Department: Electronics & Communication Engineering

3.4.5

Research papers per teacher in the Journals notified on UGC website

Supporting Documents

3.4.5 Number of research papers per teacher in the Journals notified on UGC website during the last five years (15)

3.4.5.1: Number of research papers in the Journals notified on UGC website during the last five years

Sr no	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
1	An improved butterfly optimization algorithm with chaos	Sankalap Arora and Satvir Singh	Electronics and Communication Engineering	Journal of Intelligent and Fuzzy Systems	2016	1875-8967	https://mjl.clarivate.com:/search-results?issn=1064-1246&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
2	Improved metaheuristic based energy-efficient clustering protocol for wireless sensor networks	Mann, Palvinder Singh and Singh, Satvir	Electronics and Communication Engineering	Engineering applications of Artificial Intelligence	2016	0952-1976	https://mjl.clarivate.com:/search-results?issn=0952-1976&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
3	Performance analysis of energy-efficient routing protocol for wireless sensor networks	Mann, Palvinder Singh and Singh, Satvir	Electronics and Communication Engineering	American International Journal of Research In Science, Technology, Engineering & Mathematics	2016	2328-3580	UGC old list Sr No 44994,https://www.ugc.ac.in/pdfnews/5283580_UGC-Cancelled-List.pdf
4	Artificial bee colony metaheuristic for energy-efficient clustering and routing in wireless sensor networks	Mann, Palvinder Singh and Singh, Satvir	Electronics and Communication Engineering	Soft Computing	2016	1433-7479	https://mjl.clarivate.com:/search-results?issn=1432-7643&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
5	Microwave absorbing characteristics in Co 2+ and Al 3+ substituted Ba0.5Sr0.5CoxAlxFe12-2xO19 hexagonal ferrite	Rajat Joshi, Charanjeet Singh, Dalveer Kaur	Electronics and Communication Engineering	Springer Journal of Material Science: Materials in Electronics	2016	0957-4522	https://mjl.clarivate.com:/search-results?issn=0957-4522&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
6	Performance analysis of different amplifiers for polarization dependent 10 Gbps bidirectional hybrid (WDM/TDM) with 16-QAM modulation technique	Rakesh Goyal, R. S. Kaler, T. S. Kamal	Electronics and Communication Engineering	Journal of Optical Technology	2016	1070-9762,1091-0786	https://mjl.clarivate.com:/search-results?issn=1070-9762&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
7	Comparative study of different optical amplifiers for hybrid passive optical networks	Rakesh Goyal,R,S Kler,T S Kamal	Electronics and Communication Engineering	Optoelectronics And Advanced Materials-Rapid Communications	2016	1842-6573(PRINT) ,2065-3824 (ONLINE)	https://mjl.clarivate.com:/search-results?issn=1842-6573&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
8	Analysis of SAC-OCDMA system to reduce MAI using fiber bragg gratings and MDW code	Rakesh Goyal, Navpreet Kaur, R. S. Kaler, Monika	Electronics and Communication Engineering	Optoelectronics And Advanced Materials-Rapid Communications	2016	1842-6573(PRINT) ,2065-3824 (ONLINE)	https://mjl.clarivate.com:/search-results?issn=1842-6573&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
9	Realization of High speed All Optical Logic Gates based on Nonlinear Characteristics of a SOA	Pawan Amit Gupta	Electronics and Communication Engineering	IJST	2016	0974-5645	https://mjl.clarivate.com:/search-results?issn=0974-6846&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
10	A Novel Security Enhanced Decoder Based on XOR Detection for Optical Code Division Multiple Access System Using Multi-Diagonal Code	Shivani ,Amit Gupta	Electronics and Communication Engineering	IJST	2016	0974-5645	https://mjl.clarivate.com:/search-results?issn=0974-6846&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
11	Optimized Routing in Mobile Ad hoc Networks	Dr Rakesh Kumar	Electronics and Communication Engineering	International Journal of Computer Science and Network Security	2016	1738-7906	https://mjl.clarivate.com:/search-results?issn=1738-7906&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal

12	Energy-efficient hierarchical routing for wireless sensor networks: a swarm intelligence approach	Mann, Palvinder Singh and Singh, Satvir	Electronics and Communication Engineering	Wireless Personal Communications	2017	1572-834X	https://mjl.clarivate.com:/search-results?issn=0929-6212&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
13	Node Localization in Wireless Sensor Networks Using Butterfly Optimization Algorithm	Sankalap Arora and Satvir Singh	Electronics and Communication Engineering	Arabian Journal for Science and Engineering	2017	2191-4281	https://mjl.clarivate.com:/search-results?issn=2193-567X&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
14	Energy efficient clustering protocol based on improved metaheuristic in wireless sensor networks	Mann, Palvinder Singh and Singh, Satvir	Electronics and Communication Engineering	Journal of Network and Computer Applications	2017	1084-8045	https://mjl.clarivate.com:/search-results?issn=1084-8045&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
15	Improved artificial bee colony metaheuristic for energy-efficient clustering in wireless sensor networks	Mann, Palvinder Singh and Singh, Satvir	Electronics and Communication Engineering	Artificial Intelligence Review	2017	0269-2821	https://mjl.clarivate.com:/search-results?issn=0269-2821&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
16	Graphical Processing Unit Accelerated Face Resolution Enhancement using Pixels-Homogeneity and Relative-Ratios	Mutneja Vikram and Singh Satvir	Electronics and Communication Engineering	International Journal of Current Research and Review	2017	0975-5241	UGC old list Sr No 62702,https://www.ugc.ac.in/pdfnews/5283580_UGC-Cancelled-List.pdf
17	Improved metaheuristic-based energy-efficient clustering protocol with optimal base station location in wireless sensor networks	Mann, Palvinder Singh and Singh, Satvir	Electronics and Communication Engineering	Soft Computing	2017	1432-7643	https://mjl.clarivate.com:/search-results?issn=1432-7643&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
18	Modified Viola-Jones algorithm with GPU accelerated training and parallelized skin color filtering-based face detection	Mutneja Vikram and Singh Satvir	Electronics and Communication Engineering	Journal of Real Time Image Processing	2017	1861-8219	https://mjl.clarivate.com:/search-results?issn=1861-8200&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
19	Microwave absorbing characteristics in Co 2+ and Al 3+ substituted Ba0.5Sr0.5CoxAlxFe12-2xO19 hexagonal ferrite	Jasbir Singh, Charanjeet Singh, Dalveer Kaur	Electronics and Communication Engineering	Springer Journal of Material Science: Materials in Electronics	2017	0957-4522	https://mjl.clarivate.com:/search-results?issn=0957-4522&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
20	Elucidation of Phase evolution, Microstructural, Mossbauer and Magnetic properties of Co2+ - Al3+ doped M-type Ba-Sr Hexaferrites synthesized by a ceramic method	Jasbir Singh, Charanjeet Singh, Dalveer Kaur	Electronics and Communication Engineering	Journal of Alloys and Compounds	2017	0925-8388	https://mjl.clarivate.com:/search-results?issn=0925-8388&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
21	Microwave Absorbing Characteristics of Co2+ and W4+ ions doped M-type Ba-Sr hexagonal Ferrites	Rajat Joshi, Charanjeet Singh, Dalveer Kaur	Electronics and Communication Engineering	Journal of Materials Science: Materials in Electronics	2017	0957-4522	https://mjl.clarivate.com:/search-results?issn=0957-4522&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
22	Wormhole attack detection techniques in MANET	Dalveer Kaur,Parvinder	Electronics and Communication Engineering	Wireless Personal Communication	2017	0929-6212	https://mjl.clarivate.com:/search-results?issn=0929-6212&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
23	A cost effective bidirectional hybrid passive optical network using common carrier for all optical network units (CCAONUs) technique with mitigation of non linearity impact	Rakesh Goyal, R. S. Kaler, T. S. Kamal	Electronics and Communication Engineering	Optik- International Journal for light and electron optics	2017	0030-4026	https://mjl.clarivate.com:/search-results?issn=0030-4026&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal

24	Analysis and mitigation of XPM crosstalk in the scenario of mixed line rates for next generation access networks	Rakesh Goyal, Rajinder Singh Kaler, Monika Rani	Electronics and Communication Engineering	Optoelectronics And Advanced Materials-Rapid Communications	2017	1842-6573(PRINT) ,2065-3824 (ONLINE)	https://mjl.clarivate.com:/search-results?issn=1842-6573&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
25	Flatted gain S+C+L Band RAMAN-Thulium-Doped Tellurite Fiber Amplifier hybrid optical amplifier for super dense wavelength division multiplexing system	Chakresh Kumar, Rakesh Goyal	Electronics and Communication Engineering	Journal of Optical Communication,ISSN (2191-6322)	2017		https://www.scopus.com/sourceid/19573
26	Analysis of Proposed Hybrid Amplifier Model for Single to Multi-Channel WDM Optical System at 10 Gbps with 100 GHz of Channel Spacing	Chakresh Kumar, Rakesh Goyal	Electronics and Communication Engineering	International Journal of Information Technology,ISSN (25112104)P (25112112)E	2017		https://www.scopus.com/sourceid/21101022413
27	Design and Evaluation of 10 Gbps Inter-Satellite Optical Wireless Communication Link for Improved Performance	Amit Gupta, Shaina	Electronics and Communication Engineering	Journal of Optical Communication	2017	2191-6322	https://www.scopus.com/sourceid/19573
28	Survey of Methods for Optimization of Transmit Power for Cognitive Radio Networks	Paurav Goel,Avtar Singh Buttar	Electronics and Communication Engineering	INTERNATIONAL JOURNAL FOR RESEARCH IN ENGINEERING APPLICATION & MANAGEMENT (IJREAM)	2018	2454-9150	UGC Old list Sr no. 64077,https://www.ugc.ac.in/pdfnews/5283580_UGC-Cancelled-List.pdf
29	A modified butterfly optimization algorithm for mechanical design optimization problems	Arora, Sankalap and Singh, Satvir and Yetilmezsoy, Kaan	Electronics and Communication Engineering	Journal of the Brazilian Society of Mechanical Sciences and Engineering	2018	1806-3691	https://mjl.clarivate.com:/search-results?issn=1678-5878&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
30	Butterfly Optimization Algorithm: A Novel Approach for Global optimization	Arora, Sankalap and Singh, Satvir	Electronics and Communication Engineering	Soft Computing	2018	1433-7479	https://mjl.clarivate.com:/search-results?issn=1432-7643&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
31	Optimal Node Clustering and Scheduling in Wireless Sensor Networks	Mann, Palvinder Singh and Singh, Satvir	Electronics and Communication Engineering	Wireless Personal Communications	2018	1572-834X	https://mjl.clarivate.com:/search-results?issn=0929-6212&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
32	Interference Cancellation in Broadcast Channel of Multiuser MIMO system using Block Diagonalization and Dirty Paper Coding Schemes	Neeraj Kumar, Dalveer Kaur	Electronics and Communication Engineering	International Journal of Engineering Trends and Technology	2018	2231-5381	https://www.scopus.com/sourceid/21101000284
33	Effect of interface in Dielectric relaxation properties of PEMA-BaZrO3 nanocomposites	Rajesh, Dalveer Kaur	Electronics and Communication Engineering	Springer Journal - Polymer Bulletin	2018	0170-0839	https://mjl.clarivate.com:/search-results?issn=0170-0839&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
34	Performance Evaluation of RAMAN-EDFA-RAMAN Hybrid optical amplifiers in the context of high spectral efficiency	Chakresh Kumar, Rakesh Goyal	Electronics and Communication Engineering	Journal of Nanoelectronics and Optoelectronics	2018	1555-130x,1555-1318	https://mjl.clarivate.com:/search-results?issn=1555-130X&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal

35	Performance Analysis of Hybrid Optical Amplifiers for Super Dense Wavelength Division Multiplexing System in the Scenario of Reduced Channel Spacing	Chakresh Kumar, Rakesh Goyal	Electronics and Communication Engineering	MAPAN-Journal of Metrology Society of India	2018	0974-9853 (online) 0970-3950(PRINT)	https://mjl.clarivate.com:/search-results?issn=0970-3950&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
36	A Novel flatted gain C-Band Cascaded Hybrid optical Amplifier RAMAN and Thulium Doped Fluoride fiber Amplifier for Super Dense Wavelength Division Multiplexing System	Chakresh Kumar, Rakesh Goyal	Electronics and Communication Engineering	Optica Applicata	2018	0078-5466 (PRINT)1899-7015(ONLINE)	https://mjl.clarivate.com:/search-results?issn=0078-5466&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
37	L-Band Flat-Gain RAMAN with Erbium Doped Fluoride Fiber Amplifier Hybrid optical Amplifier for Super Dense Wavelength Division Multiplexing System	Chakresh Kumar, Rakesh Goyal	Electronics and Communication Engineering	Journal of Russian Laser Research	2018	1573-8760(ONLINE) 1071-2836 (print)	https://mjl.clarivate.com:/search-results?issn=1071-2836&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
38	All-optical Integrated Parity Generator and Checker Using an SOA-based Optical Tree Architecture	Nivedita Nair, Sanmukh Kaur, Rakesh Goyal	Electronics and Communication Engineering	Current Optics and Photonics	2018	2508-7226(print) 2508-7274 (online)	https://mjl.clarivate.com:/search-results?issn=2508-7266&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
39	A Performance Enhancement and High Speed Spectrum Sliced Free Space Optical System	Aditi Thakur, Shaina Nagpal , Amit Gupta	Electronics and Communication Engineering	Wireless Personal Communications	2018	0929-6212	https://mjl.clarivate.com:/search-results?issn=0929-6212&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
40	Kerr effect based spectrum sliced wavelength division multiplexing for free space optical communication	Aditi Thakur, Shaina Nagpal , Amit Gupta	Electronics and Communication Engineering	Optik International journal of Light and Electron Optics	2018	0030-4026	https://mjl.clarivate.com:/search-results?issn=0030-4026&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
41	Efficient Utilization of Vacant Spectrum using Reconfigurable Secondary Users in Cognitive Radio Network	Manmeet Kaur, A.S Buttar	Electronics and Communication Engineering	International Journal of Computer Sciences and Engineering	2019	2347-2693	UGC old list Sr No 63193,https://www.ugc.ac.in/pdfnews/5283580_UGC-Cancelled-List.pdf
42	A Novel Approach of Cooperative Sharing Based on Hybrid Relaying Scheme of Chase Algo and Decode & Forward Using Fuzzy Logic in Cognitive Radio	Ridhima, A.S. Buttar	Electronics and Communication Engineering	International Journal of Computer Sciences and Engineering	2019	2347-2693	UGC old list Sr No 63193,https://www.ugc.ac.in/pdfnews/5283580_UGC-Cancelled-List.pdf
43	Issues and Challenges in Energy Harvested based Wireless Sensor Network",	Meenakshi Sansoy, A.S. Buttar, Rakesh Goyal	Electronics and Communication Engineering	International Journal of Computer Sciences and Engineering	2019	2347-2693	UGC old list Sr No 63193,https://www.ugc.ac.in/pdfnews/5283580_UGC-Cancelled-List.pdf
44	A review on solar energy harvesting wireless sensor network	Meenakshi Sansoy, A.S. Buttar, Rakesh Goyal	Electronics and Communication Engineering	International Journal of Computer Sciences and Engineering	2019	2347-2693	UGC old list Sr No 63193,https://www.ugc.ac.in/pdfnews/5283580_UGC-Cancelled-List.pdf
45	Nurturing Wireless Communication: Coalition of Cognitive Radio with Li-Fi	Ridhima, A.S. Buttar	Electronics and Communication Engineering	International Journal of Computer Sciences and Engineering	2019	2347-2693	UGC old list Sr No 63193,https://www.ugc.ac.in/pdfnews/5283580_UGC-Cancelled-List.pdf
46	Survey on Non Orthogonal Multiple Access (NOMA)- A key technique for future radio network access",	Shampal Singh,Avtar Singh Buttar,Dalvir kaur	Electronics and Communication Engineering	International Journal of Computer Sciences and Engineering	2019	2347-2693	UGC old list Sr No 63193,https://www.ugc.ac.in/pdfnews/5283580_UGC-Cancelled-List.pdf

47	An Interval Type 2 Fuzzy Logic Framework For Faster Evolutionary Design	Singh, Sarabjeet and Singh, Satvir and Banga, Vijay Kumar	Electronics and Communication Engineering	Journal of computational and theoretical nanoscience	2019	1546-1955	https://www.scopus.com/sourceid/28136
48	Enhance the Capacity of MIMO Wireless Communication channel using SVD and Optimal Power allocation algorithm	Dalveer Kaur, Neeraj Kumar	Electronics and Communication Engineering	International Journal of Electronics and Telecommunication	2019	2300-1933	https://mjl.clarivate.com:/search-results?issn=2081-8491&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
49	Investigation of Structural & Dielectric Properties of Polymer nanocomposites for Embedded Capacitor applications	Rajesh, Dalveer Kaur	Electronics and Communication Engineering	International Journal of Research & Analytical Reviews	2019	2349-5138	UGC old list Sr No 43602,https://www.ugc.ac.in/pdfnews/5283580_UGC-Cancelled-List.pdf
50	Performance Evaluation of Dynamically Flattened Gain L-Band Raman-EDFA-Raman Hybrid Optical Amplifier for Super Dense Wavelength Division Multiplexing system	Chakresh Kumar, Ghanendra Kumar and Rakesh Goyal	Electronics and Communication Engineering	Indian Journal of Pure & Applied Physics	2019	0019-5596	https://mjl.clarivate.com:/search-results?issn=0019-5596&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
51	Experimental Evaluation of HOA in term of Flat Gain in C-Band for Super Dense Optical Communication System	Chakresh Kumar and Rakesh Goyal	Electronics and Communication Engineering	Wireless Personal Communications	2019	0929-6212	https://mjl.clarivate.com:/search-results?issn=0929-6212&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
52	RAMAN-Ytterbium Doped Hybrid Optical Amplifier yielding Flat Gain in S-band for Super Dense Wavelength Division Multiplexing System	Chakresh Kumar and Rakesh Goyal	Electronics and Communication Engineering	Journal of Scientific & Industrial Research	2019	0975-1084(online) ,0022-4456(Print)	https://www.scopus.com/sourceid/23649
53	A unified non-linear approach based on recurrence quantification analysis and approximate entropy: application to the classification of heart rate variability of age-stratified subjects	Dr Amit Gupta	Electronics and Communication Engineering	Medical & Biological Engineering & Computing	2019	ISSN: 0140-0118 (Print) 1741-0444 (Online)	https://mjl.clarivate.com:/search-results?issn=0140-0118&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
54	Designing and analysis of cross-shaped CRLH metamaterial for wide band negative index characteristics	Dr Amit Gupta	Electronics and Communication Engineering	Material Research Express	2019	2053-1591	https://mjl.clarivate.com:/search-results?issn=2053-1591&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
55	Effiecient resource allocation of MIMO OFDM sustem using convex optimization	Momd Asif,Dalvir Kaur,Avtar Singh Buttar	Electronics and Communication Engineering	Journal of Emerging Technology and Innovative Research	2020	2349-5162	Old UGC list Sr No.63975,https://www.ugc.ac.in/pdfnews/5283580_UGC-Cancelled-List.pdf
56	Lifetime Enhancement of wireless sensor network using solar energy harvesting technique	Harmandeep Kaur,Avtar Singh Buttar	Electronics and Communication Engineering	IET Wireless Sensor Systems	2020	2043-6386 ,2043-6394	https://mjl.clarivate.com:/search-results?issn=2043-6386&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
57	Channel Estimation in OFDM Systems: A Survey Paper	H.P.S. Rishi. Dalveer Kaur	Electronics and Communication Engineering	International Journal of Computer Sciences and Engineering	2020	2347-2693	UGC old list Sr No 63193,https://www.ugc.ac.in/pdfnews/5283580_UGC-Cancelled-List.pdf
58	Measurement of AC and DC relaxation properties in Polyvinyl chloride (PVC) Nanocomposites	Rajesh, Dalveer Kaur	Electronics and Communication Engineering	Elsevier Journal - Measurement	2020	0263-2241	https://mjl.clarivate.com:/search-results?issn=0263-2241&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
59	A novel design of energy efficient bidirectional passive optical green networks using reduced buffer with small packet size technique	Rakesh Goyal, Rajinder Singh Kaler, Monika Rani	Electronics and Communication Engineering	Microwave and Optical technology Letters	2020	1098-2760	https://mjl.clarivate.com:/search-results?issn=0895-2477&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal

60	Highly Sensitive and Reusable Cu+2/Polyaniline /Reduced Graphene Oxide Nanocomposite Ink Based Non-Enzymatic Glucose Sensor	Vijay Kumar Anand, Archana Bukke, Kapil Bhatt, Sandeep Kumar, Sandeep Sharma, Rakesh Goyal, G. S. Virdi	Electronics and Communication Engineering	Applied Physics A	2020		https://link.springer.com/article/10.1007/s00339-020-03620-4
61	Design And Investigation Of High-Capacity Spatial-Division Multiplexing Network Employing A Multimode Fiber	Ashish Malhotra, Gurmanik Kaur, Rakesh Goyal, Monika Rani	Electronics and Communication Engineering	Journal of Russian Laser Research	2020	10712836, 15738760	https://mjl.clarivate.com:/search-results?issn=1071-2836&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
62	Impact of High Speed Differential Quadrature Amplitude Modulation using Hybrid Optical Amplifier for Super Dense Wavelength Division Multiplexing System	Chakresh Kumar, Rakesh Goyal	Electronics and Communication Engineering	Indian Journal of Pure & Applied Physics	2020	0019-5596	https://mjl.clarivate.com:/search-results?issn=0019-5596&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
63	Development of 32-GBaud DP-QPSK free space optical transceiver using homodyne detection and advanced digital signal processing for future optical networks	Sahil Nazir Pottoo, Rakesh Goyal, Amit Gupta	Electronics and Communication Engineering	Optical and Quantum Electronics	2020	0306-8919 , 1572-817X	https://mjl.clarivate.com:/search-results?issn=0306-8919&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
64	Transmission of audio over LTE packet based Wireless Networks using wavelets	Dr Amit Gupta	Electronics and Communication Engineering	Wireless Personal Communications	2020	0929-6212	https://mjl.clarivate.com:/search-results?issn=0929-6212&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
65	Optimization of hybrid WDM/TDM (16×1024) PON for future access systems	Dr Amit Gupta	Electronics and Communication Engineering	Optoelectronicsa nd Advanced materials :Rapid Communication	2020	1842 - 6573	https://mjl.clarivate.com:/search-results?issn=1842-6573&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal

An improved butterfly optimization algorithm with chaos

Article type: Research Article

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Abstract: Butterfly Optimization Algorithm (BOA) is a new comer in the category of nature inspired metaheuristic algorithms, inspired from food foraging behavior of the butterflies. Similar to other metaheuristic algorithms, it encounters two probable problems; (1) entrapment in local optima and (2) slow convergence speed. Chaotic maps are one of the best methods to improve the performance of metaheuristic algorithms. In the present study, chaos is introduced into BOA which increases its performance in terms of both local optima avoidance and convergence speed. Ten chaotic maps are employed to enhance the performance of the BOA. The proposed chaotic BOAs are validated on unimodal and multimodal benchmark test functions as well as on engineering design problems. The results indicate that the chaotic maps are able to significantly boost the performance of BOA.

Keywords: Butterfly optimization algorithm, chaotic map, metaheuristic, optimization

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Improved metaheuristic based energy-efficient clustering protocol for wireless sensor networks

Palvinder Singh Mann [a], Satvir Singh [b]

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Abstract

Energy-efficient clustering protocols are much sought specially for low-power, multi-functional Wireless Sensor Networks (WSNs). With the application of Computational Intelligence (CI) based approaches, various metaheuristics have been developed for energy-efficient clustering in WSNs. Artificial Bee Colony (ABC) is one such metaheuristic which arose much interest over other population-based metaheuristics for solving optimization problems in WSNs due to its ease of implementation and adaptive nature. However, its solution search equation, which is poor at exploitation process, contributes to its insufficiency. Thus, we present an improved Artificial Bee Colony (iABC) metaheuristic with an improved solution search equation to improve its exploitation capabilities. Additionally, in order to increase the global convergence of the proposed metaheuristic, an improved population sampling technique is introduced through *Student's-t* distribution. The proposed metaheuristic maintains a good balance between exploration and exploitation search abilities with least memory requirements, moreover the use of first of its kind compact *Student's-t* distribution makes it suitable for limited hardware requirements of WSNs. Further, an energy efficient clustering protocol *BeeCluster* based on iABC metaheuristic is introduced, which inherits the capabilities of the proposed metaheuristic to obtain optimal cluster heads (CHs) and improves energy-efficiency in WSNs. Simulation results show that the proposed clustering protocol outperforms other well known protocols on the basis of packet delivery, throughput, energy consumption, network lifetime and latency as performance metric.

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Keywords

Energy-efficient clustering; Wireless sensor networks; Improved Artificial Bee Colony (iABC)

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Performance analysis of energy-efficient routing protocol for wireless sensor networks

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Abstract: *Energy efficient routing in Wireless sensor networks (WSNs) require new paradigm for design and development of energy efficient protocols and can be applied for optimal routing of data, in an energy constraint WSNs environment. In this paper, we present BeeSwarm, an energy-efficient hierarchical routing protocol for WSNs. Our protocol integrate three phases for clustering, data routing and transmission, which is the key aspect of this proposed protocol, thus ultimately contributes to its robustness. Evaluation of simulation results show that BeeSwarm perform better in terms of packet delivery and energy consumption compared to other hierarchical routing protocols for WSNs.*

Keywords: *Wireless Sensor Networks, Energy-efficient Routing.*

I. Introduction

Advances in sensor networks have enabled distributed sensor networks (DSNs) to evolve from small cluster of sensors to large swarm of microsensors, from fixed sensor nodes to mobile nodes, from wired communication to wireless communication, from static network topology to dynamically changing topology. In such dynamic environment design and development of efficient routing protocol remains a challenge for researches around the world. Wireless Sensor Networks (WSNs) consist of large number of sensor nodes which sense, process and transmit the required collected data for a desired physical environment, collaboratively. Sensor nodes communicate not only with each other but also with a *Base Station* (BS) or *Sink* using their wireless radios, allowing them to disseminate their sensor data to remote processing, visualization and analysis [1]. Many researchers are currently engaged in developing architectures, routing protocols and schemes that fulfill the requirements of these key features. The main aim is to find ways for energy-efficient route setup and reliable relaying of data from the sensor nodes to the base station so that the lifetime of the network is maximized. There is always a trade off between computation and communication in each node when it makes the route decision and data aggregation. As the size of WSNs grows, so does the complexity of the data routing. Therefore a key area of WSNs research is in developing new routing algorithms to meet the strict low-power limitations [2].

II. BeeSwarm - Protocol Description

BeeSwarm is, energy-efficient hierarchical routing protocol for WSNs inspired from the natural behaviour of honey bees. Honey bees are eco-friendly species on our earth and helped researchers to solve critical optimization problems in the past. Our protocol is based on an integrated three phase layer structure namely 1) Setup Phase 2) Route Discovery Phase and finally 3) Data Transmission Phase. Below we discuss each phase of our proposed protocol in detail and provide an insight of its working.

III. Set up Phase

The proposed WSN model will consists of number of homogeneous sensor nodes randomly distributed over a geographical area with a BS. After cluster formation, which is based on our proposed clustering algorithm, all CHs prepare a TDMA schedule and transmit this schedule to sensor nodes register with them within their cluster. This ensures there will be no collisions among data events send by various nodes and also allows the radio components of each non- CH node to be turned off at all times except during their transmit time, thus further reducing the energy consumed by the individual sensors. After the TDMA schedule is known by all senor nodes, they will be ready to forward events to their respective CHs. Then each node will send data to its respective CH based on proposed routing algorithm using multi-hop communication and CHs forward it to BS after aggregation using single hop communication.

IV. Route Discovery Phase

After selection of CHs, the next phase *BeeSearch* will discover routes for event communication through scout bees. BeeSearch is a two way process 1) Forward Search and 2) Backward Search. Forward Search will explore the network

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Artificial bee colony metaheuristic for energy-efficient clustering and routing in wireless sensor networks

Journal: Soft Computing > Issue 22/2017

Authors: Palvinder Singh Mann, Satvir Singh

Important notes

Abstract

Swarm intelligence (SI)-based metaheuristics are well applied to solve real-time optimization problems of efficient node clustering and energy-aware data routing in wireless sensor networks. This paper presents another superior approach for these optimization problems based on an artificial bee colony metaheuristic. The proposed clustering algorithm presents an efficient cluster formation mechanism with improved cluster head selection criteria based on a multi-objective fitness function, whereas the routing algorithm is devised to consume minimum energy with least hop-count for data transmission. Extensive evaluation and comparison of the proposed approach with existing well-known SI-based algorithms demonstrate its superiority over others in terms of packet delivery ratio, average energy consumed, average throughput and network life.

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Microwave absorbing characteristics in Co^{2+} and Al^{3+} substituted $Ba_{0.5}Sr_{0.5}Co_xAl_xFe_{12-2x}O_{19}$ hexagonal ferrite

Jasbir Singh, Charanjeet Singh, Dalveer Kaur, S. Bindra Narang, Rajshree Jotania & Rajat Joshi

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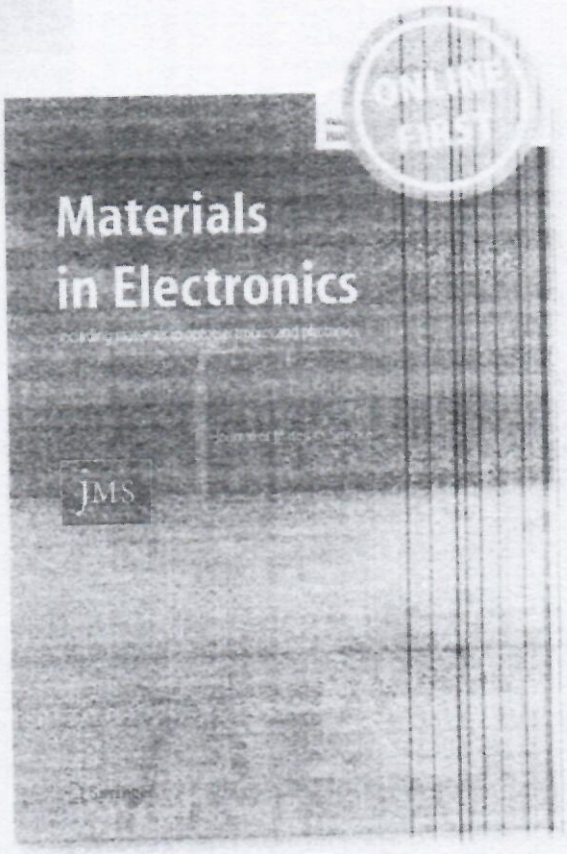

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PERFORMANCE ANALYSIS OF DIFFERENT AMPLIFIERS FOR POLARIZATION DEPENDENT 10 GBPS BIDIRECTIONAL HYBRID (WDM/TDM) WITH 16-QAM MODULATION TECHNIQUE

© 2016 **Rakesh Goyal**[*], Assistant Professor; **R. S. Kaler**[**], Senior Professor; **T. S. Kamal**[***], Director, RIET

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In this paper, we have investigated bidirectional hybrid Wavelength-Division Multiplexing/Time-Division Multiplexing Passive Optical Networks (WDM/TDM PONs) for RAMAN, Semiconductor Optical Amplifier (SOA) and EDFA amplifiers at 10 Gbps data rate with 128 numbers of Optical Network Units (ONUs). The system is improved using polarization modulation with 16-QAM to utilize the maximum bandwidth. A circulator is used to achieve the bidirectional transmission in the same channel. The upstream data is transmitted at 1300 nm and downstream data is transmitted at 1550 nm wavelength so that crosstalk effect can be minimized. Q factor and

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OPTOELECTRONICS AND ADVANCED MATERIALS – RAPID COMMUNICATIONS Vol. 10, Iss. 1 - 2, January - February 2016, p. 9 - 11

Comparative study of different optical amplifiers for hybrid passive optical networks

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In this manuscript, we have investigated different optical amplifiers like RAMAN, Semiconductor Optical Amplifier (SOA) and EDFA for bidirectional hybrid (WDM/ TDM) Passive Optical Networks (PONs) at 10 Gbps data rate with 128 numbers of Optical Network Units (ONUs). The performance of the system is enhanced with polarization modulation with 16-QAM technique. To make the system simple, a circulator is used for bidirectional transmission through the same fiber. The upstream data is transmitted at 1300 nm wavelength and downstream data is transmitted at 1550 nm wavelength. Various results for BER are shown at 40 and 50 KMs distance. It has been observed that EDFA amplifier shows better performance than SOA and RAMAN.

(Received September 12, 2014; accepted February 10, 2016)

Keywords: Hybrid Passive Optical Networks, Bidirectional communication, Amplifiers, Fiber to the Home (FTTH), Optical Network Unit (ONU)

1. Introduction

In current scenario, the numbers of subscribers of internet are increasing day by day [1]. The demand for huge bandwidth and high data speed is the main concern for the researchers [2]. These motivate the researchers towards the optical networks as fiber provides the largest bandwidth and suitable for long distance communications [3]. Passive Optical Networks (PONs) are the best choice for such type of access networks [4]. Hybrid (Wavelength division multiplexing/ time division multiplexing) PON is good postured to be one of the chief ladder in the evolution of access-metro optical networks [5]. In recent years, various techniques based PONs like Wavelength Division Multiplexing (WDM) PON [6], Time Division Multiplexing (TDM) PON [7] and hybrid (WDM / TDM) PON [8] have been believed the most promised solution for fiber-to-the-home (FTTH) systems [9].

Wei Han et al. [6] proposed a protection scheme for transmitters in WDM-PON. If any downstream transmitter encountered problems at the Central Office (CO), the interrupted communication was restored immediately by injecting a Fabry–Perot Laser Diode (FP-LD) with the upstream light wave corresponding to the failure transmitter. A 1:36 protection capability was implemented with a 2.5 Gbit/s downstream transmission capability over 10 km distance.

C. H. Wang et al. [7] proposed a new architecture for TDM-PON using externally injection locked FP-LDs in each Optical Network Unit (ONU). Four directly modulated 2.5 Gb/s FP-LDs were injection-locked by Continuous Wave (CW) carriers distributed from the Optical Line Terminal (OLT). The data was successfully transmitted up to 25 km standard single mode fiber (SMF) without dispersion compensation. The performance of the injection-locked FP-LD was also studied.

R. Goyal et al. [8] analyzed the performance and feasibility of a hybrid (WDM/ TDM) PON system with 128 ONUs. The triple play services (video, voice and data) were successfully transmitted up to a distance of 28 km to all ONUs.

Simranjit Singh et al. [10] compared 10 Gbps WDM systems at 16, 32 and 64 channels with EDFA, RAMAN and SOA amplifiers. It was demonstrated that when the dispersion was 2 ps/nm/km and the number of channels were less, then SOA provided better results and when dispersion was increased from 2 to 10 ps/nm/km, EDFA provided better results than SOA in the term of BER and output power.

In literature, we have studied various research works on PONs. Considering [6], a protection scheme for transmitters in WDM-PON was proposed using a FP-LD with a 2.5 Gbit/s downstream transmission capability over 10 km distance. In [7] TDM-PON is proposed with four directly modulated 2.5 Gb/s FP-LDs to transmit data up to 25 km. In [8] triple play services (video, voice and data) were successfully transmitted to a distance of 28 km to 128 ONUs. In this paper, we are presenting hybrid PON architecture with 10 Gb data rates and more transmission distance. Two different wavelengths 1550nm and 1300 nm are used for downlink and uplink data to avoid the use of extra tunable devices and reduce the effect of non linearity. Also, the non employment of various complex components like WSSs, FBGs and AWGs (those increases the complexity and cost of the network), is implemented for the sake of simplicity and flexibility. Further, the system is investigated with different types of optical amplifiers to find out the best suitable for the same.

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OPTOELECTRONICS AND ADVANCED MATERIALS – RAPID COMMUNICATIONS Vol. 10, No. 7-8, July-August 2016, p. 485 - 489

Analysis of SAC-OCDMA system to reduce MAI using Fiber Bragg Gratings and MDW codes

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In this manuscript, we have analyzed a Spectral Amplitude Coding-Optical Code Division Multiple Access (SAC-OCDMA) System. The uniform Fiber Bragg Gratings (FBGs) are used at transmitter and receiver end to improve the overall performance of the system. Multiple Access Interference (MAI) has been reduced using a mathematical model and MDW codes for the proposed system. Further, we have transmitted data at 100 Gbps rate up to a distance of 80 Km by increasing the ten numbers of FBGs. The proposed system has been analyzed in terms of output power, distance, BER and Quality Factor. The Optisystem7 tool has been used to analyze the system performance.

(Received September 20, 2015; accepted August 3, 2016)

Keywords: OCDMA, FBG, MAI, MDW, SAC

1. Introduction

Code Division Multiple Access (CDMA) has been well studied in the wireless communication systems. Recently, the spread spectrum technique has gotten a lot of attention in the optical fiber transmission due to the inherent large bandwidth of fibers. OCDMA has several benefits such as asynchronous transmission, flexibility in network design, accommodation of burst traffic and variable bit rate traffic [1]. Nevertheless, the OCDMA systems suffer from certain noises such as PIIN, shot noise and thermal noise etc. In these networks, Multiple Access Interference (MAI) is the main factor responsible for performance degradation, especially, when a large number of users are involved in the OCDMA systems. Therefore, the most important consideration is the code designs for reducing contribution of the MAI at the optical power receiver end. Among all OCDMA techniques, Spectral Amplitude Coding (SAC) has the advantages of suppressing the effect of MAI due to its flexibility in phase cross-correlation which can be utilized as address sequence and balance detection at the receiver side [2]. In this manuscript, we have analyzed the OCDMA system based on FBG through the mathematical model and exhaustive optical simulator called Optisystem7 software from Optiwave.

2. Theory

A. OCDMA: The aim of OCDMA is to take benefits of radio frequency communications with sharing of the huge optical bandwidth. The block diagram for OCDMA is shown in Fig. 1.

Fig. 1. Block Diagram of OCDMA

An OCDMA system for each user can be described by a data source, containing the data that will be sent, followed by an encoder and then a laser which maps the signal from electrical form to an optical pulse sequence. At the receiver end, an optical correlator is used to extract the encoded data. Many subscribers transmit data simultaneously [3]. Each user has its own codeword, which is approximately orthogonal to all other code words. The encoded data is sent to the Nx1 star coupler, from where the optical channel carries the signal through the optical fiber and couples to a 1xN coupler and broadcast to all nodes [4]. All users encoded data are then added together chip by chip and the result, which is called the superposition, are sent over the channel. The individual receivers consisting of optical correlate continuously observe the superposition of all incoming pulse transmission and recover the data from the corresponding transmitter. This is done by correlation between the incoming signal and stored copies of that user unique sequence [5].

B. FIBER BRAGG GRATING: A fiber bragg grating (FBG) is a type of distributed bragg reflector constructed in a short segment of optical fiber that reflects particular wavelengths of light and transmits all others. This is achieved by creating a periodic variation in there refractive index of the fiber core, which

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Realization of High Speed All-Optical Logic Gates based on the Nonlinear Characteristics of a SOA

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Abstract

Objectives: In this paper the method to overcome the bit rate limitations caused by dual conversion of the signal has been examined. Taking this phenomenon as base for this paper, a novel and potentially integrable circuit design is proposed for the realization of all-optical logic gates based on non-linear properties of SOA. Methods/Statistical Analysis: For this purpose a relatively new method to achieve larger transmission capacity and longer transmission distance with high data rates by employing many logic XOR, AND, OR, NOT gates based on non-linear characteristics of Semiconductor Optical Amplifier (SOA) in optical communication systems is used. Findings: This is done by eliminating the need of optoelectronics conversions and therefore the data remains in the optical domain. This XOR, AND, OR and NOT gate can be executed on 60 gigabits per second on any bit sequence in order to achieve such a high data rate. Application/Improvement: Its application includes Agile radar aircraft antenna system, control of electronic automatic RF attenuator, Automotive courtesy light etc.

Keywords

Mach-Zehnder Interferometer, Multi-Quantum-Well, Optical Logic Gates, Semiconductor Optical Amplifier, XOR Gate.

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A Novel Security Enhanced Decoder Based on XOR Detection for Optical Code Division Multiple Access System Using Multi-Diagonal Code

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DOI: 10.17485/ijst/2016/v9i36/101480

Abstract

Objective: The main aim of this research paper is to design a security enhanced decoder based on the XOR logic gate detection technique. Methods/Statistical Analysis: An all optical XOR gate has been designed by using Semiconductor Optical Amplifier (SOA) for the secure transmission in Optical code division multiple access system. Multi Diagonal (MD) code is implemented with all optical logical gate detection using non-linear effects in semiconductor optical amplifiers. To realize the XOR gate, two identical SOAs in MZI structure have been used. Finding: The Non-Return-to-Zero (NRZ) and RZ bit format have been compared and results show that using NRZ bit format the performance is better than RZ bit format and its optimum power comes out to be 0.6mW. A new design of Multi-diagonal code has been proposed by using all optical logical gate detection considering nonlinear effects in SOA. The design has successfully worked at Bit Error Rate (BER) 8.77×10^{-09}. Application/Improvements: This design having decoder based on XOR logic gate utilizing the Multi-diagonal code will have wide applications in military for the secure transmission of data.

Keywords

Cross Gain Modulation, Cross Phase Modulation.

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Optimized Routing in Mobile Ad hoc Networks

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Summary:
A mobile ad hoc network is type of wireless network without any infrastructure and it has a fast changing network topology, as a result of which new mobile nodes frequently gets added and move away from the radio range of network. Due to frequent movement of nodes in the network, this network can have hostile attacks from the external unauthorized nodes which temper the secure communication between the nodes, due to this security becomes a very vital factor which hinders the performance of network. In this paper, first a brief introduction of mobile ad hoc network and its routing protocols is given, and after that implementation results of a secured routing protocol by using intelligent mathematical techniques along cryptographic techniques is presented which can be effectively used in securing the MANETs.

Keywords:
MANET, Routing Protocol, Security and Cryptographic Algorithms.

1. Introduction

Mobile ad hoc network is a collection of mobile nodes forming short lived or temporary networks without the aid of any centralized equipment. Mobile ad hoc network has its roots associated with U.S defence agency DARPA, which is also known as Defence Advanced Research Project Agency, which initiated research on the viability of using packet- switched radio communications to provide reliable computer communications and came up with packet radio network in 1973, also known as DARPA PRNET. The routing protocols used in PRNet were designed to enable reliability, speed and correctness and also included network management facilities. These packet radio networks were known as first generation packet radio networks. After the first generation, second generation survivable adaptive radio networks(SURAN) evolved in around 1980s which provided packet switched networking environment to the mobile battlefield elements in infrastructure- less situations and it was the second generation of MANETs. In 1990 and onwards with the invention of notebook computers and viable communication devices based on radio waves, concept of commercial ad-hoc networks arrived and it was the start of third generation ad hoc networks. .At the same time two new technologies named Bluetooth and Ad hoc sensors were also evolved.[3].Routing in ad hoc networks is a very important issue ,which if not addressed properly may affect severely the throughput of the network. Routing protocols for the MANETs can be classified into three categories which are reactive, proactive and hybrid routing protocols. One other important factor that affects the secure delivery of data to the destination node in the ad hoc network is the Security. It deals with confidentiality, authorization and authentication. The major challenges that are being identified in the MANETs are the insecurity of the wireless links, energy constraints, relatively poor physical protection of nodes in a hostile environment, and the vulnerability of statically configured security. There is limitation of MANETs that protocols used in wired network can't be used for MANETs, as they operate in highly dynamic environment and due to this they are the perfect candidates for numerous provisions.

2. Routing Protocols

For communication within a network, a routing protocol is required to produce reliable and effective routes between a pair of nodes so that data may be transmitted between them efficiently and number of routing protocols have been proposed for these ad hoc networks. These protocols find a route for packet delivery and deliver the packet to the correct destination. The studies on various aspects of routing protocols and development of new routing algorithms have been an active area of research for many years. Many protocols have been suggested. Basically, routing protocols can be broadly classified into two types as (a) Table Driven Protocols or Proactive Protocols and (b) On-Demand Protocols or Reactive Protocols. In this paper more stress is given on reactive routing protocols

Proactive (Table Driven) Routing: This approach is similar to the connectionless approach of traditional datagrams networks and nodes based on periodic update process attempt to compute a priori and provide consistent and up to date routing information to every other node in network. The approach is called proactive the nodes calculate all possible paths to all destinations independently of their effective use. Some of the proactive protocols are DSDV,WRP and OLSR

Reactive (on demand) Routing: These protocols evaluate the network on as needed basis and create routes only when there is a need for carrying the traffic. Some of the reactive protocols are AODV, TORA, SSR, DSR,ABR.

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Energy-Efficient Hierarchical Routing for Wireless Sensor Networks: A Swarm Intelligence Approach

Wireless Personal Communications

January 2017, Volume 92, Issue 2, pp 785–805 | Cite as

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Article
First Online: 08 August 2016

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Abstract

Energy efficient routing in wireless sensor networks (WSNs) require non-conventional paradigm for design and development of power aware protocols. Swarm intelligence (SI) based metaheuristic can be applied for optimal routing of data, in an energy constraint WSNs environment. In this paper, we present

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Node Localization in Wireless Sensor Networks Using Butterfly Optimization Algorithm

Arabian Journal for Science and Engineering

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Research Article - Computer Engineering and Computer Science
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Abstract

Accurate localization of sensor nodes has a strong influence on the performance of a wireless sensor network. In this paper, a node localization scheme using the application of nature-inspired metaheuristic algorithm, i.e., butterfly optimization algorithm, is proposed. In order to validate the proposed scheme, it is simulated on different sizes of sensor networks ranging from 25 to 150 nodes whose distance measurements are corrupted by gaussian noise. The

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Journal of Network and Computer Applications
Volume 83, 1 April 2017, Pages 40-52

Energy efficient clustering protocol based on improved metaheuristic in wireless sensor networks

Palvinder Singh Mann [a], Satvir Singh [b]

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Abstract

Energy efficient clustering is a well accepted NP-hard optimization problem in Wireless sensor networks (WSNs). Diverse paradigm of Computational intelligence (CI) including Evolutionary algorithms (EAs), Reinforcement learning (RL), Artificial immune systems (AIS), and more recently, Artificial bee colony (ABC) metaheuristic have been used for energy efficient clustering in WSNs. Due to ease of use and adaptive nature, ABC arose much interest over other population-based metaheuristics for solving optimization problems in WSNs. However, its search equation, which is comparably poor at exploitation and require storage of certain control parameters, contributes to its insufficiency. Thus, we present an improved Artificial bee colony (iABC) metaheuristic with an improved solution search equation to improve its exploitation capabilities. Additionally, in order to increase the global convergence of the proposed metaheuristic, an improved population sampling technique is introduced through Student's-t distribution, which require only one control parameter to compute and store, hence increase efficiency of proposed metaheuristic. The proposed metaheuristic maintain a good balance between exploration and exploitation search abilities with least memory requirements, moreover the use of first of its kind compact Student's-t distribution, make it suitable for limited hardware requirements of WSNs. Further, an energy efficient clustering protocol based on iABC metaheuristic is introduced, which inherit the capabilities of the proposed metaheuristic to obtain optimal cluster heads (CHs) and improve energy efficiency in WSNs. Simulation results shows that the proposed clustering protocol outperforms other well known protocols on the basis of packet delivery, throughput, energy consumption, network lifetime and latency as performance metric.

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Improved artificial bee colony metaheuristic for energy-efficient clustering in wireless sensor networks

- Palvinder Singh Mann ✉ &
- Satvir Singh

Artificial Intelligence Review **51**, 329–354 (2019)

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- Metrics

Abstract

Energy-efficient clustering is a well known NP-hard optimization problem for complex and dynamic Wireless sensor networks (WSNs) environment. Swarm intelligence (SI) based metaheuristic like Ant colony optimization, Particle swarm optimization and more recently Artificial bee colony (ABC) has shown desirable properties of being adaptive to solve optimization problem of energy efficient clustering in WSNs. ABC arose much interest over other population-based metaheuristics for solving optimization problems in WSNs due to ease of implementation however, its search equation contributes to its insufficiency due to poor exploitation phase and storage of certain control parameters. Thus, we propose an improved Artificial bee colony (iABC) metaheuristic with an improved search equation to enhance its exploitation capabilities and in order to increase the global convergence of the proposed metaheuristic, an improved population sampling technique is introduced through *Student's-t* distribution, which require only one control parameter to compute and store, hence increase efficiency of proposed metaheuristic. The proposed metaheuristic maintain a good balance between exploration and exploitation search abilities with least memory requirements, moreover the use of first of its kind compact *Student's-t* distribution, make it suitable for limited

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hardware requirements of WSNs. Further, an energy efficient bee clustering protocol based on iABC metaheuristic is introduced, which inherit the capabilities of the proposed metaheuristic to obtain optimal cluster heads and improve energy efficiency in WSNs. Simulation results show that the proposed clustering protocol outperforms other well known SI based protocols on the basis of packet delivery, throughput, energy consumption and extend network lifetime.

Introduction

Developments in wireless communication and electronics has led to the growth of low-cost, low-power, multi-functional WSNs that can operate in wide variety of diverse and complex environments and deliver wide range of applications. WSNs contain self-configured, distributed and autonomous Sensor Nodes (SNs) that monitor physical or environmental activities like humidity, temperature or sound in a specific area of deployment (Yick et al. 2008). SNs can have more than one sensor to capture data from the physical environment, wherever deployed. A sensor with limited storage and computation capabilities receive the sensed data through analogue to digital Converter (ADC) and process it further for transmission to a main location, known as *Base Station* (BS), where the data can be analysed for decision making in variety of applications (Al-Karaki and Kamal 2004). Every node also acts as a repeater for passing information of other sensor nodes to the sink. The most important part of the sensor node is its power supply,

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Research Article

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Graphical Processing Unit Accelerated Face Resolution Enhancement using Pixels- Homogeneity and Relative-Ratios

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ABSTRACT

This work presents a GPU (Graphical Processing Unit) accelerated spatial domain oriented face resolution enhancement algorithm based on the homogeneity levels and relative-ratios of the pixels with respect to its surrounding pixels. The algorithm has been developed, implemented as well as tested in the MATLAB environment. MATLAB is slow in processing but at the same time a resourceful environment for the development in the area of image processing owing to its extremely rich set of functions and programmer-friendly integrated development environment. However, to compensate for the speed loss in testing and implementation phase, we have made use of GPU computing i.e. done parallelization of the algorithm on NVIDIA GPU using CUDA (Compute Unified Device Architecture) interface in the MATLAB environment. It is a simple but efficient algorithm in which kernel matrices are created encoding the homogeneity levels and relative-ratios of all pixels in surrounding four quadrants. Kernel matrices are subsequently applied to reconstruct the HR (High-Resolution) version from input LR (Low-Resolution) facial image.

Key Words: Image processing, GPU computing, Face resolution enhancement, Surveillance videos, Spatial domain processing

INTRODUCTION

The processing of the facial images is an essential task in the smart video surveillance systems. The resolution of the facial images from surveillance videos is usually very less owing to the various factors such as hardware constraints, distance between the subjects and camera. Therefore enhancement concerning resolution is a major step for the purpose of overall improvement in the task of face detection and recognition. As the task of video processing demands of fast computational processing, the parallelization of proposed algorithm has been done on the NVIDIA Graphical Processing Unit (GPU) in CUDA (Compute Unified Device Architecture) under MATLAB environment.

The facial image processing systems can be classified based on different attributes, such as the number of input facial images, face angle, quality and source of images etc. Some of the techniques use single input LR (Low-Resolution) image, while some use multiple LR images which are captured generally from consecutive frames of video. The latter technique reconstructs the HR image from multiple LR images, therefore called as reconstruction based techniques. The other type of techniques which have attracted large amount of research work in past one decade are the learning based techniques. The relationship between single or multiple LR images and corresponding HR image is learned via a machine learning or intelligent technique. Further, the optimization techniques may be applied for tuning of weights to improve the results. Most of the learning based methods are based on the single facial image as input and use the trained system or dictionary to estimate the missing HR details. Reconstruction based models are based on the generalized smoothness priors while the learning based techniques use recognition based priors.

Based upon the region of interest, the human facial image processing systems can be classified in two major categories. The methods which use the positions of facial landmarks such as left eye, right eye, nose tip and other facial regions are called as local methods (Yang et al. (2010), Liu and Yang

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Improved metaheuristic-based energy-efficient clustering protocol with optimal base station location in wireless sensor networks

Soft Computing

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Abstract

Efficient clustering is a well-documented NP-hard optimization problem in wireless sensor networks (WSNs). Variety of computational intelligence techniques including evolutionary algorithms, reinforcement learning, artificial immune systems and recently, artificial bee colony (ABC) metaheuristic have been applied for efficient clustering in WSNs. Due to ease of use and adaptive nature, ABC arose much interest over other population-based metaheuristics

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Modified Viola–Jones algorithm with GPU accelerated training and parallelized skin color filtering-based face detection

Journal of Real-Time Image Processing

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Abstract

Face detection is a prominent research domain in the field of digital image processing. Out of various algorithms developed so far, Viola–Jones face detection has been highly successful. However, because of its complex nature, there is need to do more exploration in its various phases including training as well as actual face detection to find the scope of further improvement in terms of efficiency as well as accuracy under various constraints so as to detect and process the faces in real time. Its training phase for the screening of large amount of Haar features and generation of cascade classifiers is quite tedious and computationally intensive task. Any modification for improvement in its features or cascade classifiers requires re-training of all the features through example images, which are very large in number. Therefore, there is need to enhance the computational efficiency of training process of Viola–Jones face detection algorithm so that further enhancement in this framework is made easy. There are three main contributions in this research work. Firstly, we have achieved a considerable speedup by parallelizing the training as well as detection of rectangular Haar features based upon Viola–Jones framework on GPU. Secondly, the analysis of features selected through AdaBoost has been done, which can give intuitiveness in developing more innovative and efficient techniques for selecting competitive classifiers for the task of face detection, which can further be generalized for any type of object detection. Thirdly, implementation of parallelization techniques of modified version of Viola–Jones face detection algorithm in combination with skin color filtering to reduce the search space has been done. We have been able to achieve

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Microwave absorbing characteristics in Co^{2+} and Al^{3+} substituted $Ba_{0.5}Sr_{0.5}Co_xAl_xFe_{12-2x}O_{19}$ hexagonal ferrite

[illegible] Singh[1] · Charbujeet Singh[2,3] · Dalveer Kaur[4] · S. Bindra Narang[2] · [illegible] Jotania[5] · Rajat Joshi[1]

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Abstract The Co^{2+} and Al^{3+} ions substituted M-type hexagonal ferrites with chemical composition $Ba_{0.5}Sr_{0.5}Co_xAl_xFe_{12-2x}O_{19}$ ($x = 0.0, 0.2, 0.4, 0.6, 0.8$ and 1.0) were synthesized by a standard ceramic method. The prepared samples were characterized using X-ray diffraction in order to check phase purity. The absorber testing device method is adopted to investigate microwave absorption of ferrite compositions as a function of frequency, substitution and thickness from 8.2 to 12.4 GHz. The microwave absorption has been evaluated using the standard model of quarter wavelength mechanism and impedance matching mechanism. The microwave absorption is enhanced with the substitution of Co^{2+} and Al^{3+} ions in synthesized Ba–Sr hexagonal ferrites. Composition $x = 1.0$ exhibits good microwave absorber characteristics with 96.94 % absorbed power and -16.4 dB RL at matching frequency and thickness of 11.22 GHz and 2.9 mm respectively.

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1 Introduction

The tremendous growth in wireless technology sector has produced electromagnetic pollution attributing to high speed electronic devices operating in micro and millimeter wave regime. This undesired severity renders electromagnetic interference (EMI) leading to the malfunctioning of devices comprising of electrical and electronic circuits. The electronic devices, particularly oscillators or processors operating at GHz, generate harmonics or stray electromagnetic radiation causing bit error in the data received by wireless receivers. Furthermore, when the width of copper tracks of printed circuit boards is near to the quarter wavelength of the passing high frequency GHz signal, these tracks starts working as an antenna and radiate spurious electromagnetic signal referred as EMI. The microwave absorbers or radar absorbing materials (RAM) are used to suppress or attenuate this EMI or stray electromagnetic reflection from military aircraft, tank, radar etc.

Ferrites are employed in communication channel filters, ferrite rod antenna, Faraday law based microwave passive components, radar absorbing materials, tuning slug, radio frequency choke, wideband transformers etc. [1–4]. Their performance in electromagnetic interference (EMI) suppression is better compared to the conventional dielectric counterparts owing to the good magnetic properties. M-type hexagonal ferrites are ferrimagnetic in nature and incorporated particularly as microwave absorber and exhibit dielectric and magnetic losses, domain wall resonance and ferromagnetic resonance (FMR) associated with spin relaxation [4, 5]. They show high resistivity at microwave frequencies which is pertinent for reducing the unwanted eddy currents.

The various reports are available on the microwave absorption studies in ferrites. Moradi et al. [6] discussed

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Elucidation of phase evolution, microstructural, Mössbauer and magnetic properties of Co^{2-}–Al^{3-} doped M-type Ba–Sr hexaferrites synthesized by a ceramic method

Jashanpreet Singh [a], Charanjeet Singh [b, c], Dalveer Kaur [d], Hesham Zaki [e, f], I.A. Abdel-Latif [g, h], S. Bindra Narang [i], Rajshree Jotania [j], Sanjay R. Mishra [k], Rajat Joshi [b], Preksha Dhruv [l], Madhav Ghimire [m], Sagar E. Shirsath [n, *], S.S. Meena [o]

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ABSTRACT

M-type hexagonal ferrites with chemical composition $Ba_{0.5}Sr_{0.5}Co_xAl_xFe_{12-2x}O_{19}$ (x = 0.0, 0.2, 0.4, 0.6, 0.8 and 1.0) have been synthesized by a standard ceramic method. The structural and parameters associated with magnetic properties have been investigated as a function of Co^{2-} and Al^{3-} ions substitution in $Ba_{0.5}Sr_{0.5}Co_xAl_xFe_{12-2x}O_{19}$ ferrites at room temperature. X-ray diffraction and Fourier transform infrared spectroscopy were used to study the structure of the compositions, and grain morphology was evaluated with scanned electron micrographs (SEM). The Mössbauer studies were performed to investigate the site occupancy and hyperfine interactions in the compositions. The vibrating sample magnetometer was used to record hysteresis loops and magnetic parameters were calculated from hysteresis curves. XRD and FTIR analysis depict the formation of M-type and Spinel phases of the synthesized compositions. SEM images of all compositions show micrometer size structure in the compositions and variation of observed porosity in SEM with substitution is in agreement with calculated porosity from XRD and bulk density. The substitution of Co^{2-} and Al^{3-} ions results in reduction of coercivity and saturation magnetization by 76.79% and 38.40% respectively from x = 0.0 to 1.0. The remanent magnetization also observes reduction with substitution. The compositions have good scope for recording and microwave absorber applications.

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1. Introduction

Ferrimagnetic ($MFe_{12}O_{19}$) M-type hexagonal ferrites are the ferrimagnetic materials with magnetoplumbite (P63/mmc) structure and are incorporated for various technological applications such as microwave absorbers or radar absorbing materials (RAM), magnetic recording, channel filters, tuning slugs and microwave gyromagnetic devices. These applications are attributed to their temperature and time stability, low processing cost, tunable microwave absorption, high-saturation magnetization, large dielectric and magnetic losses, high resistivity, and low synthesis cost [1–5].

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Microwave absorption characteristics of Co^{2+} and W^{4+} substituted M-type $Ba_{0.5}Sr_{0.5}Co_xW_xFe_{12-2x}O_{19}$ hexagonal ferrites

Rajat Joshi[1] · Charanjeet Singh[1,3] · Dalveer Kaur[4] · S. Bindra Narang[3] · Rajshree Jotania[5] · Jasbir Singh[2]

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Abstract The Co^{2+} and W^{4+} ions substituted M-type hexagonal ferrites, with chemical compositional formula $Ba_{0.5}Sr_{0.5}Co_xW_xFe_{12-2x}O_{19}$ ($x = 0.0$, 0.2, 0.8 and 1.0), were synthesized by a standard ceramic method. The phase evolution of the compositions was characterized by using an X-ray diffraction. The microwave absorption of compositions has been investigated as a function of frequency, substitution and thickness from 8.2 to 12.4 GHz by an absorber testing device method. The microwave absorption has been evaluated using the standard model of quarter wavelength mechanism and an impedance matching mechanism. The microwave absorption is enhanced in $x = 0.0$ and 0.2, with former owes 97.0 % absorbed power at 11.22 GHz and 2.4 mm respectively. Compositions $x = 0.0$, 0.2 and 0.8 exhibit −10 dB absorption bandwidth of 500 MHz while $x = 1.0$ owes 330 and 340 MHz.

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Published online: 19 August 2016

1 Introduction

The proliferation in information technology sector, associated with circuits of electronic devices operating at micro and millimeter wave regime, has given rise to the wireless or electromagnetic pollution. This undesired severity renders electromagnetic interference (EMI) leading to the malfunctioning of devices comprising of electrical and electronic circuits. The electronic devices, particularly oscillators or processors operating at GHz, generate harmonics or stray electromagnetic radiation causing bit error in the data received by wireless receivers. Furthermore, when the width of copper tracks of printed circuit boards is near to the quarter wavelength of the passing high frequency GHz signal, these tracks starts working as an antenna and radiate spurious electromagnetic signal referred as EMI. The microwave absorbers or radar absorbing materials (RAM) are used to suppress or attenuate this EMI or stray electromagnetic reflection from military aircraft, tank, radar etc.

Ferrites are employed in antenna, gyromagnetic devices, RAM, channel filters, tuning slug, radio frequency coil, wideband transformers etc. [1–4]. Their performance in electromagnetic interference (EMI) suppression is better compared to the conventional dielectric counterparts owing to the good magnetic properties. M-type hexagonal ferrites are ferrimagnetic in nature and incorporated particularly as microwave absorber, and exhibit dielectric and magnetic losses, domain wall resonance and ferromagnetic resonance (FMR) associated with spin relaxation [4, 5]. They show high resistivity at microwave frequencies which is pertinent for reducing the unwanted eddy currents.

The number of investigators has reported the microwave absorption in materials: Guanglei Wu et al. reported various investigations on hollow Fe_3O_4 thickness, [illegible]

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Wormhole Attack Detection Technique in Mobile Ad Hoc Networks

Parminder Kaur[1] · Dalveer Kaur[2] · Rajiv Mahajan[3]

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Abstract A wormhole attack is harmful attack against routing protocols in ad hoc network where node attracts packets from one location and retransmits them to other location using [illegible] within the network. A wormhole attack can be easily launched between two attacker nodes without compromising the mobile nodes. Most of routing protocols don't have any defending technique against wormhole activities so in the presence of attacker nodes malicious activities may occur and disrupt network communication by tamper the data or forward the message to unknown location of the network to disrupt it functionality. Several routing protocols have been proposed to defend against wormhole attack in mobile ad hoc networks by adapting synchronization clocks, GPS or any special hardware. In this research article, we proposed a novel wormhole detection technique which identifies the wormhole attack by calculating the maximum end to end delay between two nodes within the communication range. Mobile nodes do not need to be equipped with GPS, clock synchronization or any other type of special hardware. The simulation results prove that proposed technique detects wormhole attack.

Keywords Mobile ad hoc networks (Manets) · AODV · Wormhole attack · Metrics · Network simulator · Friis equation · DelPHI

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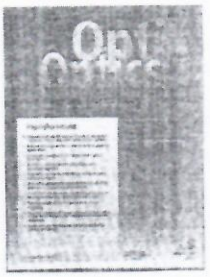

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Analysis and mitigation of XPM crosstalk in the scenario of mixed line rates for next generation access networks

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In this paper, we analyzed Cross Phase Modulation (XPM) crosstalk in bidirectional Passive Optical Networks. The proposed network is designed for Mixed Line Rates (MLRs) i.e. 10/ 20/ 40 Gbps to meet the requirement of high volume of heterogenic traffic. Further, the investigation is focused on uniform channel spacing and mixed channel spacing for MLRs. Various multidimensional results are presented to highlight and evaluate the impact of XPM in term of carrier to noise ratio (CNR), input power, received output power and BER. It is depicted that mixed channel spacing for MLRs performs better than conventional uniform channel spacing. It is also investigated that the effect of XPM on the system performance can be minimized with an optimal launch power.

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Keywords: Passive Optical Networks (PON), XPM crosstalk, Mixed channel spacing, Mixed Line Rates (MLRs)

1. Introduction

The volume of the demand of traffic in the next generation access networks brings up various design issues for supporting high data rate, large data bandwidth, enhanced security and scalability for the future applications [1, 2]. Hybrid Passive Optical Networks (PONs) with different multiplexing techniques like Wavelength Division Multiplexing (WDM), Time Division Multiplexing (TDM) and Code Division Multiple Access (CDMA) etc. are shown as a prominent solution to provide a cost-effective and scalable network to prop up the rising heterogeneity of traffic demands by having Mixed Line Rates (MLRs) over number of channels for all the end subscribers [3-5]. Due to propagation of number of channels in the same fiber and the increase in the channel bit rate, nonlinear impairments dominate the performance.

Monika et al. [2] reported Four Wave Mixing (FWM) in optical communication system for different number of input channels (2, 4, 6, 8, 12) using various values of uniform channel spacing i.e. 6.25 GHz, 12.5 GHz, 25 GHz, 40 GHz, 50 GHz with input channels. Wei Ji et al. [6] introduced a WDM-RoF-PON based linearly polarized dual-wavelength fiber laser and CSRZ-DPSK modulation without making any major changes in its infrastructure. Naresh Kumar et al. [7] evaluated WDM network with different modulation frequencies, transmission lengths and optical powers for variety of fiber for XPM-induced crosstalk at Single Mode Fiber (SMF), dispersion compensation fiber (DCF), True Wave Fiber (TWF), True Wave-Reduced Slope Fiber (TW-RSF) and Large Effective Area Fiber (LEAF). Various results were shown that, in Cross Phase Modulation (XPM) as the dispersion and effective area of fiber decreases, crosstalk increases with increase in modulation frequencies, transmission distaces. R. Goyal et al. [8] analyzed the performance of a hybrid (WDM/TDM) PON system for triple play services (video, voice and data) up to a distance of 28 km to 128 ONUs.

As per the literature survey, various architectures of PON have been investigated [2, 6, 8]. But the necessity of heterogeneities in the data rate and channel spacing is not achieved yet. In this paper, we have extended our previous work [8] and proposed a network with multi data rates at different channel spacing which have better results than conventional uniform channel spacing networks. Through this model, we can provide a flexible network to the end users in terms of data rate, bandwidth, channel spacing etc. as per their demand.

This paper focuses on the analysis of nonlinear crosstalk caused by XPM in PONs for MLRs i.e. 10/ 20/ 40 Gbps. Further, the two schemes (i) uniform channel spacing, (ii) mixed channel spacing for MLRs are discussed for the proposed network. The paper is organized into four sections. In section 1, introduction to PON is reported. Theoretical analysis of crosstalk due to XPM is studied in section 2. The proposed system setup is described in section 3. In section 4, results have been discussed for different non linear effects with carrier to noise ratio (CNR), input power, received output power, BER, number of ONUs. Finally, in section 5, conclusion is made.

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Chakresh Kumar* and Rakesh Goyal

Flattened gain S + C + L Band RAMAN–Thulium-Doped Tellurite Fiber Amplifier Hybrid Optical Amplifier for Super Dense Wavelength Division Multiplexing System

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Abstract: In this paper we have examined the performances of 180 × 10 Gbps super dense wavelength division multiplexing (SD-WDM) system using the RAMAN–thulium-doped tellurite fiber amplifier (TDTFA) hybrid optical amplifier (HOA) with the channel spacing of 50 GHz in S + C + L band. Accepted rating flattened gain of 39.21 dB with the noise figure less than 5 dB is archived with the dual-pumping (power level of 500 mW at 980 nm and at 1100 nm for RAMAN optical amplifier and similar, power level of TDTF amplifier is set to 500 mW and 350 mW at 1150 nm) technique. The effect of the proposed hybrid amplifier is evaluated in terms of gain and noise figure without using any coast effective technique. The outcome from the proposed model is also compared here with the existing optical amplifier.

Keywords: RAMAN, TDTF, gain, noise figure, hybrid optical amplifier, S + C + L band

1 Introduction

The demands of wide-band amplifier have been increased extensively for increasing the transmission capacity for super dense wavelength division multiplexing (SD-WDM) optical communication system [1–7]. A lot of work has been reported on thulium-doped tellurite fiber amplifier (TDFA) in S-band in terms of gain. The combination of silica- and tellurium Er^{3+}-doped fiber amplifier exhibits a large wavelength spectrum from 40 nm to 80 nm for super dense multiplex system [8, 9]. In the present research, the effects of amplified spontaneous emission (ASE) can be dismissed with the help of Er^{3+}- and Tm^{3+}-co-doped silica fiber amplifier [10]. In fact, rare-earth-doped fiber amplifier shows the tremendous growth in the best rating output because these amplifiers have their own bandwidths. In the recent years, the performances of Tm^{3+}- and Pr^{3+}-doped fiber amplifiers have been looked out for acceptable rating amplification in the range of 1,450 nm to 1,520 nm and 1,280 nm to 1,340 nm, respectively [11, 12, 13, 14]. Moreover, Tm^{3+}-co-doped fiber amplifier has shown a large seamless emission spectrum upto 200 nm in the super dense system.

To the best of our knowledge, this paper is reported for the very first time to archive the good rating flattened gain for S + C + L band with least noise figure with combination of RAMAN– thulium-doped tellurite fiber amplifier (TDTFA) hybrid optical amplifier (HOA) for 180 × 10 Gbps SD-WDM. The paper consists of four sections. Section 1 explains the introduction of current research, Section 2 explores about the simulation setup, Section 3 shows the detailed description of results and Section 4 gives the final conclusion of the proposed model.

2 Simulation setup

The performances of proposed HOA are evaluated in S + C + L band for 180 × 10 Gbps SD-WDM system with channel spacing 50 GHz. The simulation is done with the help of optsim software and its diagram is shown in Figure 1. Here, we have used 180 CW laser sources to generate the 180 optical signal. Data rate is set to 10 Gbps which was further fed to the NRZ electrical drive to generate the electrical signal. Amplitude modulator is the key component which helps out to convert the low-power signal to higher power signal means modulation. In this way, execution of one channel transmitter is completed. In a similar manner, the 180 channels are arranged in the bunch of compound component (CC).

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ORIGINAL RESEARCH

Analysis of proposed hybrid amplifier model for single to multi-channel WDM optical system at 10 Gbp/s with 100 GHz of channel spacing

Chakresh Kumar[1,2] · Rakesh Goyal[1]

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Abstract In this paper, we have investigated a possible single to multi-channel upgrade employing different amplification (Booster, EDFA amplifier and Raman amplifier). A 10 GB/s single channel signal is launched onto a fiber ($D = 3$ ps/nm/km) link of 140 km. The system works at the sensitivity limit. To upgrade the system, the power-budget at the receiver must increase employing an optical preamplifier. Two alternatives are explored: an EDFA or a RA. Two 10-channels WDM systems are shown employing respectively an EDFA and a Raman amplifier. EDFA gain and Rama amplifier counter propagating pump are determined to obtain the same optical gain for both the system configurations. A multiple run has been carried on to search the optimum RA configuration.

Keywords Wavelength division multiplexed system · Hybrid optical amplifier · RA and gain flatness

1 Introduction

Today's is the demand to increase the total capacity of long haul optical transmission systems. The advances in the optical communications have been promoted by development of efficient and powerful optical amplifiers, which eliminate the need of costly conversions from optical to electrical signal. The hybrid optical amplifier (RAMAN–SOA) has wide gain spectrum, large signal gain, pump consumption efficiency, and effective gain-bandwidth [1, 2]. At the same time, deregulation of telecommunication markets and global success of the internet has driven the demand for higher and higher system capacity. DWDM with hybrid optical amplifier is the key technology for increasing the transmission capacity in an optical fiber networks. In recent years, dense wavelength-division multiplexing (DWDM) transmission experiments utilizing a hybrid optical amplifier technique with a capacity of several terabits per second have been reported [3, 4]. Dispersion and internal losses are the main problem in the optical fiber communication system so to control these losses and fulfill the requirements of current optical research domain optical amplifier play the main role. Basically there are different type of optical amplifier are present in the optical domain, which are EDFA, SOA, RAMAN and optical waveguide amplifier. But each one of them has its own limitations, and Individual one cannot fulfill the high channel demands. So Hybrid optical amplifier is the promising and challenging technology for wavelength division multiplexing to dense wavelength division multiplexing technology [5, 6]. In the WAN networks different topologies have been used for increasing the capacity of bandwidth and efficiency [7, 8]. Moreover dispersion $D = 2$ ps/nm/km can be reduced in the multi channel with SOA [9]. Hybrid amplification, multiplexing and high speed signal transmission also the feature aspect. The feature requirement of high speed will be possible by combining the hybrid technology [10].

A hybrid passive optical network based FTTH is proposed for feature aspect which support voice, video signal and transmit data at the wavelengths range of

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Design and Evaluation of 10-Gbps Inter-satellite Optical Wireless Communication Link for Improved Performance

Amit Gupta ✉ / **Shaina Nagpal**

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Abstract

Inter-satellite optical wireless communication (IsOWC) systems can be chosen over existing microwave satellite systems for deploying in space in the future due to their high bandwidth, small size, light weight, low power and low cost. However, the IsOWC system suffers from various attenuations due to weather conditions, turbulence or scintillations which limit its performance and decreases its availability. So, in order to improve the performance, IsOWC system using directly modulated laser source is proposed

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Survey of Methods for Optimization of Transmit Power for Cognitive Radio Networks

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Abstract: Application of wireless devices and their services are growing at fast speed in few years, and because of this the demand of frequency resources has increased in a dramatic way. Accommodation of these wireless applications and related services within the limited spectrum bands has become a big challenge to the existing fixed spectrum allocation scheme. Thus, there is a need of spectrum regulations that are more flexible. Cognitive radio devices, can dynamically adjust their transmission parameters (transmit power, transmission rate, operating frequency, and etc.), and are capable to improving the spectrum consumption. The spectrum consumption can be enhanced by if primary users (PUs) and cognitive users (CUs) can operate simulateously in the similar frequency band. For this Cognitive radio (CR) is gaining a lot of attention.

Keywords - (CR) Cognitive radio, Secondary user, Primary user, efficient utilization of spectrum, power allocation strategy, Dynamic spectrum access

I. INTRODUCTION

Cognitive radio (CR)

Cognitive radio is a very smart technology which enhances the utilization potency of the scarce radio frequency spectrum and now these days it has attracted incredible interests. A key feature of CR technology is to enable cognitive user (CU) to share the similar band authorized to primary users (PUs) as long because the transmission of secondary/cognitive user does not adversely have an effect on any PU [1]. As a result, the first goal of the CR network is to guard the PUs from dangerous interference induced by the CUs further on meet the standard of service (QoS) demands of CUs. This transmission strategy is named as spectrum sharing [11].

Efficient utilization of spectrum

Recent decades are considered as an era of wireless communication. With the swift boom of communication technologies the spectrum resources are facing scarcity due to huge demands, so the proficient consumption of spectrum is becoming indispensable. Cognitive radio is a users) to work in underlay mode or overlay mode depending on whether the primary user is present or absent [14] respectively and thus helps in spectrum consumption..

Physical insufficiency and in addition proliferation of wireless devices has in current years caused a shortage within the electromagnetic radio spectrum. This has been created worse by the unskilled fullness and under-utilization that has resulted in spectrum holes. So as to enhance the potency of spectrum utilization, more versatile and dynamic spectrum management techniques and rules are needed. Cognitive radio was initial planned by Mitola[15], as a way to realize versatile spectrum management and thereby increase spectrum potency. Cognitive radio helps exploit spectrum holes and allows secondary (unlicensed) transmitters to opportunistically use global organization allotted spectrum or spectrum that is commissioned to primary users while not degrading the potency and capacity[8].In the few years, there are fast developments in the wireless technology, leading to the very rapid rise of wireless devices, good phones, tablets, and hand-held computers. It has been foreseen that the amount of wireless devices will reach around a hundred billion by 2025. This

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A modified butterfly optimization algorithm for mechanical design optimization problems

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Abstract

This paper presents a modified butterfly optimization algorithm (MBOA) for solving mechanical design optimization problems. The modification is focused on an additional intensive exploitation phase which provides more chance to solutions to improve itself. The performance of the proposed algorithm is validated on fifteen benchmark test functions and three engineering design problems which have different natures of objective functions, constraints and decision variables. The experimental results are analyzed in comparison with those reported in the literature. The results indicate that the MBOA provides very competitive results in comparison with other existing optimization algorithms.

Keywords

Butterfly optimization algorithm Intensive exploitation Benchmark functions Engineering design problems

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Butterfly optimization algorithm: a novel approach for global optimization

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Abstract

Real-world problems are complex as they are multidimensional and multimodal in nature that encourages computer scientists to develop better and efficient problem-solving methods. Nature-inspired metaheuristics have shown better performances than that of traditional approaches. Till date, researchers have presented and experimented with various nature-inspired metaheuristic algorithms to handle various search problems. This paper introduces a new nature-inspired algorithm, namely butterfly optimization algorithm (BOA) that mimics food search and mating behavior of butterflies, to solve global optimization problems. The framework is mainly based on the foraging strategy of butterflies, which utilize their sense of smell to determine the location of nectar or mating partner. In this paper, the proposed algorithm is tested and validated on a set of 30 benchmark test functions and its performance is compared with other metaheuristic algorithms. BOA is also employed to solve three classical engineering problems (spring design, welded beam design, and gear train design). Results indicate that the proposed BOA is more efficient than other metaheuristic algorithms.

Keywords

Butterfly optimization algorithm Global optimization Nature inspired Metaheuristic Benchmark test functions Engineering design problems

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1 Introduction

For million of years, nature has been developing many biological systems and helping them in their survival. With the time, these natural systems have become so robust and efficient that they can solve most of the real-world problems (Fister et al. 2013). Using key characteristics of these biological systems, various metaheuristic algorithms have been developed and employed to various optimization problems, whereas the conventional optimization algorithms fail to produce satisfactory results for problems with nonlinearity and multimodality (Back 1996; Onwubolu and Babu 2004). In engineering, many design applications require optimal solution under highly complex constraints over

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Optimal Node Clustering and Scheduling in Wireless Sensor Networks

Wireless Personal Communications

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Article
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Abstract

Selection and rotation of cluster head (CH) is a well known optimization problem in hierarchical Wireless sensor networks (WSNs), which affects its overall network performance. Population-based metaheuristic particularly Artificial bee colony (ABC) has shown to be competitive over other metaheuristics for solving optimization problems in WSNs. However, its search equation contributes to its insufficiency due to poor exploitation phase and low convergence rate. This paper, presents an improved artificial bee colony (iABC)

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Interference Cancellation in Broadcast Channel of Multiuser MIMO system using Block Diagonalization and Dirty Paper Coding Schemes

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Abstract — *In Multiuser MIMO system, multiple antennas are placed on base station and also on multiple users. Multiple antennas technique enhanced the performance parameters like reliability and data rate of wireless communication system without required more bandwidth. multiple antennas at transmitting and receiving end provides transmitting and receiving diversity. diversity increases the reliability of signal and spatial multiplexing increases the data rate by transmitting multiple information streams between transmitter and receiver. The base station transmits multiple streams to mobile station through downlink channel, known as broadcast channel and mobile users also transmit multiple streams to base station through uplink channel, known as multiple access channel. This paper considers only broadcast channel, the major issue in information transmission in broadcast channel is that the desired signal on the receiving side is affected by other user interference as well as intersymbol interference. So, interference cancellation schemes on the transmitting end plays very important role to reduced interference on receiving end in multiuser MIMO wireless communication system. This paper discusses two interference cancellation schemes, Block Diagonalization (BD) and Dirty Paper Coding (DPC). Block Diagonalization is linear precoding technique that is used at transmitting end and it uses singular value decomposition operation to get block diagonalization precoding weights. Dirty Paper Coding is non-linear precoding technique; this technique is applied only when channel gains are completely known at transmitting end. This paper also shows performance comparison of block diagonalization and dirty paper coding schemes in term of Bit Error Rate.*

Keywords-*Multiuser MIMO, Block Diagonalization, DPC.*

I. INTRODUCTION

MIMO technique was first introduced for point to point or Single User communication system, in this technique: multiple antennas are placed on base station and mobile station. SU-MIMO plays very important role in Long Term Evolution (LTE), which needs 300 Mb/s data rate for Downlink Channel (DLC) and 75 Mb/s for Uplink Channel (ULC). In LTE advanced, the data rate target is approximately 1 Gb/s for DLC and 500 Mb/s for ULC. MU-MIMO is the key technique to achieve the date rate 1 Gb/s in DLC. In MU-MIMO system, more than one user is used and all users are equipped with multi antennas and base station with multiple antennas provides services to multiples users simultaneously. Fig.1 shows the Single User and Multiuser communication system [1].

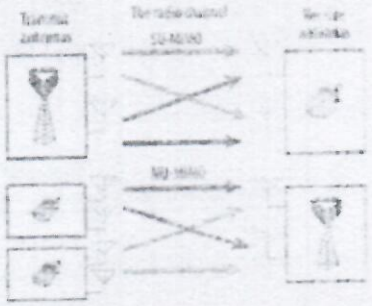

Fig.1. SU-MIMO and MU-MIMO system

A. CHALLENGES IN MU-MIMO

There are two challenges in a multiuser MIMO scenario, one is uplink challenge and second one is downlink challenge. The uplink problem is addressable by using array processing and multi-user detection can be done by base station for separating signals sent by user. The downlink problem is to be analysed differently. There is much similarity between Multi User-MIMO downlink and single user MIMO, however the receiver antennas are distributed among different independent users. This may cause a problem while decoding the received symbols since joint decoding requires that every user has all symbols received from receiver antennas of

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ORIGINAL PAPER

Effect of interface in dielectric relaxation properties of PEMA–$BaZrO_3$ nanocomposites

Pramod Kumar Singh[1] · Pankaj Goyal[1] · Ashutosh Sharma[2] · Rajesh[3] · Dalveer Kaur[3] · M. S. Gaur[1]

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Abstract XRD peaks demonstrate the interaction of nanoparticles with polymer matrix. It is evident from the dielectric data that observed change in dielectric parameters would result from appropriate changes in chain mobility due to nanoparticles–polymer interactions. FT-IR spectra represent the significant changes in intensity, shape and position of the different vibrational bands corresponding to –OH stretching, C–O–C stretching, C–H stretching and C–O–C in C–H stretching modes occur as a result of the incorporation of $BaZrO_3$ nanofiller. Thermally stimulated discharge current (TSDC) and transient discharging current study presented the dipolar and interfacial type of relaxations.

Keywords PEMA · $BaZrO_3$ · FT-IR · Cole–Cole plot · TSDC

Introduction

In recent years, polymer nanocomposites have become a great challenge for scientists to create novel polymer-based systems with peculiar structural and functional properties [1]. The properties of nanocomposites are differing from the properties of both bulk materials and individual nanoparticles. Thus, nanocomposite

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ARTICLE

Performance Evaluation of RAMAN-EDFA-RAMAN Hybrid Optical Amplifier in the Context of High Spectral Efficiency

Chakresh Kumar[1, 2, *] and Rakesh Goyal[1]

In this paper, we have proposed a new modulation technology based on return-to-zero (RZ) and differential quadrature phase shift keying (DQPSK) for 100 × 100 Gbps and 200 × 100 Gbps super dense wavelength division multiplexing (SD-WDM) system with 6.25 GHz channel spacing. High spectral modulating signals have transmitted with the support of RAMAN-EDFA-RAMAN hybrid optical amplifier (HOA). Acceptable outcomes have recorded in terms of quality factor (12 dB) and bit error rate (BER) (1e-28) with transmission rate of 100 Gbps. Further, it has also observed that input power of 5 mW has provided acceptable flat gain with least variation of 2.5 dB for 100 × 100 Gbps SD-WDM system. Furthermore, outcomes from the proposed modulation technology in terms of quality factor (Q-factor) and bit error rate (BER) have fully supported to 200 × 100 Gbps SD-WDM system for high-spectral efficiency.

Keywords: SD-WDM, Hybrid Optical Amplifier, RAMAN, EDFA.

1. INTRODUCTION

High transmission speed in optical communication domain is today's promise technology. But the demand for huge bandwidth is also a big problem that can be resolved by using different orthogonal modulated technique. In fact, most of the research group have been shown their interest in this area and research has been carried out in number of modulation technologies such as symmetrical differential phase shift keying (SDPSK) [1], differential quadrature phase shift keying (DQPSK) [2], Duobinary [3], and non-return-to-zero (NRZ) [4] etc. Hybrid optical amplifier (HOA) is the main candidate for super dense wavelength division multiplexing system (SD-WDM), which not only overcome the effect of fiber nonlinearity and amplified spontaneous emission (ASE) but also provided the platform to enhance the channel capacity [12–13]. Sho et al. [4] have proposed new modulation techniques such as dark return-to-zero (DRZ), differential quadrature phase shift keying (DQPSK) and polarization-shift-keying (POISK) to enhance the performance of transmission system in terms of least bandwidth with high data rate. Further, authors have also claim that proposed technology was capable to transmit 100 Gbps data rate in terms of least phase error. Unfortunately, in this paper, impact of hybrid optical amplifier has not been shown, which should be an important consideration for high-speed data transmission for long haul super dense optical communication. Lee et al. [5] have proposed an experimental setup for improving the transmission capacity with the help of hybrid amplifier. Best outcomes have reported in terms of bit error rate and gain. Singh et al. [6] have proposed a new modulation technology (NRZ and polarization-shifting-keying) for DWDM system and remarkable performances have been claim in terms of optical power, bit error rate and quality factor for enhancing the high spectral transmission efficiency. In fact, this proposed work has really helped us for the betterment in this research work using RAMAN-EDFA-RAMAN hybrid optical amplifier for proposed modulation technique (return-to-zero (RZ) and differential quadrature phase shift keying (DQPSK) in super dense wavelength division multiplexing (SD-WDM) system. Yufeng et al. [1] have presented a new transmission technology with the help of delay line Mach-Zehnder interferometer with two-phase modulation. Further, authors have declared that

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ORIGINAL PAPER

Performance Analysis of Hybrid Optical Amplifiers for Super Dense Wavelength Division Multiplexing System in the Scenario of Reduced Channel Spacing

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Abstract: In this paper, we have evaluated 200 channels super dense wavelength division multiplexing system (SD-WDM) with varying channel spacing from 100 to 900 GHz. Effect of proposed RAMAN-EDFA-RAMAN, RAMAN-EDFA, EDFA-SOA and SOA–SOA hybrid optical amplifier (HOA) have been traced out in term of the quality factor, bit error rate, gain, eye closure and output power respectively. It has also analyzed that RAMAN-EDFA-RAMAN HOA delivers the best rating outcome with the channel spacing of 3.125 GHz for long haul communication system. Further, dispersion compensation technique has also used to enhance the data rate up to 50 Gbps with the support of RAMAN-EDFA-RAMAN HOA. Maximum transmission distance of 400 km has covered by the same HOA with acceptable parameters in term of least bit error rate, good rating quality factor, and best-reported output power from the proposed system.

Keywords: Hybrid optical amplifier; Super dense wavelength division multiplexing system; Bit error rate; Channel spacing; RAMAN; EDFA; SOA; Dispersion compensation

1. Introduction

The enormous demand of high-speed internet for huge data transmission creates the tremendous growth in bandwidth for super dense wavelength division multiplexing system (SD-WDM) [1–4]. Hybrid optical amplifier sets the benchmark for the super dense wavelength division multiplexing system (SD-WDM) in term of bit error rate, quality factor, crosstalk, and massive output power [5–7]. Different combination of the optical amplifier has been recommended in the existing article, which further support to the super dense system to attain good rating flattened gain and large gain bandwidth [8–10]. The arrangement of the hybrid optical amplifier has made with the help of fiber RAMAN amplifier (FRA), erbium-doped fiber amplifier (EDFA) and semiconductor optical amplifiers (SOA) amplifier for getting the desired outcome in term of low-noise, highly efficient with high gain, and compact. The demand of EDFA amplifier is increasing for the long haul optical communication system, which is mainly operated on (1.5–1.6) μm band amplification. In recent years, tremendous data speed of several terabits per second has been projected for the dense wavelength-division multiplexing system (DWDM) [11, 12]. On the other hand, the performances of the RAMAN amplifier and combination of SOA and EDFA have been noticed down in term of gain flatness, bit error rate and data speed by adjusting the pump wavelength for dense multiplexing system [13–16].

Huri et al. [17] have evaluated the performance of a hybrid amplifier (SOA-EDFA) to achieve the flattened gain. The amplifiers have operated at 4 dB of gain flatness and 11 dB of noise figure for multiplexing system. Unfortunately, the effect of the hybrid amplifier has not been considered in terms of narrow channel spacing in this paper, which is an important consideration for long haul communication system, moreover this proposed model has also not been operated for ultra-broadband to neglect the effect maximum variation in term of gain and noise figure.

Tiwari et al. [18] have represented the performance of less than eight channel wavelength division system in term

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A novel flattened gain C-band cascaded hybrid optical Raman and thulium-doped fluoride fiber amplifier for super dense wavelength division multiplexing system

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In this paper, we have reported a very advanced hybrid optical amplifier (Raman-TDFF amplifier) for the 180 × 10 Gbps super dense wavelength division multiplexing system with the channel spacing of 100 GHz. The performances of the model have been evaluated in terms of gain and noise figures for the C-band (from 1525 to 1565 nm). Gain flatness (>21 dB) is recorded with the least variation of 2.5 dB without using any cost effective technique. Further, the effect of the proposed hybrid optical amplifier has also been analyzed with slightly shifting the wavelength spectrum for the same feature.

Keywords: gain, noise figure, Raman amplifier, thulium-doped fluoride fiber (TDFF) amplifier, super dense wavelength division multiplexing (SD-WDM), hybrid optical amplifier.

1. Introduction

The transmission of optical signals with high spectral efficiency now required the newly advanced optical amplifier for the super dense wavelength division multiplexing (SD-WDM) system. Thulium-doped fluoride fiber (TDFF) amplifier has been recently exposed as the right candidate for the next generation (SD-WDM) system. It has shown accepted rating for S$^+$-band (1450–1480 nm), S-band (1480–1530 nm) and L-band with the combinations of Raman, EDFA and SOA amplifiers [1–3]. Numbers of experiments have been evaluated with the TDFF amplifier [4, 5]. The capacity of the proposed amplifier can be increased with the help of pumping techniques, which are given as single wavelength conversion pumping [6, 7], dual wavelength pumping, and triple wavelength pumping [5, 8–12], respectively. The highest gain can be attained with the lowest

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L-BAND FLAT-GAIN RAMAN WITH ERBIUM-DOPED FLUORIDE HYBRID OPTICAL AMPLIFIER FOR SUPERDENSE WAVELENGTH DIVISION MULTIPLEXING SYSTEM

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Abstract

To the best of our knowledge, we explore, for the very first time, the performance using Raman-EDFFA hybrid amplifier for super dense multiplexing system. We evaluate the system in terms of flat gain, noise figure, and good rating quality factor for *L*-band. A highest flat gain of 26.01 dB is observed over a wavelength range of 1,578 to 1,640 nm with a smaller variation of 1.5 dB without using any cost influence techniques. Further, we also observe that an input power level of −25 dB is quite suitable for acceptable amplification.

Keywords: RAMAN, EDFF, flat gain, noise figure, hybrid optical amplifier, *L* band.

1. Introduction

The super-dense wavelength division multiplexing system (SD-WDM) is the future technology to enhance the transmission capacity, which sets up the benchmark to transmit a large number of channels from one transmission path to the other [1]. For transmitting the huge capacity signal, an advanced cascaded optical amplifier is required. The erbium-doped fluoride fiber amplifier (EDFFA) is the straightforward choice for acceptable outcome in terms of flat gain, good rating quality factor, and higher spectrum flatness.

However, the ordinary optical amplifier, such as the erbium-doped silica fiber amplifier (EDSFA), is not able to deliver best rating outcomes in terms of gain bandwidth [2] and uniform gain spectrum. In the past, a number of ways have been proposed to raise the flat gain for multiplexing system [3,4]. The flat gain can be archived using the following techniques: (a) to inline the hybrid amplifier in the transmission fiber [5], (b) to find a parallel arrangement of gain bands [6,7], (c) to employ new host material [7], and (d) to gain equalizing optical filters [8,9].

Our purpose in this paper is to explore the performances of Raman-EDFFA hybrid optical amplifier (HOA) for a 180×10 Gbps (SD-WDM) system.

This paper consists of four sections. In Sec. 1, we give an introduction of the existing technology, while in Sec. 2 we explore the simulation setup. In Sec. 3, we present the final outcome in terms of different aspects and summarize the obtained results in Sec. 4.

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All-optical Integrated Parity Generator and Checker Using an SOA-based Optical Tree Architecture

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The Semiconductor Optical Amplifier (SOA)-based Mach-Zehnder interferometer is a major contributor in all-optical digital processing and optical computation. Optical tree architecture provides one of the new, alternative schemes for integrated all-optical arithmetic and logical operations. In this paper, we propose an all-optical 3-bit integrated parity generator and checker using SOA-MZI-based optical tree architecture. The proposed scheme, able to process input signals at a desired operating wavelength, has been characterized using RZ-modulated signals at 10 Gbps. The maximum extinction ratios achieved at the output of the parity generator and checker are 10 dB and 8 dB respectively.

Keywords: Semiconductor optical amplifier (SOA), SOA-MZI, Parity generator, Parity checker, Optical tree architecture (OTA), Optical computing
OCIS codes: (060.1155) All-optical networks; (060.1810) Buffers, couplers, routers, switches and multiplexers; (060.2320) Fiber optics amplifiers and oscillators

I. INTRODUCTION

The data communication industry demands a major increase in the bandwidth of the transmission channel. Electronic systems are not capable of processing a large amount of data at high frequencies (above GHz), but this limitation can be overcome if the traditionally used electrons are replaced by photons, for digital circuits based on switching and data processing [1, 2].

Many distinct techniques have been proposed to implement all-optical digital devices using nonlinear effects in either optical fiber or a semiconductor optical amplifier (SOA). Compared to the nonlinearity of optical fiber, SOA-based all-optical switches exhibit tremendous performance in terms of low power consumption, optical integration, and high speed [3, 4]. Out of the different types of all-optical switches that are used to design combinational circuits, the SOA-based Mach-Zehnder Interferometer (SOA-MZI) has been widely preferred, due to its fast operational speed and easy integration with active and passive components [5-7].

In optical computing, the optical interconnecting systems are the primary elements constituting various architectures and algorithms. Optical tree architecture (OTA) plays a significant role in optical interconnecting networks, and SOA-MZI-based OTA can be used to realize all-optical digital devices by selection of the suitable branch of the tree [8].

To verify the integrity of recovered digital data, parity generation and checking has been the most widely used method in digital communication systems. A parity-generator circuit plays an important role in analyzing the discrepancy between transmitted and received bit patterns simultaneously. A parity bit is included in the binary message, which is sent from the transmitting end and then checked for errors at the receiving end. If the received bits do not correspond to the transmitted bits, error is detected. A parity-checker circuit thus contributes by checking for errors in the number of bits transmitted and received, and therefore is used in data computing systems [9].

Poustie *et al.* reported an all-optical parity checker with

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A Performance Enhancement and High Speed Spectrum Sliced Free Space Optical System

Wireless Personal Communications

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Abstract

A cost effective Kerr nonlinearity based spectrum sliced (SS) WDM free space optical communication system is demonstrated under different weather instabilities. The investigated supercontinuum spectrum sliced WDM FSO system is evaluated at 2.5 Gbps up to 5 km of link distance. A highly nonlinear fiber is a channel for the generation of high power broad spectrum for spectrum slicing. A dense SS-WDM is investigated at 75 GHz channel spacing among 4 channels to make system bandwidth efficient. The system is investigated for different line coding (return to zero, non return to zero) and advanced modulation format such as compressed spectrum return to zero. A major degrading factor in free space communication i.e. beam divergence is also analyzed for investigated work. Antenna diameters of receiver and transmitter play a vital role in FSO, thus various diameters performances are also studied. The approach is to cater the high-speed data demands and thus system deliberated and demonstrated from 2.5 to 10 Gbps. To strengthen the signal in this FSO system, three optical amplifiers are scrutinized such as erbium doped fiber amplifier (EDFA), semiconductor optical amplifier (SOA) and Raman amplifier in terms of bit error rate and quality factor. Results revealed that EDFA is the best amplifier in investigated SS-WDM-FSO system.

Keywords

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Original research article

Kerr effect based spectrum sliced wavelength division multiplexing for free space optical communication

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Abstract

The super-continuum spectrum sliced WDM FSO system is evaluated at 2.5 Gbps data rate up to link distance of 5 Km. A Highly Nonlinear Fiber (HNLF) is channel for the generation of high power broad spectrum for spectrum slicing. A dense SS-WDM is investigated at 75 GHz channel spacing among 4 channels to make system bandwidth efficient. Performance of SC-SS-WDM and WDM is scrutinized for FSO system under rain, fog, haze etc. Wavelength division free space optical system exhibits more error at 5 Km as compared to spectrum sliced WDM FSO system. Also, the demonstrated architecture is accommodative, flexible and low cost system that can perform well under atmospheric turbulences.

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Efficient Utilization of Vacant Spectrum using Reconfigurable Secondary Users in Cognitive Radio Network

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Abstract – In the era of entirely wireless, mobile communication technology, the demand of high-speed, high-performance has been increasing infinitely. But the radio spectrum used for wireless and mobile communications is a finite resource. Cognitive radio comes out as a solution to this problem as it allows the vacant frequency band in the licensed spectrum to be used by an unlicensed user without causing interference to the licensed user. In this paper, method of allocating the vacant spectrum to the unlicensed user, in a way to improve spectral efficiency is discussed.

Index Terms – Cognitive radio, Dynamic spectrum allocation, OFDM, Capacity, IEEE 802.16 WiMAX standard.

1. INTRODUCTION

Cognitive radio has emerged as potential technology to improve the spectral utilization. According to FCC (Federal Communication Commission), Cognitive radio senses the electromagnetic environment, identifies the unused frequency bands in the spectrum, dynamically varies the radio operating parameters according to the availability of unused frequency band and then operates in those unused frequency bands where no activity by licensed user is detected. For further improving the spectral efficiency several DSA (Dynamic Spectrum Access) models have been proposed depending on the specificities of the environment. In the specific DSA context, the following definition proposed in [1] is one of the most cited ones: "Cognitive radio is an intelligent wireless communication system that is aware of its surrounding environment, and uses the methodology of understanding by building to learn from the environment and adapt its internal states to statistical variations in the incoming Radio Frequency (RF) stimuli by making corresponding changes in certain operating parameters (e.g., transmit power, carrier-frequency and modulation strategy) in real-time, with two primary objectives in mind:

- Highly reliable communication whenever and wherever needed
- Efficient utilization of the radio spectrum."

Several DSA models have been proposed to increase spectrum usage efficiency depending on the specificities of the environment. As described in Figure 1, DSA strategies can be in general classified into three different models [2]

Dynamic spectrum allocation approach used in this paper improves spectrum efficiency by dynamically assigning spectrum based on the spatial and temporal traffic statistics of different services. To implement this approach, the detected vacant frequency band is allocated to the OFDM standards employing unlicensed Secondary users which will re-configures its OFDM parameters according the available bandwidth. The aim of the research is to first sense the spectrum to find the vacant frequency bands and allocate the detected vacant frequency bands to the unlicensed user. In the second part, the research focuses on increasing the spectral efficiency. There are so many techniques available in the literature for spectrum sensing, each designed keeping in mind different requirements. Energy detection being one of them, it doesn't requires prior knowledge of the transmitting signal of the primary user. Thus making it most reliable and widely used. So for sensing the spectrum, Energy based detection technique is used and assuming the channel noise to be AWGN (Additive White Gaussian Noise).

Dynamic spectrum allocation approach used in the research improves spectrum efficiency by dynamically assigning spectrum based on the spatial and temporal traffic statistics of different services. To implement this approach, the detected vacant frequency band is allocated to the OFDM standards employing unlicensed Secondary users which will re-configures its OFDM parameters according the available bandwidth. Thus minimizing the difference between the available capacity and the capacity achieved by the unlicensed user to improve the spectral efficiency.

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A Novel Approach of Cooperative Sharing Based On Hybrid Relaying Scheme of Chase Algo and Decode & Forward Using Fuzzy Logic in Cognitive Radio

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Abstract :Throughput of Cooperative network can be enhanced by using different relay selection scheme ,therefore interest in relay selection is going upwards .It an open research topic these days.We proposed a relay selection algorithm named as chase algorithm which select the best relay on the basis of some parameters like SNR, channel allocation, power allocation, interference constraint .Further at every relay node, Decode & Forward protocol is used for removing the noise in further stages .Finally with the help of fuzzy controller in which the SNR,channel allocation ,power allocation,interference constraint are the fuzzy parameters ,we propose an expected model that reduce some computational load and enhance the channel rate.

Keywords—*CooperativeCommunication , ChaseAlgo, Decode and forward , FuzzyLogic*

I. INTRODUCTION

Nowadays Cooperative Communication has been widely used.By cooperative Communication not only the throughput increase but the power is sufficiently allocated ,acquire better quality of service ,improving spatial diversity,good transmission opportunities exploitation and SNR also gets improved.So that is the reason ,Cooperative Spectrum Sharing has a great zeal and a open research topics these days[1-2].For exploiting the diverse attributes of the wireless communication. Relays came into a picture between source & destination which in simpler way acts as a forwarding the signal from Source to destination .Here making secondary users(SU's) as a relay for opportunistically exploitation of spectrum which is basic requirement well discussed in DSA(Dynamic Spectrum Access) technique[3].The relays forwards the message by some relaying protocols mention as Amplify and Forward , Decode and Forward ,Compressed and Forward etc[4].Relay selection is studied broadly nowadays by researchers and splendid work being going in this field[5-7].So,broadly categorize the relay selection into 5 major classification as on the basis of technique selection.

a.Geographical information based relay selection: This relay selection method based upon the distance from source to relay and from relay to destination .its aim to reduce the symbol error probability but this proposed algo is not suitable for practical situation cases because of shadowing and channel effects.[8]

b.Energy efficient based relay selection: Generally total energy is used to explore the best relay.[9].with the motive of reducing the overall lifetime of network ,power aware relay selection is proposed .furthermore ,optimal power allocation also came into picture.[10]

c. **c.Outage probability based relay selection:**In this case of outage probability based relay selection scheme best relay is selected on the basis of its maximum probability without disturbing the performance and with the amendments in network lifetime.[11]

d.interference aware relay selection: In case of wireless communication ,interference is the very common hurdle ,and it is more severe in multihop transmissions by interference based relay selection .we can explored the maximization of mutual information on cooperative communication network with the limited interference distribution.[12]

e.Channel state information(CSI) based relay selection:Opportunistic relay is one of the best technique for relay selection because in this source have a full knowledge of source to relay and from relay to destination ,only then source identify the best relay [13].The Author in [14] exploit the outdated CSI(channel state information) for selecting the best feasible relay .Moreover in [15], Author took residual energy and CSI as the input fuzzy parameters for selecting the best relay.

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Issues and Challenges in Energy Harvested based Wireless Sensor Network

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Abstract— Wireless sensor network (WSN) suffers the problem of battery consumption, which cannot be replaced in remote regions. Energy harvesting is a prominent technique for the above problem. Energy can be harvested from the external environment like solar energy, wind energy, thermal energy, RF energy, piezoelectric energy, etc. to recharge the batteries which subsequently increases the life of the network. These conventional sources of energy provide energy on a macro scale but in relation to WSN they need to be carried out on a smaller scale. Energy harvesters may or may not provide the continuous energy to the networks. This area needs to be explored while keeping in mind issues and challenges to meet the requirements of the network. This paper discusses the limitations of WSN, energy harvesting techniques and the issues and challenges in implementing energy harvesting in WSN. Environment, design, size, reliability, performance, resource sharing, hybrid energy harvesting, battery issues, low power and security are some of the major issues and challenges in energy harvesting based WSN.

Keywords—Wireless Sensor Network, Issues and Challenges, Limitations, Energy Harvesting, Solar harvesting, RF energy harvesting.

I. INTRODUCTION

Wireless Sensor Network (WSN) consists of tiny sensory units called nodes interconnected to form a network for a special task. These sensory units or nodes detect the surrounding environment, accumulate data, process it and pass it onto the sink node. Sensor networks have a number of applications like medical applications, farming, environmental science, weather prediction, tracking and monitoring, military applications, and so on A sensor node performs various tasks like sensing, conversion of data, computation, storage and communication. All its working relies on batteries.

Use of batteries limits the life of the sensor nodes, therefore, approaches must be there to prolong the battery lifetime of the network. The above can be done using energy harvesting techniques to harvest the energy from the external sources to extend the lifetime of the network. Energy harvesting capable node is equipped with energy harvesting circuit which extracts the energy from the external environment, converts it into the usable electrical signal which is then can be used for later use. [1],[2]

This paper is organized as follows, section I introduces the energy harvesting in WSN, section II discusses the limitations of WSN, section III gives a brief description of energy harvesting techniques used in WSN and various issues and challenges in energy harvesting in WSN are listed in section IV and section V concludes the paper.

II. LIMITATIONS OF WSN

WSN has a number of limitations in different fields. Following are some major limitations of WSN [1], [2]:

1. Limited Battery Capacity

Sensor nodes are equipped with relatively small batteries, which is one of the limitations of WSN. The majority of the sensor nodes die due to the loss of power for operation. Low battery powered nodes result in data loss, network failure and degradation.

2. Large Battery Size, Cost and Weight

As WSN suffers from limited battery capacity for its operation, using large batteries incurs high cost and adds weight to the node making it bulky and incompatible with the node.

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A Review on Solar Energy Harvesting Wireless Sensor Network

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Abstract— The finite energy of batteries associated with wireless sensor networks is a major constraint which limits its lifetime. One of the methods to overcome this major limitation is energy harvesting systems. Thither are many energy sources available nowadays, but solar energy is flexible, mature and external power source so it is broadly used for energy harvesting in WSN to enhance the life of the network used. This paper presented an overview of solar energy harvesting system and the impact of solar energy harvesting on Wireless Sensor Network. We have also propounded the various energy harvesting sources that are used for WSNs and energy harvesting process. This paper also describes the supercapacitor and various recharging batteries.

Keywords— Wireless sensor network (WSN), Energy Harvesting (EH), Solar energy harvesting (SEH)

I. INTRODUCTION

Wireless sensor network (WSN) is a network, in which there is a random or a symmetric deployment of nodes depending upon the application, to sense the data to execute numerous operations. Due to the miniature size of the WSN, it is employed within a vast diversity of applications comprising defense, medical, industrial applications, environmental and ocean monitoring. WSN is one of the biggest and furthermost used networks in the world. The life cycle and performance of the wireless sensor node and communication paths play a key role in these applications of WSNs. A sensor node comprises of four primary components a sensing unit, a transceiver unit, a processing unit, power unit and it might have secondary application-dependent constituents such as mobilizer, position detection system and power generator [1]. The power unit is one of the prime components of sensor nodes. Solar cells and other subunits used as a scavenging unit to back up power units of sensor network depending upon the application [1]. Mostly power can be supplied to WSN through energy storage devices such as batteries or supercapacitors but now a day some renewable sources are applied to supply power to the network.

Since most of the WSN applications are situated in an inhospitable area consequently replacement of the batteries would be inconvenient. Hence, it is strenuous to enlarge the lifespan of WSNs under a finite power of device [2]. Therefore, energy harvesting technologies could be utilized to prolong the life span of the wireless sensor network and the supreme familiar sources that are used for energy harvesting are solar, wind, vibration, RF (Radio frequency), thermal.

One of the novel techniques to extend the WSN lifetime is solar energy harvesting (SEH) system which can transform the solar power into electrical power and stowed it in the sensor batteries for upcoming purposes. The advantages of solar energy are given as follows [3]:

- Solar energy is the eternal power source and eco-friendly.
- Highest achieved power density of the solar energy is 10–15 mW/cm² as a contrast to other renewable energy sources.
- Solar energy is flexible, complimentary of cost and doesn't pollute the surroundings.
- Solar energy systems require compact preservation and last up to a number of years.

The main applications of SEH-WSNs are Temperature monitoring, light intensity measurement, Humidity measurement, pressure monitoring, environment monitoring, Burning Mountains monitoring, Construction monitoring, Transportation monitoring, air quality monitoring, and Forest monitoring [3].

The rest of the paper is organized as follows. Section 2 Renewable energy resources for WSN. Section 3 Energy harvesting in WSN, Section 4 presents Energy storage devices in WSN, Solar energy harvesting WSN (SEH-WSN) is described in Section 5, whereas Section 6 describes the impact of solar energy harvesting on WSN. Finally, Section 6 draws the conclusions.

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Nurturing Wireless Communication: Coalition of Cognitive Radio with Li-Fi

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Abstract— Evolution of surplus gadgets accessing web facilities has eventually actuated the resource congestion. Several alluring data grabbing techniques are utilized with their respective pros and cons. The paper administers a concept which is based on the integration of the Li-Fi with the Cognitive Radio technology, diversifying the wireless communication with hiking spectrum utilization and vast capacity. The concept adheres to improve the multi-user communication by relying on the use of both the optical as well as the radio frequency spectrums in a communicating network which is more effective instead of using Li-Fi or Cognitive Radio independently.

Keywords— Cognitive Radio (CR), LED (Light Emitting Diode), Light Fidelity (Li-Fi), Visible Light Communication (VLC).

I. INTRODUCTION

Surging advancement in the technology is required to meet the escalating demand over the generations to access wireless spectra for data trans-reception. To alleviate the problem of spectrum scarcity crisis, several innovative techniques have been developed over the times.

Propounded by Dr. Joseph Mitola III at the Royal Institute of Technology in Stockholm in 1998, the concept of Cognitive Radio administers a technology that drives software based, smart and intelligently adaptable wireless transceiver in [1]. Cognitive Radios service to provide best spectrum utilization by methods of Spectrum Sensing by instant identification of the unoccupied licensed band (Spectrum Holes or White Spaces) of the Primary User, hooking to the channel by the Secondary User (unlicensed user) without any hindrance to Primary user's operation and vacating once the licensed user grips to that particular channel. This method of Dynamic Spectrum Access (DSA) as shown in Figure 1 deliberately enhances the massive user sustainability that has been studied from [2].

Other reformation in Wireless Communication is Li-Fi, a methodology coined by Professor Harald Haas in the 2011 TED Global talk. Light Fidelity uses flickering LED light bulbs with intensity faster than human eyes to follow yet with constant outputs for the optical data transmission in [3].

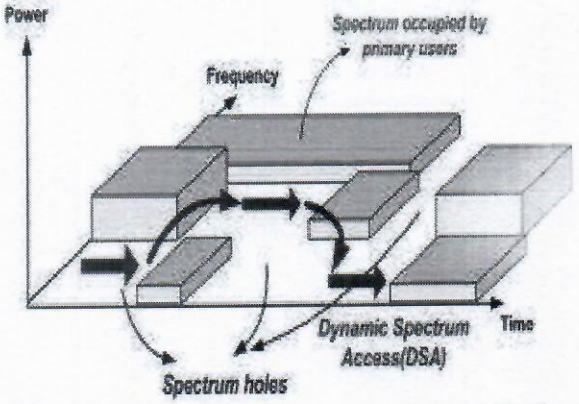

Figure 1: Spectrum holes concept in cognitive Radio

Accomplishing access to the optical spectrum for data reception by the method of illumination provides blistering transmission rates up to 10 Gbps and high data density. This appears as a new greener, healthier and cheaper module for high speed optical wireless system. Despite of all the advantages, issues regarding network coverage, reliability pertain in Li-Fi which account for development of new data communicating techniques. In this paper we have considered the problems with Li-Fi and examined how an innovative architecture of collaborating Li-Fi technology with the Cognitive Radio concept serves in overcoming the spectrum scarcity troubles faced by massive users.

The propounded architecture works at two levels. At one hand it is presumed to work with the optical communication

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Survey on Non Orthogonal Multiple Access (NOMA) - A key technique for future Radio Network Access

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***Abstract*—** All Orthogonal Multiple Access techniques including Orthogonal Frequency Division Multiple Access (OFDMA) techniques fail to achieve the system limit due to individuality in resource allocation. To mitigate this issue Non Orthogonal Multiple Access (NOMA) introduce for 5th Generation (5G) wireless communication system. This paper presents the results and detailed survey of (NOMA) techniques that are helpful in improving the 5G system and meeting the demands of users. In this detailed survey, the prime focus is on the different proposed NOMA techniques in the literature and discussion of existing works on performance analysis, resource allocation, Multiple input multiple output NOMA (MIMO- NOMA), Single user NOMA (SU-NOMA), Multi User NOMA (MU-NOMA). Finally, we discuss the features and further research challenges of NOMA.

***Keywords*—** OFDM,NOMA, IDMA, TDMA, PDMA, MIMO, Mulituser MIMO, SU MIMO, 3G, 4G, 5G, Wi-Fi

I. INTRODUCTION

Orthogonal Frequency Division Multiplexing (OFDM) technique has been widely used in wireless communication systems such as Wi-Fi, Wi-Max, 3G, 4G, LTE, LTE Advance. Recent Mobile Networks have challenges of higher spectral efficiency, lower latency and massive connectivity. To resolve these challenges NOMA technologies have been recognized for 5G systems [1]. Multiple access techniques are fundamental function in a wireless communication system. Generally, multiple access techniques are classified into two categories (i) Orthogonal (ii) Non Orthogonal. In Orthogonal Multiple Access (OMA) every user served in different allocated time and frequency resources and cross correlation of signals from different users is zero. Some of the OMA techniques are Time Division Multiple Access (TDMA), Frequency Division Multiple Access (FDMA) and Orthogonal Frequency Multiple Access (OFDMA) [2,3]. But in NOMA multiple user's signals are superposed in the power domain by exploiting their respective channel gain differences so that all users can use resources simultaneously that is a non zero cross correlation between the signals from different users, which leads inter user interference [4,5]. To mitigate inter user interference a non linear detection algorithm used such as Successive Interference Cancellation (SIC), Maximum a Posteriori (MAP) or Maximum Likelihood (ML) at the receiver side. Some NOMA techniques are Interleave Division Multiple Access (IDMA) [6]. In recent years, a number of NOMA techniques proposed such as Pattern Division Multiple Access (PDMA) [7,8], Polar Coded NOMA (PC-NOMA) [9], Sparse Code Multiple Access (SCMA) [10], Bit Division Multiplexing (BDM) [11], Coordinated Operation Access Scheme and Multi User Sharing Access (MUSA) [12,13] etc.

II. BASIC OF NOMA TECHNOLOGY

In order to understand the basic concept of the NOMA, for simplicity, we take NOMA downlink system with User1 and User2 as shown in Fig. 1. As shown in figure a Base Station (BS) can serve two users at the same time, same frequency and same code, but with different power levels. In conventional techniques, by using water filling power allocation strategies, more power allocated to users with strong channel. But, in NOMA, more transmission power allocated to users with poor channel condition. To get the data at the receiver side, a user with the weaker channel condition and high transmission power will detect its data from signal directly by ignoring other user's data as noise. In particular, the message to the user with the weaker channel condition is allocated more transmission power, which ensures that this user can detect its message directly by treating the other user's information as noise. The second user with the stronger channel condition will detect data for its partner, then subtract it from its observed data and finally decode its own data. This is successive Interference Cancellation (SIC) scheme.

Let assume the overall system transmission bandwidth is to be 1 Hz. The base station transmits signal for both user1 and user2 are x_1 and x_2 respectively with transmitting power P_1 P_2. The sum of power is restricted to P at maximum. In NOMA, both signals are superposition coded as

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An Interval Type 2 Fuzzy Logic Framework for Faster Evolutionary Design

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In this paper, a fast processing and efficient framework has been proposed to get an optimum output from a noisy data set of a system by using interval type-2 fuzzy logic system. Further, the concept of GPGPU (General Purpose Computing on Graphics Processing Unit) is used for fast execution of the fuzzy rule base on Graphics Processing Unit (GPU). Application of Whale Optimization Algorithm (WOA) is used to ascertain optimum output from noisy data set. Which is further integrated with Interval Type-2 (IT2) fuzzy logic system and executed on Graphics Processing Unit for faster execution. The proposed framework is also designed for parallel execution using GPU and the results are compared with the serial program execution. Further, it is clearly observed that the parallel execution rule base evolved provide better accuracy in less time. The proposed framework (IT2FLS) has been validated with classical bench mark problem of Mackey Glass Time Series. For non-stationary time-series data with additive gaussian noise has been implemented with proposed framework and with T1 FLS. Further, it is observed that IT2 FLS provides better rule base for noisy data set.

Keywords: CUDA-C; Fuzzy Logic System; Graphics Processing Unit; Time Series Forecasting; Whale Optimization Algorithm

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Enhance the Capacity of MIMO Wireless Communication Channel using SVD and Optimal Power Allocation Algorithm

Dalveer Kaur, and Neeraj Kumar

Abstract—Multiple input multiple output (MIMO) is a multiple antenna technology used extensively in wireless communication systems. With the ever increasing demand in high data rates, MIMO system is the necessity of wireless communication. In MIMO wireless communication system, where the multiple antennas are placed on base station and mobile station, the major problem is the constant power of base station, which has to be allocated to data streams optimally. This problem is referred as a power allocation problem. In this research, singular value decomposition (SVD) is used to decouple the MIMO system in the presence of channel state information (CSI) at the base station and forms parallel channels between base station and mobile station. This practice parallel channel ensures the simultaneous transmission of parallel data streams between base station and mobile station. Along with this, water filling algorithm is used in this research to allocate power to each data stream optimally. Further the relationship between the channel capacity of MIMO wireless system and the number of antennas at the base station and the mobile station is derived mathematically. The performance comparison of channel capacity for MIMO systems, both in the presence and absence of CSI is done. Finally, the effect of channel correlation because of antennas at the base stations and the mobile stations in the MIMO systems is also measured.

Keywords—MIMO, water filling algorithm, singular value decomposition, channel state information, channel capacity

I. INTRODUCTION

THE The demand of high data rate is increasing day by day in a wireless communication system; the multiple antenna technology plays a vital role to enhance the data rate as well as the reliability of wireless communication systems. According to the white paper published by Cisco, the expected overall growth in mobile data rate is 48.3 Exabyte's per month by 2021 [1]. The single input single output (SISO) is incapable to meet this requirement of ever increasing data rates [2]. In SISO, the only single antenna is used at the base station and the mobile station so there is a single link between base station and mobile station. If this link gets faded, then it affects the complete communication and single link can not carry more data. Therefore, SISO system is less reliable and have low data rate communication system [3].

To meet the higher data rate requirement, mobile service provider companies are running toward 4G and 5G [4]. The 4G wireless network is capable of providing very high internet speed. The applications such as HD videos, online gaming, video conferencing etc. are supported by higher data rate services. So it is a big challenge for a wireless network to provide higher data rate services in limited spectrum [5-6].

Presently MIMO technology is playing a key role in wireless communication systems to achieve higher data rates with lesser transmitting power and bandwidth [7]. In MIMO system, multiple antennas are used at the transmitters and receivers, these multiple antennas provide diversity and spatial multiplexing to the wireless communication system [8]. In diversity, the same message symbol is transmitted through different antennas; thereby the reliability of wireless communication is improved. In spatial multiplexing, different symbols are transmitted through different antennas so that the data rate is improved. Diversity improves the reliability of wireless communication system by providing multiple paths between base station and mobile station and spatial multiplexing improves the capacity of wireless communication system by transmitting multiple data streams between base station and mobile station, simultaneously [9].

Consider a multiple antennas scenarios, firstly, when a base station has multiple antennas, and they communicate with single antenna at mobile station know as multiple input single output (MISO) system and the channel is called uplink channel (ULC) [10]. Secondly, when the mobile has multiple antennas to communicate with a single antenna base station knows as single input multiple output (SIMO) system and the channel is called downlink channel (DLC). Lastly, when base station and mobile station, both have multiple antennas so that system is called a MIMO system. MIMO system can also be classified as single user MIMO system and multiuser MIMO system. In single user MIMO system, base station communicates only with one mobile device. In multiuser MIMO system, base station communicates with multiple mobile devices. The single user MIMO system shown in Fig.1. has N_B antennas at the base station and N_M antennas at mobile station and a channel matrix C between base station and mobile station [11-12].

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Investigation on structural and microwave absorption property of Co^{2+} and Y^{3+} substituted M-type Ba-Sr hexagonal ferrites prepared by a ceramic method

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ABSTRACT

The Co^{2+} and Y^{3+} ions substituted M type $Ba_{0.5}Sr_{0.5}Co_xY_xFe_{12-2x}O_{19}$ hexagonal ferrites (x = 0.0, 0.2, 0.4, 0.6, 0.8 and 1.0) were synthesized by a standard ceramic method. The phase evolution of prepared hexagonal ferrite samples was studied using X ray diffraction technique. XRD analysis shows that compositions have M-type as major phase and $BaFe_2O_4$ as minor phase. The absorber testing device method is adopted in order to investigate microwave absorption property of prepared ferrite composites as a function of frequency (8.2–12.4 GHz), substitution and thickness. The microwave absorption property has been evaluated using the quarter wavelength mechanism and impedance matching mechanism. The variation in parameters measured experimentally is in agreement with our form theoretical models. In doped compositions, the microwave absorption is found to increase with the substitution of Co^{2+} and Y^{3+} ions. Compositions x = 0.0 and 1.0 exhibit poor microwave absorber characteristics with absorbed power of 86.2 and 94.7% at 11.22 and 10.04 GHz respectively. The quarter wavelength mechanism contributes for large microwave absorption in compositions x = 0.4, 0.6 and 1.0, whereas impedance matching mechanism is primarily responsible for absorption in x = 0.2, 0.4 and 0.8.
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1. Introduction

The exponential growth in information technology or wireless devices has produced wireless or electromagnetic pollution. The electromagnetic interference (EMI), caused by electromagnetic pollution, results in the malfunctioning of electronic devices and is also physically harmful for biological systems. The microwave absorbers or EMI suppressors are used to reduce or attenuate this EMI or other electromagnetic signals.

Devices are abundantly used in electrical, electronic and wireless communication such as wideband transformers, antenna, channel filters, gyromagnetic devices, radar absorbing materials, RAM etc. [1–4]. Their good dielectric and magnetic properties make them better EMI suppressers than conventional dielectric materials. M-type hexaferrites are ferrimagnetic by nature and used as microwave absorbers or EMI reduction owing to large dielectric and magnetic losses, domain wall resonance and ferromagnetic resonance (FMR) [5,6]. The various researchers have investigated microwave absorption properties of M-type substituted hexagonal ferrites [7–10].

In the present paper, we report microwave absorption property of Co^{2+} and Y^{3+} ions substituted M-type $Ba_{0.5}Sr_{0.5}Co_xY_xFe_{12-2x}O_{19}$ (x = 0.0, 0.2, 0.4, 0.6, 0.8 and 1.0) hexagonal ferrites prepared by a standard ceramic method and elucidated the absorption with quarter wavelength mechanism and impedance matching mechanism; a few researchers have reported the present work based on these two mechanisms.

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Performance evaluation of dynamically flattened gain *L*-band RAMAN-EDFA-RAMAN hybrid optical amplifier for super dense wavelength division multiplexing system

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In this paper, we have evaluated the performances of super dense Wavelength Division Multiplexing (SD-WDM) system with respect to flat gain. RAMAN-EDFA-RAMAN hybrid optical amplifier (HOA) is the backbone of the system. Further, this model has investigated the effects in terms of L-band flattened gain, output power, crosstalk, and bit error rate with 50 GHz channel spacing. Flat gain greater than 14 dB has obtained at 5 mW and reported the poor performances by 7 mW and 17 mW with the range of 188-192 THz. Gain variation < 2.1 dB has obtained. Highest output power has also obtained at 5 mW, 7Mw and 17 mW accordingly. Final conclusion has recommended that better gain flatness has attained without using any costly components such as gain equalizer and multi-pumping for SD-WDM system.

Keywords: SD-WDM system, Gain flatness, Hybrid optical amplifier

1 Introduction

Hybrid optical amplifier shows the remarkable improvement in the long haul super dense multiplex system. Gain flatness is an important parameter to boost up the level of the SD-WDM system and more flattened gain are reflected the best performance of the system with least bit error rate and cross talk. Now a day, it is the hot topic for the researcher. Simranjit *et al.*[1] have explored a model for flat gain and proven to attain (> 10 dB) flat gain with minor variation (< 4.5 dB). The best performances of the system can be enchanced by RAMAN-EDFA-RAMAN. So, many modifications have made to enhance the performances with this amplifier in terms of flat gain. Kaler *et al.*[2] have explored the performances of 130x10 Gbps WDM system with 0.02 nm channel spacing. Further, it has observed with the declaration that Er-doped waveguide amplifier and Er-Yb co-doped waveguide amplifier has been reduced the variation in terms of power and gain from 7.2-3.1 dB. Least variation and distortion are the current requirement of for high speed network. So, cascaded optical amplifier has been shown the best choice for the researcher to enhance the performance of the SD-WDM system. Karasek *et al.*[3] have explored the model to enhance the performance of HOA gain and best rating of OSNR has been reported in literature[1&2]. Takushima *et al.*[4] have investigated the gain spectrum of EDFA with the observation that the gain has clamped in the band of 1555 nm.and depends up on the power level for the band of 1535 nm with suggestion that the improvements can be made by the MZ gain equalizer. Yen *et al.*[5] have demonstrated a model based on EDFA and EDWA with the help of two experiments. In the first experiment, maximum gain variation of 2.05 dB can be accomplished in the range of 1528-1562 nm. Evaluation with respect to gain has been made by the optical feedback method in the second experiment. It has also been suggested that GF and GC were the main parameters to adjust the gain variation. Piskarska *et al.*[6] & Kaler *et al.*[7] have reported that RAMAN and EDFA amplifier were the essential backbone for the SD-WDM system.

Kidorf *et al.*[8] have reported that EDFA amplifier provides the best response to the system in terms of flat gain than RAMAN amplifier due to multi layer transmission, but it could be further improved by providing suitable pumping. Furthermore, hybrid

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Experimental Evaluation of HOA in Terms of Flat Gain in C-Band for Super Dense Optical Communication System

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Abstract
The impact of RAMAN–EDFA hybrid optical amplifier (HOA) in C-band for 80×10 Gbps super dense wavelength division multiplexing (SD-WDM) system with the channel spacing of 12.5 GHz is analyzed. A flat gain of (> 17 dB) is obtained with suitable pump power of HOA in the wavelength range from 1545 nm to 1565 nm with less variation of 5 dB. Further, the performance of the proposed system is also evaluated in term of acceptable flattened gain without using any cost effective technique. The recorded value of crosstalk ($< 10^{-1}$) and power penalty (−0.5) dB are also supported to maintain long haul super dense optical communication.

Keywords Super dense wavelength division multiplexing (SD-WDM) system · Hybrid optical amplifier · Gain flatness · Noise figure

1 Introduction

The demand of high-speed internet and data transferring increases the need of super dense wavelength division multiplexing (SD-WDM) optical communication system [1]. The standard optical amplifiers such as RAMAN, erbium doped fiber amplifier (EDFA) and semiconductor optical amplifier (SOA) are not individually capable to fulfill this requirement. But, hybrid optical amplifiers (HOAs) are the right candidate for maintaining long haul acceptable communication [2, 3]. The hybrid optical amplifier (RAMAN/EDFA) is the most promising technology for the future SD-WDM system, which supports the super dense optical signals by neglecting the effect of fiber nonlinearity and induced internal crosstalk [20]. These amplifiers give high amplified spontaneous emission (ASE) cascaded connection in the optical medium with large bandwidth but it can be adjusted by proper arrangement of suitable pump power to enchance the gain flatness for SD-WDM system [4]. Moreover, using the proper design of hybrid amplifiers ensure the require gain in wavelength spectrum by proper adjusting the pump power. Enlargement of the

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RAMAN-Ytterbium Doped Hybrid Optical Amplifier yielding Flat Gain in S-band for Super Dense Wavelength Division Multiplexing System

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The present paper describes for the first time to the analysis of RAMAN and YDFA (Ytterbium-Doped Fiber Amplifier) hybrid optical amplifier (HOA) and delivering the best results in the context of 400x10 Gb/s super dense wavelength division multiplexing (SD-WDM) system with reduced channel spacing of 0.2 nm in term of flat gain and noise figure for S-Band. The maximum gain of 38.5 dB with the flat gain in the range of 1460 nm to 1535 nm is attained with the least variation of (0.9 dB). The value of noise figure of (2.2 dB) has also recorded from the proposed HOA. Further the performance of the proposed hybrid optical amplifier has also evaluated in the different range of the proposed spectrum (S-band) for analysis the outcome in terms of the same characteristics.

Keywords: Super dense wavelength division multiplexing system, YDFA, EDFA, RAMAN, SOA, Noise figure, Flat gain

Introduction

To retain the flat gain with less effect of noise figure (NF) for optical super dense wavelength division multiplexing (SD-WDM) communication system, Ytterbium-Doped fiber amplifier (YDFA) is the right choice and lot of achievement has been credited in the commercial research[1-3]. It is energized with the dual pumping[3-4]. In fact, multiple pumping can also couple and effect of thermal can be controlled for the uniform optical amplification[5].YDFA delivers the amplification for broad wavelength from 975 nm to 1200 nm and its principle is somehow quite close to laser[7-12]. YDFA has been reported the best results in many aspects than the EDFA amplifier. It has credited a number of applications in term of free-space communications and fiber sensing applications in optical communication domain[13]. In this paper, we have extended our previous research to achieve flat gain by cascaded RAMAN-YDFA hybrid amplifier for super dense multiplexing system. Variations in gain, shows the high distortion in optical signal, consequently the effect of internal losses have shown the dominating nature on the optical signals. This is a challenging issue for super dense multiplexing channel, but it has been resolved with the help of the proposed hybrid amplifier. After the introduction of the current state of the art research in segment one, the proposed simulation setup and results are described in segment two and three respectively. Section four, describes the conclusion of the work.

Simulation setup

The simulation setup of the proposed model has been implemented with the help of Optsim software in figure 1. The simulation setup composed of 400 channel SD-WDM system covering the range of bandwidth from1580 nm to 1520 nm with the channel spacing of (0.2 nm). The NRZ modulation format is used with the data rate of 10 Gb/s per channel. The power level per channel is set to (-30 dBm). Optical signals are multiplexed and fed to inline different combinations of the hybrid optical amplifier (HOA). Each of the proposed optical amplifier injected with the dual pump power, which are given as (14450 nm (780mW)) and (1860 nm (750mW)) for RAMAN amplifier, and (1095 nm (667 mW)) and (1225 nm (680 mW)) for YDFA amplifier respectively. Dual injected pump of each of the optical amplifiers is coupled to optical power passive coupler (OPPC). The gain flattening filter (GFF) is used to retain the flat gain, which also helps to dismiss the effect of attenuation.

Result and Discussion

The impact of RAMAN-YDFA hybrid optical amplifier is plotted in term of gain and noise figure

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ORIGINAL ARTICLE

A unified non-linear approach based on recurrence quantification analysis and approximate entropy: application to the classification of heart rate variability of age-stratified subjects

Vikramjit Singh[1] · Amit Gupta[1] · J. S. Sohal[2] · Amritpal Singh[3]

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Abstract
This paper presents a unified approach based on the recurrence quantification analysis (RQA) and approximate entropy (ApEn) for the classification of heart rate variability (HRV). In this paper, the optimum tolerance threshold (r_{opt}) corresponding to $ApEn_{max}$ has been used for RQA calculation. The experimental data length (N) of RR interval series (RR_i) is optimized by taking r_{opt} as key parameter. r_{opt} is found to be lying within the recommended range of 0.1 to 0.25 times the standard deviation of the RR_i, when $N \geq 300$. Consequently, RQA is applied to the age stratified RR_i and indices such as percentage recurrence (%REC), percentage laminarity (%LAM), and percentage determinism (%DET) are calculated along with $ApEn_{max}$, r_{opt}^{min}, r_{opt}^{max}, and an index namely the radius differential (R_D). Certain standard HRV statistical indices such as mean RR, standard deviation of RR (or NN) interval (SDNN), and the square root of the mean squared differences of successive RR intervals (RMSSD) (Eur Hear J 17:354–381, 1996) are also found for comparison. It is observed that (i) R_D can discriminate between the elderly and young subjects with a value of 0.1151 ± 0.0236 (mean ± SD) and 0.0533 ± 0.0133 (mean ± SD) respectively for the elderly and young subjects and is found to be statistically significant with $p < 0.05$. (ii) Similar significant discrimination was obtained using r_{opt}^{min} with a value of 0.1827 ± 0.0382 (mean ± SD) and 0.2248 ± 0.0320 (mean ± SD) (iii) other significant indices were found to be %REC, %DET, %LAM, SDNN, and RMSSD; however, $ApEn_{max}$ was found to be insignificant with $p > 0.05$. The above features of RR_i time series were tested for classification using support vector machine (SVM) and multilayer perceptron neural network (MLPNN). Higher classification accuracy was achieved using SVM with a maximum value of 99.71%.

Keywords Heart rate variability · Autonomic nervous system (ANS) · Non-linear methods · Information theory · Approximate entropy · Recurrence quantification analysis · Support vector machine

1 Introduction

Heart rate variability (HRV) is the variation in the time interval between successive R-peaks of an electrocardiogram (ECG) signal. The study of HRV is useful in the diagnosis and prognosis of various physiological and pathophysiological conditions [1–4]. HRV is a result of the dynamic interactions between several feedback loops regulating the cardiovascular system occurring at variable rates. This leads to dynamic complexity in the HRV that is altered under different physiological and pathophysiological conditions [5]. It has been established that HRV is altered by several factors like respiratory sinus arrhythmia (RSA); Valsalva maneuver; decreases in venous return, the baroreflex, and the vasovagal reaction; exercise; thermo-regulation; embolisms; intra-venous (IV) injections; circadian rhythms; inter-patient factors like genetics and family history, sex, age, medical condition, and level of fitness; emotion; stress; sleep; body posture; smoking; caffeine; humoral factors, etc. [1–5]. Genesis of HRV is a highly interdependent and complex phenomenon that involves the interactions among parasympathetic and sympathetic branches of

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Materials Research Express

PAPER

Designing and analysis of cross-shaped CRLH metamaterial for wide band negative index characteristics

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Abstract

The compact sized cross-shaped metamaterial design is evaluated for single negative, double negative and double positive behavior for a wide range of frequencies to investigate the gap and gapless transition from backward to forward wave propagation near 17 GHz. The metamaterial designed in this study is analyzed for negative index characteristics of permittivity, permeability and refractive index over the broad range of frequencies. The dispersion diagram of the material is also investigated for left or right behavior of the material. The equivalent circuit diagrams along with circuit simulations of the parameters are also presented for detailed analysis and understanding. The designed metamaterial behaves like a double negative material for low frequencies below 17.23 GHz and double positive materials for high frequencies above 17.23 GHz. The design is simulated using CST Microwave studio and obtained results are authenticated using the wave-guide measurement technique.

1. Introduction

The wave propagation behaviors of any material can be described with the help of basic key parameters like permittivity (ε), permeability (μ) and refractive index (n). All the natural materials have positive values of permittivity and permeability and are known as Double Positive Material (DPS). While, metamaterials are the artificial material that may have either negative permittivity or permeability or both may be negative simultaneously [1]. Depending upon the signs of these two parameters (permittivity and permeability), the material can be classified into four categories [2]. Apart from natural positive values of DPS, the possibility of single negative value of permittivity or permeability [3] is also there and are known as Single Negative Materials (SNG). These single negative metamaterials includes Epsilon Negative (ENG) and Mue Negative (MNG) materials [4]. If the permittivity of the material is negative with positive permeability, then they are known as ENG materials. On the other hand, if the permeability of the material is negative with positive permittivity, then they are known as MNG materials. The last type of metamaterials is Double Negative (DNG) materials, which are having negative values of permittivity and permeability both [5]. They are not found in nature and have a negative refractive index, which result in extraordinary properties. Some of them include negative refraction, backward wave propagation, inverse Doppler effect, perfect lens, cloaking and many more [6], [7].

The term metamaterial was first coined by Victor Veselago [8] in theoretical form. He discussed that wave propagation in such material will be in the opposite direction than the naturally occurring materials. The concept was converted into reality by Smith *et al* [9] by simultaneously verifying the negative values of permeability and permittivity. The Split Ring Resonators (SRR) were designed for this purpose which results in a left handed materials and follows reverse Doppler effect, backward wave propagation and inverse Snell's law. Since the Smith experiment created out the DNG materials and confirmed the Veselago's theory regarding negative refractive index, the study of left handed materials has become a new frontier that pulls scientific community's attention.

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EFFICIENT RESOURCE ALLOCATION OF A MIMO-OFDM SYSTEM USING CONVEX OPTIMIZATION

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Abstract

For higher order Multiple Input Multiple Output (MIMO) networks with and without Zero Forcing (ZF) technique, we consider the problem of sum rate maximization. The aim is to maximize the achievable communication sum rate by formulating the user dependent MIMO channel matrix. To obtain a quality to the existing non-convex problem, we devise a method based on convex optimization by applying the negative sum rate of the non-convex optimization. Furthermore, to obtain the optimal power allocation channel coefficients, the KKT condition is applied. Simulations are performed for 4×4, 8×8, 16×16, 32×32, 64×64, 128×128 and 256×256 MIMO systems. Simulation results prove that ZF technique performs better at higher power levels.

Introduction

On the efficient radio resource allocation schemes, several works have already been carried out for 5G wireless communication systems. To attain much higher data throughput and improved spectral efficiency without the requirement for increased bandwidth and redundant base stations, the non-orthogonal multiple access (NOMA), multiple input and multiple output and relaying technologies have been discussed in [1]. Considering the typical indoor environment, cooperative and coordinated multi-cell resource allocation methods for 5G ultra reliable low latency connection, has been presented by the authors in [2]. Moreover for 5G networks with application to device to device (D2D) and machine to machine (M2M) communications various other resource allocation schemes have been presented in [3–5]. Efficient resource allocation for MIMO and OFDM in 5G is a non-convex optimization problem [6]. Using the convex optimization routine in MATLAB, by considering the negative sum rate of the optimization objective function a less complex closely approaching optimal solution for such problems can be obtained.

Problem Description

For the 5G wireless communication systems, the promising technologies are Massive MIMO, cooperative communication, etc. To efficiently allocate the channel resources and to support the spectrum reuse, at both the base station and the mobile station, a large array of high directive/gain antennas are employed, multiplexed spatially for highly directed beam-forming in massive MIMO. The resource allocation scheme does not guarantee the optimal solution of the problem for MIMO and OFDM based wireless system architectures as the resource allocation scheme here is a non-convex optimization problem. In this section, for obtaining the solution of the non-convex optimization problems we introduce a duality counterpart by minimizing the negative sum rate of the objective function. By minimizing the objective function or cost function subject to certain real-time constraints (inequality or equality constraints) the optimal solutions for all the convex optimization problems related to judicious allocation of network resources can be obtained. The convex optimization techniques form the basis for the efficient resource allocation like spectrum reuse, energy efficiency, bit error rates, etc.

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ORIGINAL RESEARCH PAPER

Lifetime enhancement of wireless sensor network using solar energy harvesting technique

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Abstract

The finite energy of batteries associated with wireless sensor networks is a major constraint, which limits its lifetime. One of the methods to overcome this major limitation is the energy harvesting (EH) systems. There are many energy sources available nowadays, but solar energy is flexible, mature and is an external power source; so, it is broadly utilised for EH in the wireless sensor network to enhance the life of the network. The solar EH technique along with the low energy adaptive clustering hierarchy protocol is applied. The charging and discharging curves of the battery and energy status of the nodes are propounded. The simulation results demonstrate that the lifetime of the battery and the network gets augmented after applying the solar EH technique.

1 | INTRODUCTION

In this era, the wireless sensor network (WSN) is one of the popular and foremost used networks in the world. WSN consists of the sensor nodes that are capable of monitoring the different environmental conditions and forwards the data to the sink where it transfers further for processing.

A WSN node is frequently powered by the batteries. Batteries can be rechargeable or non-rechargeable. The non-rechargeable batteries limit the life span of the WSN and also affect the performance of the network, which is a critical issue. As a consequence, rechargeable batteries must be used. Since most of the WSN applications are situated in an inhospitable area, consequent replacement of the batteries would be inconvenient. Hence, it is strenuous to enlarge the life span of WSNs under a finite power of the device. Therefore, energy harvesting (EH) technologies could be utilised to prolong the life span of the WSN, and the supreme familiar sources are solar, wind, vibration, radio-frequency (RF), and thermal [1] that are used for EH.

Different EH techniques are available nowadays for the WSN, but solar EH technique is extensively used because solar cells give the highest power density of 15 mW/cm^2. Hence, it is adequate to fulfil the power needs of the WSN [2]. The different power densities of EH sources are given below in Table 1.

Solar energy is one of the greenest technologies. The periodic availability of solar energy makes it feasible for the WSN and enhanced the life span of the network. So, we used solar EH technique to enhance the life span of the network. Solar energy can be harvested through a photovoltaic conversion technique [1]. The photovoltaic panel consists of different cells; cells are either attached in series or parallel to meet the requirements of power while adjusting the values of the current and voltage supplied by these cells [3]. The cells are made according to different technologies such as polycrystalline silicon, amorphous silicon, monocrystalline silicon, and thin films [3].

The study is organised as follows: Section 1 elucidates the introduction. Section 2 recounts the related work. Sections 3 and 4 designate about the solar cell, its model and about the rechargeable battery, respectively, which we utilised during the simulation, whereas performance evaluation is given in Section 5 and finally section 6 draws the conclusion.

2 | RELATED WORK

In recent years, researchers make efforts to use renewable energies as a power source for WSN such as the solar energy, wind, thermal, vibration and RF. Several researchers propound different harvesting models. Minami et al. [4] designed a solar biscuit, which is a battery-less wireless system for the surveillance of the environment. Simjee et al. [5] presented a supercapacitor operated solar-powered wireless sensor node, called Everlast. Yin et al. [6] designed an intelligent solar EH system using maximum power point tracking (MPPT) for WSNs.

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Channel Estimation in OFDM systems: A Survey paper

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Abstract— The OFDM (Orthogonal Frequency Division Multiplexing) is a modulation technique which can offer high spectral efficiency and data facility up to the customer end. Developing an understanding of the Channel estimation of OFDM can be best achieved by studying the types of estimation techniques. This paper discusses the model building of channel estimation of OFDM. This model is a beneficial reporting as a useful resource for the students and the scholars who want to base their studies and research in the domains of OFDM. Its performance can be enriched by using some kind of Intelligence technique. This paper also discusses the benefits of using channel estimation in an OFDM system.

Keywords— orthogonal frequency division multiplexing (ofdm), channel estimation, block type pilot arrangement, comb type pilot arrangement.

I. INTRODUCTION

The major challenge which is to be tackled by ensuing wireless communication systems is to bestow immense data rates and better quality of service (QoS). There are also some of the other challenges like resource deficiency and transmission is troubled by fading and interference from other users [1]. As the data rate increases symbol duration gets abridged and ISI will also be present as a result of selective fading. Orthogonal frequency division multiplexing (OFDM) is a novel technique which is applicable for future high data rate wireless communication systems and also is robust to multipath fading and ISI as cyclic prefix and guard band are used in transmitter of OFDM system. Thus it is used as a principle technique in many of the major wireless communication applications such IEEE 802.11a(WLAN), 802.16 (WiMAX), DAB (digital audio broadcasting) and HIPERLAN 2.[2]

OFDM is basically a type of MCM (multicarrier modulation) in which several sub-carriers are set parallel to each other information is sent over these sub-carriers, total signal bandwidth are divided into number of sub-carriers. OFDM can be assumed that OFDM is a type of frequency division multiplexing in which subchannels are overlapping without interference. Spectrum efficiency of OFDM is due to the overlapping of sub-carriers. Spacing between each subcarrier is to be selected carefully in such a way that each subcarrier is orthogonal to another subcarrier. Two signals are said to be orthogonal over an interval when the integral of both signals over that period of interval is zero [1].

Due to the frequency selective and time varying nature of channel effective and dynamic channel state information is necessary to be known before the demodulation stage. Generally it is assumed that the channel is slow fading in which channel characteristics are not changing rapidly in one OFDM block and is stationary. In fast fading channels there are several changes in channel characteristics in one OFDM block. Sub-carriers used in modulation combine to form one OFDM block.

Coherent and Differential are two types of methods available in wireless communication. Coherent detection requires estimation of channel's effect on the transmitted signal which as it is not required in the case of Differential detection though we have to suffer a 3-4 dB deficit in signal to noise ratio (SNR) [1,4].

Channel Estimation can be broadly divided into two types' blind and non-blind channel estimation. Blind channel estimation requires heaps of data and utilizes statistical behaviour of receiver and has a degraded performance in fast fading channel. Another type estimation which is non-blind channel estimation utilizes knowledge of previous channel estimates available at the receiver end. This estimation is further divided into two categories: data/pilot aided or decision directed channel estimation (DDCE).

Further, pilot aided estimation is divided into block type channel estimation and comb type channel estimation. In block type estimation pilot tones are inserted into each of the subcarrier of OFDM symbol. This technique assumes that the channel is slow fading and channel statistics rates are not

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Measurement of AC and DC relaxation properties in polyvinyl chloride (PVC) nanocomposites

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ABSTRACT

In present investigation, thin film of polyvinylchloride (PVC)/silicon dioxide (SiO_2)/montmorillonite (MMT) nanocomposites were prepared by solution casting method. AFM analyzed the grain size, roughness and dispersion of nanofillers in PVC nanocomposites. However FTIR describes the interaction of nanofillers in PVC structure. The AC and DC relaxation properties of these nanocomposites were measured by means of dielectric spectroscopy and thermally stimulated depolarization current (TSDC) respectively. The dielectric spectroscopy has been applied to measure dielectric constant and tangential loss at different frequencies and temperatures; then, it has been specified the effect of nanoparticles on dielectric performance as compared with pure PVC. The permittivity of nanocomposites is enhanced remarkably, which can be understood by the interfacial polarization. The high dielectric constant of value 37 is obtained in the nanocomposite with 4 wt.% MMT at 50 °C. The temperature dependent dielectric constant could be explained on the basis of free volume associated free charge carriers and MWS relaxation process. The dielectric characteristics are highly influenced by nature of fillers and can be understand by the frequency and temperature dependence of the interfacial relaxation. TSDC peaks are orginated due to dipolarization process and MWS relaxation process.

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1. Introduction

PVC has excellent electrical insulation characteristics as high resistivity and high dielectric strength and widely used as an insulating material for power cables. The dielectric losses of PVC are quite high and they become even higher due to the use of fillers needed to enhance its softness diminishes the electrical resistivity and increase the dielectric constant. The main reasons for huge interest on measurement of relaxation properties are the promising results on PVC nanocomposites are reported in literature [1]. These improvements are exciting both in terms of commercial application and for the fundamental insight that can be gained by studying the mechanisms controlling the enhanced dielectric properties [2]. The recommendation of these new materials for industrial applications ranging from dielectrics for high energy storage capacitors up to electrical insulations with low losses and high breakdown resistance. Polymer nanocomposites, designed with high dielectric constant and low dissipation factors, will find applications as dielectrics in capacitors and transmission lines to be used in communications equipment, computers, and power systems [3]. TSDC technique is ideal for the investigation of the structure of polymers semi-crystalline polymers and copolymers since it is a more sensitive alternative than other thermal techniques for detecting the transitions that depend on changes in the mobility of molecular scale structural units [4,5]. TSDC is applied to understand molecular relaxation process and removal of DC field in nanodielectrics under application and removal of DC field at elevated temperature [6,7]. The excellent dielectric and viscoelastic properties of silica are extensively used in dynamic random access memory and field effect transistors. Nano-crystalline silica has been incorporated into a variety of polymers to obtain better mechanical properties [8]. Therefore, we will invest gate the effect of the addition of SiO_2 nanoparticles in PVC matrix on structural and dielectric properties. MMT has been widely used due to its layered structure and reactivity together with high strength, thermal swelling behaviour and large surface area. It is environmentally friendly low cost nanofiller which have been applied in various industrial fields [9–14]. Furthermore, when MMT is properly modified and dispersed in the polymer matrix, effective interactions arise between organic and inorganic phases of composite materials that can cause synergistic effects [15,16]. The enhancement

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RESEARCH ARTICLE

A novel design of energy efficient bidirectional passive optical green networks using reduced buffer with small packet size technique

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Abstract

Energy saving and reduction in the emission of carbon dioxide, sulfur, etc. have become one of the prime focus for the deployment of next generation networks. Due to less power consuming, passive optical networks are the best promising solution for such networks. We have proposed different aggressive schemes to reduce the energy consumption viz. no buffer, with buffer, reduced buffer, and reduced buffer with small packet. We evaluated the performance of proposed schemes for downstream and upstream by exploring the relationship between power consumption, delay, and average traffic load. The "reduced buffer with small packet" scheme has shown a reduction of more than 35% of total leakage power at the central office with the compromise of delay in packets receiving.

KEYWORDS

energy efficient green networks, passive optical networks, RBSP

1 | INTRODUCTION

Due to the tremendous growth in numbers of users, the networks are deployed with large number of user end equipment.[1] These equipment consumed high amount of electricity power. This consumption led interest in designing of power efficient green networks for future generation. International Telecommunication Union and Institute of Electrical and Electronics Engineers have defined energy efficient Gigabit Passive Optical Networks (GPON) in 2011[2] and Ethernet Passive Optical Networks in 2012,[3] respectively, with discrete transmission instead of continuous mode in conventional transmission system.[4] The energy consumption can be minimized at physical and medium access control (MAC) layers. Small size and low power consumptions devices (optical transmitters, receivers, multiplexers, etc.) are proposed at physical layers.[5] At the data link layer, the optical line terminal (OLT) can communicate direct to optical network unit (ONU) without consisting any remote node (RN) is another solution proposed in Reference 6. Use of function module in sleeping mode is another efficient solution at MAC layer control.[4] In sleeping mode, all the modules of ONU are power-off except essential supporting modules.

In GPON, the receivers consume 40%, the transmitters consume 25%, the MAC layer controls, and other devices consume 35% of the total power of the central office (CO). There is more than 3 W of leakage power consumption at the ONU with 2 MB buffer capacities. The power burden adds up with the upgrade in the memory.[6-8] In this article, we have addressed four aggressive schemes viz. no buffer (NB), with buffer (WB), reduced buffer (RB), and reduced buffer with small packet (RBSP) to reduce the leakage power. The reduction of the packet size leads the delay and hence overall degradation in the service. We have also discussed the effect of the packet delay to the network performance. The article is organized into four sections. In Section 1, we study the different energy efficient networks. The proposed schemes are described in Section 2. In Section 3, results have been discussed of different schemes in terms of energy consumption, delay, and average traffic load. Section 4 consists of conclusion.

2 | SYSTEM SETUP

The block diagram of system setup for bidirectional hybrid (WDM/TDM) PON based on tree topology is shown in

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Highly sensitive and reusable Cu^{+2}/polyaniline/reduced graphene oxide nanocomposite ink-based non-enzymatic glucose sensor

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Abstract
The present work focuses on the preparation and characterizations of a highly sensitive, reusable, linear, anti-interferent, and low-cost Cu^{+2}/polyaniline (PANI)/reduced graphene oxide (rGO) nanocomposite ink-based non-enzymatic glucose (NEG) sensor. The synergistic properties of Cu^{+2}/PANI and rGO result in a large number of electrochemically active and stable sites which catalytically favored the glucose oxidation. The crystal structure and morphology of PANI, Cu^{+2}/PANI composite, and Cu^{+2}/PANI/rGO nanocomposite ink encouraged the usefulness of Cu^{+2}/PANI/rGO nanocomposite ink as an electrocatalyst in NEG detection. A NEG sensor was prepared by drop coating Cu^{+2}/PANI/rGO nanocomposite ink on a low-cost patterned FR4 electrode. The cyclic voltammetry and chronoamperometry tests were performed to estimate the electrochemical behavior of prepared Cu^{+2}/PANI/rGO/FR4 NEG sensor. The electrooxidation of glucose was achieved at an applied potential of 0.66 V. An anti-interferent Cu^{+2}/PANI/rGO/FR4 NEG sensor demonstrated a linear response in two different glucose concentration regimes 2.8–22.2 μM and 0–4 mM with current sensitivity of 4168.37 μA mM^{-1} cm^{-2} and 525.4 μA mM^{-1} cm^{-2}, respectively. The prepared sensor displayed a limit of detection (LOD) of 4.93 μM with a response time of < 5 s. The excellent performance parameters of the Cu^{+2}/PANI/rGO/FR4 NEG sensor recommend its relevance in human serum samples. These values of operating voltage, current sensitivity, linear range, LOD and anti-interference ability promise its usefulness in practical applications.

Keywords Nanocomposite · Glucose oxidation · Non-enzymatic · Sensor · Sensitive

1 Introduction

The prevalence of diabetes is quickly increasing all over the world at a frightening rate. People suffering from diabetes must maintain their blood glucose level within the normal physiological range, because the increased blood glucose level may cause loss of sight, heart attack, stroke, hypertension, kidney malfunction, and limb elimination, etc. [1]. The accurate monitoring of blood glucose level is essentially required for diabetics, to maintain it within the normal physiological range. The high sensitivity, excellent selectivity, decreased sample volume, decreased response time, immunity toward potential interferents, and improved user-friendly operating procedures make the commercial enzymatic glucose sensors best in their class [2]. Despite all these advantages of enzymatic glucose sensors, there are several disadvantages associated with them like poor shelf life due to the inherent instability of an enzyme [2], fabrication complexity because of difficult enzyme immobilization procedures, interference caused by soluble redox mediators, and the cost of the enzyme, etc. To surmount the restrictions of enzymatic glucose sensors, mediator-less non-enzymatic glucose sensors are being worked out more by engineers and scientists.

However, the high cost of NEG sensors makes them unfit for commercial use. The elevated cost of NEG sensors is governed by the costly conventionally used electrodes

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DESIGN AND INVESTIGATION OF HIGH-CAPACITY SPATIAL-DIVISION MULTIPLEXING NETWORK EMPLOYING A MULTIMODE FIBER

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Abstract

In spatial division multiplexing (SDM)-based communication systems, each spatial mode can act as an independent information-bearing carrier capable of scaling the total transmission capacity by several orders of magnitude. It has been reported that in SDM networks the signal amplitude depends upon the optical-path-length (OPL) difference between the various optical modes. In this work, we realize SDM technique using a multimode fiber (MMF), because MMFs have a potential to increase transmission capacity drastically by transmitting signals over large number of modes separately. The system performance is analyzed on the basis of following parameters: visualizer spatial profile, mode index profiles, fiber transfer function, refractive index profile, bit error rate, and quality factor. Also we measure changes in the optical path length due to a phase-shifting laser beam. We conclude that MMFs have huge scope for future ultrahigh-capacity transmission systems employing SDM.

Keywords: spatial division multiplexing (SDM), multimode fiber (MMF), mode division multiplexing (MDM), optical fiber communication (OFC), optical path length (OPL).

1. Introduction

The acceleration of data traffic and machine-to-machine connections has catalyzed researchers around the globe to look for possible strategies to increase the capacity of optical fiber networks and optimize the available optical spectrum. Spatial-division multiplexing (SDM) is a revolutionary technology, which increases the aggregate data rate by a factor equal to the number of modes that can be precisely generated and demultiplexed. SDM technique has immense potential in telecommunication sector, as it does not put extra load on already crowded spectrum [1]. The use of the spatial structure of the electromagnetic wave is mooted as a potential solution to address the pending capacity crunch. Further, different mode shapes have been proposed to realize SDM in optical communication systems [2].

Due to providing large capacity for long-haul fiber links, SDM network, which can be implemented with multimode fibers, has been paid considerable attention in the literature [3]. In [4], a high-precision arbitrary-mode converter has been proposed for mode-division-multiplexing optical-fiber communication

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Impact of High Speed Differential Quadrature Amplitude Modulation using Hybrid Optical Amplifier for Super Dense Wavelength Division Multiplexing System

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In this paper, a Differential Quadrature Amplitude Modulation (DQAM) technique for 200 x100 Gbps Super Dense Wavelength Division Multiplexing (SD-WDM) system is proposed. Optimized rating outcome in terms of the quality factor, bit error rate, crosstalk, and acceptable minor effect of the channel spacing with the support of RAMAN-EDFA-RAMAN Hybrid Optical Amplifier (HOA) is reported.

Keywords: Differential Quadrature Amplitude Modulation, Hybrid Optical Amplifier, quality factor, bit error rate (BER), crosstalk, output power

1 Introduction

Transmission of high spectral efficiency optical signal from one place to another place with less loss and good rating of quality factor is also an interesting challenge for a researcher. Many researchers have proposed the different modulation techniques such as Amplitude Modulation (AM), Frequent Modulation (FM), Phase Modulation (PM) and much more. But these are the basic modulation technologies which have some limitations in term of optical signal transmission. In fact, low power signal is converted into a high power signal with the help of the carrier signal. Moreover, the optical carrier signal is generated from the CW laser and boost up the level of the optical signal in terms of the modulation signal for long haul distance. Many researchers are focusing to raise the transmission speed up to 100 Gbps or more with the support of different advanced modulation technology for optical communication such as M-ary Differential Phase Shift Keying (DPSK)[1], Optical Differential Quadrature Phase Shift Key (ODQPSK)[2], Differential Quadrature Phase Shifting Keying (DQPSK)[3] and Symmetrical Differential Phase Shift Keying (SDPSDK)[4] etc. Unfortunately, the effect of the hybrid optical amplifier is not considered in the literatures, which is an important consideration for long haul optical communication. Super dense wavelength division multiplexing system is the advanced technology to transmit the higher capacity optical signal[5-7]. In the multiple play services, a number of channels are packed to provide the services such as high-quality video and communication[8]. But the effect of the fiber nonlinearity and amplified spontaneous (ASE) emission can be dismissed with the help of different Hybrid Optical Amplifiers (HOAs)[9].

High spectral efficiency is the hot demand for the optical network. Chung *et al.*[10], have explored the new technology for 16 x 10 Gbps for the transmission distance of 1040 km with the help of RAMAN amplifier, but this model only highlighted the data transmission speed up to 10 Gbps which does not fulfill the demand of high capacity transmission. Downie *et al.*[11] have evaluated the error free data transmission of 43Gbps for the transmission distance of 1200 km with 50 GHz channel spacing, but the effect of the hybrid amplifier is not shown in this literature which is an important effect in terms of low bit error and good rating quality factor for single span optical communication system.

In this paper, we have used a very advanced modulation (DQAM) technology for optical transmission. Transmission of 100 Gbps is shown by the support of RAMAN-EDFA-RAMAN hybrid optical amplifier (HOA). Moreover, the layout of the

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Development of 32-GBaud DP-QPSK free space optical transceiver using homodyne detection and advanced digital signal processing for future optical networks

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Abstract
Free space optical (FSO) communication provides the capacity to deliver high-speed digital data links into the far off and rural factions where topography, set-up cost or groundwork safety pose acute barriers to deployment. The challenges in any FSO system are the transmission impairments and space loss which deteriorate the link performance. This article deals with the design and analysis of a single channel Gray-coded dual polarization-quadrature phase shift keying (DP-QPSK) based FSO communication system with balanced homodyne detection (BHD) and digital signal processing (DSP). We have implemented a series of high-level digital impairment compensation algorithms strategically between the BHD and signal retrieval stages to mitigate the amplitude and phase noise, and compensate for free-space loss. The proposed system exhibits a 3 dB greater receiver sensitivity using optical homodyne detection compared to heterodyne detection. The system performance has been numerically evaluated with regard to bit error rate (BER $\leq 2 \times 10^{-3}$, i.e. FEC limit), error vector magnitude (EVM), and constellation diagram based on OptiSystem V.16 photonic software. Furthermore, we investigate the joint BER and EVM performance of the proposed system under the influence of launched optical power, laser linewidth, and beam divergence. We obtain the transmission of 32 GBaud DP-QPSK data bearing optical signal up to a link distance of 2.65 km at 128-Gb/s data rate, and an optical signal-to-noise ratio penalty lower than 2.5 dB compared to the back-to-back case. The outcomes of this research demonstrate direct practical relevance and could therefore form the basis for the implementation of next-generation optical wireless networks.

Keywords Free space optics · Polarization division multiplexing · Quadrature phase shift keying · Balanced homodyne detection · Digital signal processing · Next-generation optical wireless

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Transmission of Audio over LTE Packet Based Wireless Networks Using Wavelets

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Abstract
In the present study, the main goal is to analyse the performance of audio data for wireless VOIP (Voice Over IP) proposed model utilizing wavelets. This treatise represents a performance study of wireless VOIP for recorded audio signal using different wavelet families such as Coiflet, Daubechies family (Db2, Db4, Db6, Db8, and Db10), Haar and Symlet. The performance was approximated with the subsequent procedure. Firstly, the recorded audio data was decomposed up to 4-levels by means of wavelet transform. From simulation results it is clear that wavelets are more practical and dominant tool meant for analyzing audio signals, as it exhibits multi-resolution property with a considerable decrease in the time complexity for removing resolution problems. Furthermore, it was concluded that Coiflet performs best at 1st and 3rd decomposition levels, while Haar and Db8 (Daubechies 8) performs the best among the other wavelets at 2nd and 4th decomposition levels respectively. Further, the parameters such as SNR (Signal/Noise Ratio), PSNR (Peak S/N Ratio), NRMSE (Normalized Root Mean Square Error), PRSE (Percentage of Retained Signal Energy) and Compression Ratio are used to investigate the performance. Additionally, transmission capabilities are also analyzed using packet loss and delay. Finally, ANOVA (Analysis of Variance) statistical tool has been applied to test the effectiveness of recorded data on 4 groups.

Keywords Soft computing · Simulation · Signal processing · Wavelet transform · Wireless VOIP

1 Introduction

Audio signal processing is the procedure used to analyse audio signals (such as music signals, voice signals and speech signals) using different processing techniques. The signals are generally processed in a digitized form. Audio signal is a fundamental signal for conveying intelligence from one place to another via individual voice signal, by utilizing a 4 kHz bandwidth. In addition, human ear is much more susceptible to feature deprivation

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Optimization of hybrid WDM/TDM (16×1024) PON for future access systems

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In recent years, hybrid systems have provided the solution for high bandwidth requirements of future access networks. In this paper, the architecture of hybrid WDM/TDM PON network with full system line rate of 240 Gbps with 16 optical line terminals and 1024 optical network units has been presented. The proposed system has been evaluated on the basis of Q factor and eye pattern. Hybrid optical networks are subjected to waveform spectrum analyzer. The Performance of the proposed system is analyzed for suitable receiver configuration. Access network is examined for optical detector and a comparative analysis is carried out. Also, the proposed network is evaluated for various electric filters like RC filter, Butterworth filter, Bessel filter, Gaussian filter, Chebyshev filter and Raised Cosine filter. Further, optical access network is optimized by employing Butterworth optical filter just before the photo detector so that the quality information signals are communicated with enhanced transmission span. The proposed architecture provides a practical way for growing demand of future access networks.

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Keywords: Hybrid WDM/TDM PON, Photo detector, Electric filters, Q-factor

1. Introduction

The ever growing demand for the data services offered on the Internet has resulted in higher bandwidth requirements from clients affecting access networks. Progression in services offered by the access systems for high transmission capacity requests has indicated congestion in the infrastructure near the client end. For the upcoming requirements optical fiber is considered as the most guaranteeing transmission medium for access systems [1-2]. Access networks employing optical fiber cables are called as optical access networks and are categorized into two classes, one of them uses active components called active optical network (AON) & the other employs passive components known as passive optical network (PON). In terms of quality transmission, power consumption and cost, PON outperforms AON [3]. PON comprises of an optical line terminal (OLT) at the access provider end and a substantial number of optical network units (ONUs) installed at the client's side. OLT is associated with the ONUs through an optical fiber cable which is further split utilizing a 1: N passive optical splitter equipping the clients to share the transmission medium and so sharing of hardware costs among a number of subscribers [4]. All the commercial available standards of PONs are time division multiplexed PONs (TDM-PONs), which depends on single wavelength transmission per fiber with allocation of carrier through splitter. Because of lower information rates & losses due to power split, TDM-PONs was not able to bear the requirements of Next Generation Access (NGA) systems. For NGA networks wavelength division multiplexing (WDMs) based access systems (WDM-PONs) provides a better solution in which the transmission limit of the system can be upgraded by distributing diverse wavelengths to every client and thereby enhancing the transmission rate of the network. WDM reduces the losses, but it has a drawback of serving a limited number of clients. Full service access network (FSAN) Group of world's leading telecommunication service providers, has selected time and wavelength division multiplexed network called hybrid WDM/TDM PON technology for stage 2 of next generation of passive optical access systems (NGPON2). It integrates the benefit of additional wavelengths offered by WDM-PONs and vast number of clients per wavelength given by TDM-PONs [5-6].

Researchers had analyzed WDM-PON system with channel spacing of 0.8 nm transmitting at a rate of 2.5 Gbps, network perform satisfactory for a distance of 25 Km over single mode fiber. The effect of attenuation and Inter symbol interference were evaluated for transmitting good quality information signals utilizing performance metrics like Q factor, bit error rate in [7-9]. Authors [10] presented, Time and Wavelength multiplexed passive optical network with 40 Gbps line rate for a distance of 20 Km. Hybrid WDM/TDM access network were investigated by utilizing cost effective components like reflective semiconductor optical amplifier (RSOA) and Optical add-drop multiplexer (OADM) for a line rate of 1.25 Gbps over a distance of 25 Km in [11]. Hybrid

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3.4.5 Number of research papers per teacher in the Journals notified on UGC website during the last five years (15)

3.4.5.1: Number of research papers in the Journals notified on UGC website during the last five years

Sr no	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
1	An improved butterfly optimization algorithm with chaos	Sankalap Arora and Satvir Singh	Electronics and Communication Engineering	Journal of Intelligent and Fuzzy Systems	2016	1875-8967	https://mjl.clarivate.com/search-results?issn=1064-1246&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
2	Improved metaheuristic based energy-efficient clustering protocol for wireless sensor networks	Mann, Palvinder Singh and Singh, Satvir	Electronics and Communication Engineering	Engineering applications of Artificial Intelligence	2016	0952-1976	https://mjl.clarivate.com/search-results?issn=0952-1976&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
3	Performance analysis of energy-efficient routing protocol for wireless sensor networks	Mann, Palvinder Singh and Singh, Satvir	Electronics and Communication Engineering	American International Journal of Research In Science, Technology, Engineering & Mathematics	2016	2328-3580	UGC old list Sr No 44994,https://www.ugc.ac.in/pdfnews/5283580_UGC-Cancelled-List.pdf
4	Artificial bee colony metaheuristic for energy-efficient clustering and routing in wireless sensor networks	Mann, Palvinder Singh and Singh, Satvir	Electronics and Communication Engineering	Soft Computing	2016	1433-7479	https://mjl.clarivate.com/search-results?issn=1432-7643&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
5	Microwave absorbing characteristics in Co 2+ and Al 3+ substituted Ba0.5Sr0.5CoxAlxFe12-2xO19 hexagonal ferrite	Rajat Joshi, Charanjeet Singh, Dalveer Kaur	Electronics and Communication Engineering	Springer Journal of Material Science: Materials in Electronics	2016	0957-4522	https://mjl.clarivate.com/search-results?issn=0957-4522&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
6	Performance analysis of different amplifiers for polarization dependent 10 Gbps bidirectional hybrid (WDM/TDM) with 16-QAM modulation technique	Rakesh Goyal, R. S. Kaler, T. S. Kamal	Electronics and Communication Engineering	Journal of Optical Technology	2016	1070-9762,1091-0786	https://mjl.clarivate.com/search-results?issn=1070-9762&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
7	Comparative study of different optical amplifiers for hybrid passive optical networks	Rakesh Goyal,R.S Kler,T S Kamal	Electronics and Communication Engineering	Optoelectronics And Advanced Materials-Rapid Communications	2016	1842-6573(PRINT) ,2065-3824 (ONLINE)	https://mjl.clarivate.com/search-results?issn=1842-6573&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
8	Analysis of SAC-OCDMA system to reduce MAI using fiber bragg gratings and MDW code	Rakesh Goyal, Navpreet Kaur, R. S. Kaler, Monika	Electronics and Communication Engineering	Optoelectronics And Advanced Materials-Rapid Communications	2016	1842-6573(PRINT) ,2065-3824 (ONLINE)	https://mjl.clarivate.com/search-results?issn=1842-6573&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
9	Realization of High speed All Optical Logic Gates based on Nonlinear Characteristics of a SOA	Pawan Amit Gupta	Electronics and Communication Engineering	IJST	2016	0974-5645	https://mjl.clarivate.com/search-results?issn=0974-6846&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal

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10	A Novel Security Enhanced Decoder Based on XOR Detection for Optical Code Division Multiple Access System Using Multi-Diagonal Code	Shivani ,Amit Gupta	Electronics and Communication Engineering	IJST	2016	0974-5645	https://mjl.clarivate.com:/search-results?issn=0974-6846&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
11	Optimized Routing in Mobile Ad hoc Networks	Dr Rakesh Kumar	Electronics and Communication Engineering	International Journal of Computer Science and Network Security	2016	1738-7906	https://mjl.clarivate.com:/search-results?issn=1738-7906&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
12	Energy-efficient hierarchical routing for wireless sensor networks: a swarm intelligence approach	Mann, Palvinder Singh and Singh, Satvir	Electronics and Communication Engineering	Wireless Personal Communications	2017	1572-834X	https://mjl.clarivate.com:/search-results?issn=0929-6212&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
13	Node Localization in Wireless Sensor Networks Using Butterfly Optimization Algorithm	Sankalap Arora and Satvir Singh	Electronics and Communication Engineering	Arabian Journal for Science and Engineering	2017	2191-4281	https://mjl.clarivate.com:/search-results?issn=2193-567X&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
14	Energy efficient clustering protocol based on improved metaheuristic in wireless sensor networks	Mann, Palvinder Singh and Singh, Satvir	Electronics and Communication Engineering	Journal of Network and Computer Applications	2017	1084-8045	https://mjl.clarivate.com:/search-results?issn=1084-8045&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
15	Improved artificial bee colony metaheuristic for energy-efficient clustering in wireless sensor networks	Mann, Palvinder Singh and Singh, Satvir	Electronics and Communication Engineering	Artificial Intelligence Review	2017	0269-2821	https://mjl.clarivate.com:/search-results?issn=0269-2821&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
16	Graphical Processing Unit Accelerated Face Resolution Enhancement using Pixels-Homogeneity and Relative-Ratios	Mutneja Vikram and Singh Satvir	Electronics and Communication Engineering	International Journal of Current Research and Review	2017	0975-5241	UGC old list Sr No 62702 https://www.ugc.ac.in/pdfnews/5283580_UGC-Cancelled-List.pdf
17	Improved metaheuristic-based energy-efficient clustering protocol with optimal base station location in wireless sensor networks	Mann, Palvinder Singh and Singh, Satvir	Electronics and Communication Engineering	Soft Computing	2017	1432-7643	https://mjl.clarivate.com:/search-results?issn=1432-7643&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
18	Modified Viola-Jones algorithm with GPU accelerated training and parallelized skin color filtering-based face detection	Mutneja Vikram and Singh Satvir	Electronics and Communication Engineering	Journal of Real Time Image Processing	2017	1861-8219	https://mjl.clarivate.com:/search-results?issn=1861-8200&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
19	Microwave absorbing characteristics in Co 2+ and Al 3+ substituted Ba0.5Sr0.5CoxAlxFe12-2xO19 hexagonal ferrite	Jasbir Singh, Charanjeet Singh, Dalveer Kaur	Electronics and Communication Engineering	Springer Journal of Material Science: Materials in Electronics	2017	0957-4522	https://mjl.clarivate.com:/search-results?issn=0957-4522&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal

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20	Elucidation of Phase evolution, Microstructural, Mossbauer and Magnetic properties of Co2+ - Al3+ doped M-type Ba-Sr Hexaferrites synthesized by a ceramic method	Jasbir Singh, Charanjeet Singh, Dalveer Kaur	Electronics and Communication Engineering	Journal of Alloys and Compounds	2017	0925-8388	https://mjl.clarivate.com:/search-results?issn=0925-8388&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
21	Microwave Absorbing Characteristics of Co2+ and W4+ ions doped M-type Ba-Sr hexagonal Ferrites	Rajat Joshi, Charanjeet Singh, Dalveer Kaur	Electronics and Communication Engineering	Journal of Materials Science: Materials in Electronics	2017	0957-4522	https://mjl.clarivate.com:/search-results?issn=0957-4522&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
22	Wormhole attack detection techniques in MANET	Dalveer Kaur,Parvinder	Electronics and Communication Engineering	Wireless Personal Communication	2017	0929-6212	https://mjl.clarivate.com:/search-results?issn=0929-6212&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
23	A cost effective bidirectional hybrid passive optical network using common carrier for all optical network units (CCAONUs) technique with mitigation of non linearity impact	Rakesh Goyal, R. S. Kaler, T. S. Kamal	Electronics and Communication Engineering	Optik- International Journal for light and electron optics	2017	0030-4026	https://mjl.clarivate.com:/search-results?issn=0030-4026&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
24	Analysis and mitigation of XPM crosstalk in the scenario of mixed line rates for next generation access networks	Rakesh Goyal, Rajinder Singh Kaler, Monika Rani	Electronics and Communication Engineering	Optoelectronics And Advanced Materials-Rapid Communications	2017	1842-6573(PRINT) ,2065-3824 (ONLINE)	https://mjl.clarivate.com:/search-results?issn=1842-6573&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
25	Flatted gain S+C+L Band RAMAN-Thulium-Doped Tellurite Fiber Amplifier hybrid optical amplifier for super dense wavelength division multiplexing system	Chakresh Kumar, Rakesh Goyal	Electronics and Communication Engineering	Journal of Optical Communication,ISSN (2191-6322)	2017		https://www.scopus.com/sourceid/19573
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27	Design and Evaluation of 10 Gbps Inter-Satellite Optical Wireless Communication Link for Improved Performance	Amit Gupta, Shaina	Electronics and Communication Engineering	Journal of Optical Communication	2017	2191-6322	https://www.scopus.com/sourceid/19573
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30	Butterfly Optimization Algorithm: A Novel Approach for Global optimization	Arora, Sankalap and Singh, Satvir	Electronics and Communication Engineering	Soft Computing	2018	1433-7479	https://mjl.clarivate.com:/search-results?issn=1432-7643&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
31	Optimal Node Clustering and Scheduling in Wireless Sensor Networks	Mann, Palvinder Singh and Singh, Satvir	Electronics and Communication Engineering	Wireless Personal Communications	2018	1572-834X	https://mjl.clarivate.com:/search-results?issn=0929-6212&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
32	Interference Cancellation in Broadcast Channel of Multiuser MIMO system using Block Dragonalization and Dirty Paper Coding Schemes	Neeraj Kumar, Dalveer Kaur	Electronics and Communication Engineering	International Journal of Engineering Trends and Technology	2018	2231-5381	https://www.scopus.com/sourceid/21101000284
33	Effect of interface in Dielectric relaxation properties of PEMA-BaZrO3 nanocomposites	Rajesh, Dalveer Kaur	Electronics and Communication Engineering	Springer Journal - Polymer Bulletin	2018	0170-0839	https://mjl.clarivate.com:/search-results?issn=0170-0839&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
34	Performance Evaluation of RAMAN-EDFA-RAMAN Hybrid optical amplifiers in the context of high spectral efficiency	Chakresh Kumar, Rakesh Goyal	Electronics and Communication Engineering	Journal of Nanoelectronics and Optoelectronics	2018	1555-130x,1555-1318	https://mjl.clarivate.com:/search-results?issn=1555-130X&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
35	Performance Analysis of Hybrid Optical Amplifiers for Super Dense Wavelength Division Multiplexing System in the Scenario of Reduced Channel Spacing	Chakresh Kumar, Rakesh Goyal	Electronics and Communication Engineering	MAPAN-Journal of Metrology Society of India	2018	0974-9853 (online) 0970-3950(PRINT)	https://mjl.clarivate.com:/search-results?issn=0970-3950&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
36	A Novel flatted gain C-Band Cascaded Hybrid optical Amplifier RAMAN and Thulium Doped Fluoride fiber Amplifier for Super Dense Wavelength Division Multiplexing System	Chakresh Kumar, Rakesh Goyal	Electronics and Communication Engineering	Optica Applicata	2018	0078-5466 (PRINT)1899-7015(ONLINE)	https://mjl.clarivate.com:/search-results?issn=0078-5466&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
37	L-Band Flat-Gain RAMAN with Erbium Doped Fluoride Fiber Amplifier Hybrid optical Amplifier for Super Dense Wavelength Division Multiplexing System	Chakresh Kumar, Rakesh Goyal	Electronics and Communication Engineering	Journal of Russian Laser Research	2018	1573-8760(ONLINE) 1071-2836 (print)	https://mjl.clarivate.com:/search-results?issn=1071-2836&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
38	All-optical Integrated Parity Generator and Checker Using an SOA-based Optical Tree Architecture	Nivedita Nair, Sanmukh Kaur, Rakesh Goyal	Electronics and Communication Engineering	Current Optics and Photonics	2018	2508-7226(print) 2508-7274 (online)	https://mjl.clarivate.com:/search-results?issn=2508-7266&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
39	A Performance Enhancement and High Speed Spectrum Sliced Free Space Optical System	Aditi Thakur, Shaina Nagpal , Amit Gupta	Electronics and Communication Engineering	Wireless Personal Communications	2018	0929-6212	https://mjl.clarivate.com:/search-results?issn=0929-6212&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal

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40	Kerr effect based spectrum sliced wavelength division multiplexing for free space optical communication	Aditi Thakur, Shaina Nagpal , Amit Gupta	Electronics and Communication Engineering	Optik International journal of Light and Electron Optics	2018	0030-4026	https://mjl.clarivate.com:/search-results?issn=0030-4026&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
41	Efficient Utilization of Vacant Spectrum using Reconfigurable Secondary Users in Cognitive Radio Network	Mannect Kaur, A.S Buttar	Electronics and Communication Engineering	International Journal of Computer Sciences and Engineering	2019	2347-2693	UGC old list Sr No 63193,https://www.ugc.ac.in/pdfnews/5283580_UGC-Cancelled-List.pdf
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43	Issues and Challenges in Energy Harvested based Wireless Sensor Network",	Meenakshi Sansoy, A.S. Buttar, Rakesh Goyal	Electronics and Communication Engineering	International Journal of Computer Sciences and Engineering	2019	2347-2693	UGC old list Sr No 63193,https://www.ugc.ac.in/pdfnews/5283580_UGC-Cancelled-List.pdf
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50	Performance Evaluation of Dynamically Flattened Gain L-Band Raman-EDFA-Raman Hybrid Optical Amplifier for Super Dense Wavelength Division Multiplexing system	Chakresh Kumar, Ghanendra Kumar and Rakesh Goyal	Electronics and Communication Engineering	Indian Journal of Pure & Applied Physics	2019	0019-5596	https://mjl.clarivate.com:/search-results?issn=0019-5596&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal

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51	Experimental Evaluation of HOA in term of Flat Gain in C-Band for Super Dense Optical Communication System	Chakresh Kumar and Rakesh Goyal	Electronics and Communication Engineering	Wireless Personal Communications	2019	0929-6212	https://mjl.clarivate.com:/search-results?issn=0929-6212&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
52	RAMAN-Ytterbium Doped Hybrid Optical Amplifier yielding Flat Gain in S-band for Super Dense Wavelength Division Multiplexing System	Chakresh Kumar and Rakesh Goyal	Electronics and Communication Engineering	Journal of Scientific & Industrial Research	2019	0975-1084(online) 0022-4456(Print)	https://www.scopus.com/sourceid/23649
53	A unified non-linear approach based on recurrence quantification analysis and approximate entropy: application to the classification of heart rate variability of age-stratified subjects	Dr Amit Gupta	Electronics and Communication Engineering	Medical & Biological Engineering & Computing	2019	ISSN: 0140-0118 (Print) 1741-0444 (Online)	https://mjl.clarivate.com:/search-results?issn=0140-0118&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
54	Designing and analysis of cross-shaped CRLH metamaterial for wide band negative index characteristics	Dr Amit Gupta	Electronics and Communication Engineering	Material Research Express	2019	2053-1591	https://mjl.clarivate.com:/search-results?issn=2053-1591&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
55	Effiecient resource allocation of MIMO OFDM sustem using convex optimization	Momd Asif,Dalvir Kaur,Avtar Singh Buttar	Electronics and Communication Engineering	Journal of Emerging Technology and Innovative Research	2020	2349-5162	Old UGC list Sr No.63975,https://www.ugc.ac.in/pdfnews/5283580_UGC-Cancelled-List.pdf
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59	A novel design of energy efficient bidirectional passive optical green networks using reduced buffer with small packet size technique	Rakesh Goyal, Rajinder Singh Kaler, Monika Rani	Electronics and Communication Engineering	Microwave and Optical technology Letters	2020	1098-2760	https://mjl.clarivate.com:/search-results?issn=0895-2477&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
60	Highly Sensitive and Reusable Cu+2/Polyaniline /Reduced Graphene Oxide Nanocomposite Ink Based Non-Enzymatic Glucose Sensor	Vijay Kumar Anand, Archana Bukke, Kapil Bhatt, Sandeep Kumar, Sandeep Sharma, Rakesh Goyal, G. S. Virdi	Electronics and Communication Engineering	Applied Physics A	2020		https://link.springer.com/article/10.1007/s00339-020-03620-4
61	Design And Investigation Of High-Capacity Spatial-Division Multiplexing Network Employing A Multimode Fiber	Ashish Malhotra, Gurmanik Kaur, Rakesh Goyal, Monika Rani	Electronics and Communication Engineering	Journal of Russian Laser Research	2020	10712836, 15738760	https://mjl.clarivate.com:/search-results?issn=1071-2836&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal

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62	Impact of High Speed Differential Quadrature Amplitude Modulation using Hybrid Optical Amplifier for Super Dense Wavelength Division Multiplexing System	Chakresh Kumar, Rakesh Goyal	Electronics and Communication Engineering	Indian Journal of Pure & Applied Physics	2020	0019-5596	https://mjl.clarivate.com:/search-results?issn=0019-5596&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
63	Development of 32-GBaud DP-QPSK free space optical transceiver using homodyne detection and advanced digital signal processing for future optical networks	Sahil Nazir Pottoo, Rakesh Goyal, Amit Gupta	Electronics and Communication Engineering	Optical and Quantum Electronics	2020	0306-8919 , 1572-817X	https://mjl.clarivate.com:/search-results?issn=0306-8919&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
64	Transmission of audio over LTE packet based Wireless Networks using wavelets	Dr Amit Gupta	Electronics and Communication Engineering	Wireless Personal Communications	2020	0929-6212	https://mjl.clarivate.com:/search-results?issn=0929-6212&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal
65	Optimization of hybrid WDM/TDM (16 - 1024) PON for future access systems	Dr Amit Gupta	Electronics and Communication Engineering	Optoelectronicsa nd Advanced materials :Rapid Communication	2020	1842 - 6573	https://mjl.clarivate.com:/search-results?issn=1842-6573&hide_exact_match_fl=true&utm_source=mjl&utm_medium=share-by-link&utm_campaign=search-results-share-this-journal

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