f(G)$ gravity [30], $f(\mathcal{T})$ gravity [31, 32] and $f(R,T)$ gravity [33–43], teleparallel gravity [44, 45], where $\mathcal{T}$ denotes the torsion scalar, and G is the Gauss-Bonnet invariant. Some other important work on modified theories of gravity [46–49] are available in the literature. The most recent $f(Q)$ gravity or symmetric teleparallel gravity [50] and $f(Q,T)$ [51] gravity have been proposed, where Q and T, respectively, mean the non-metricity and the trace of the energy momentum tensor.

The inflationary scenario has been challenged, and the matter bounce scenario has been presented as a possible alternative to address the initial singularity issue. The Universe goes through an initial matter dominated contraction phase, then a nonsingular bounce, and finally a causal generation for fluctuation in the bouncing scenario. For this, the bouncing scenario is a typical example, and the null energy condition (NEC) has to be violated to realize a solution in a spatially flat FLRW metric in GR. The matter bounce scenario has gained a lot of attention among numerous bouncing models proposed because it creates a scale-invariant power spectrum. Additionally, the Universe passes through a matter-dominated epoch at late times in a matter bounce scenario. Alternative gravity theories like $f(R)$ gravity [52–55], $f(G)$ gravity [56, 57], $f(R,T)$ gravity [58–62], $f(Q,T)$ gravity [63], $f(\mathcal{T})$ gravity [64], $f(Q)$ gravity [65] and $f(R,G)$ gravity [66] have all successfully studied bouncing

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Big Rip Scenario in Brans-Dicke Theory

S. Pradhan, S. K. Tripathy, +2 authors M. Bhuyan · Published 2022 · Physics

In this work, we present a Big Rip scenario within the framework of the generalized Brans-Dicke (GBD) theory. In the GBD theory, we consider an evolving BD parameter along with a self-interacting potential. An anisotropic background is considered to have a more general view of the cosmic expansion. The GBD theory with a cosmological constant is presented as an effective cosmic fluid within general relativity which favours a phantom field dominated phase. The model parameters are constrained so… Expand

Tunable room temperature ferromagnetism in fullerene thin film induced by 1 MeV proton microbeam irradiation

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Evolution of Generalized Brans-Dicke parameter within a Superbounce scenario

S. K. Tripathy, S. K. Pradhan, B. Barik, Z. Naik, B. Mishra

We have studied a superbounce scenario in a set up of Brans-Dicke (BD) theory. The BD parameter is considered to be time dependent and is assumed to evolve with the Brans-Dicke scalar field. In the superbounce scenario, the model bounces at an epoch corresponding to a Big Crunch provided the ekpyrotic phase continues until that time. Within the given superbounce scenario, we investigate the evolution of the BD parameter for different equations of state. We chose an axially symmetric metric that has an axial symmetry along the x-axis. The metric is assumed to incorporate an anisotropic expansion effect. The effect of asymmetric expansion and the anisotropic parameter on the evolving and the non-evolving part of the BD parameter is investigated.

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