Book of Abstracts

The 3rd West Asian Symposium on Optical and Millimeter-wave Wireless Communication **(WASOWC2020)**

November 24-25, 2020

Faculty of Electrical and Computer Engineering,

Tarbiat Modares University, Tehran, Iran

This book contains accepted papers of the 3rd West Asian Symposium on Optical and Millimeter-wave Wireless Communication (WASOWC2020). The final version of the papers will be appeared in the symposium proceedings, subject to a successful presentation by the authors. All papers appeared and indexed in this book, have been reviewed by the referees and revised by the authors. Authors are responsible for technical content of their papers and any published materials do not represent the views of the technical program committee.

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Welcome Message

On behalf of the Organizing Committee, and the National & International Technical Committee, and all the sponsors we are very pleased to welcome you all to the 3rd West Asian Symposium on Optical and Millimeter-wave Wireless Communication (WASOWC2020) hosted by Tarbiat Modares University, on 24-25 November 2020.

After careful consideration of world conditions related to the pandemic COVID-19 outbreak, the steering committee (SC) and the local organizing committee (LOC) of WASOWC2020 decided to reschedule the event and hold it online.

WASOWC2020 aims to bring together researchers from academia and industry to share their latest findings in the field of optical & millimeter-wave wireless communications as part of the 5th Generation and beyond wireless networks. The 3rd symposium also includes forums, workshops, invited, and keynote speakers.

The WASOWC2020 has received technical sponsorships and support from many organizations as listed on the website and the sponsor section. The sponsorship is used to award some prizes to the authors of the best papers.

The WASOWC has received papers and participants from 14 countries. Each paper has been reviewed by at least two independent reviewers and the authors have been given the opportunity to respond to the reviewers' comments, revise and resubmit their paper. We are very grateful to all the expert reviewers for their time and effort. All the accepted and presented papers will be indexed by IEEE.

Finally, we would like to wish you all a very successful and

pleasant conference and hope that WASOWC2020 will prove to be interesting, stimulating, and enjoyable both technically and socially and provide an active and productive atmosphere for the scientists and researchers to share their findings and ideas.

With best wishes,

Prof. Vahid Ahmadi
Tarbiat Modares University, Iran
Scientific Chair and Chair of LOC

Prof. Zabih Ghassemlooy
Northumbria University, UK
General Chair

Dr. Farzaneh Arabpour
Tarbiat Modares University, Iran
Executive Chair

About the Symposium

In recent years, wireless communications have significantly evolved due to the advanced technology of smartphones, portable devices, and the growth of the Internet of Things, E-health, E-commerce, intelligent transportation systems, and social networking. More recently, we have seen growing research and development interest in optical wireless communications (OWC) in several applications as a complementary technology to cellular systems, Wi-Fi and Bluetooth, to solve the spectrum crunch and provide high data rates in urban environments and crowded locations. OWCs offer many advantages such as free license, wide bandwidth, inherent security, and no radio frequency based interference, and multiple functionalities, which could be a potential candidate for the emerging 5G wireless communications.

This symposium aims to cover the entire field of OWC and bring together researchers, software, and hardware developers from academia and industry working in OWC, to present, share, and discuss their latest research results. The symposium will also include a practical demonstration of working systems.

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Symposium Program

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11:45	12:15	**Invited Speaker 1 (Room 1)** Demonstrating the Concept of Light-based IoT (LIOT)	**Invited Speaker 2 (Room 2)** Electromagnetic Active Device Modeling in mm-wave and THz Frequency Range
12:15	13:15	**Oral Session 1 (Room 1)** FSO and RF-FSO: Applications, Coding, Signaling, and Detection (1)	**Oral Session 2 (Room 2)** Photonic Devices & Components
13:15	14:15	**Break**	
14:15	14:45	**Invited Speaker 3 (Room 1)** Optical Camera Communications, a Solution to Integrate VLC on Smartphones	**Invited Speaker 4 (Room 2)** Microsystem-Based Detectors and Sensors Operating at Microwave, THz, and Infrared Bands
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16:30	17:00	**Invited Speaker 5 (Room 1)** Advanced Signal Processing for Enhancing Optical OFDM Systems	**Invited Speaker 6 (Room 2)** The Role of Optical Wireless Communications in Future Access Networks
17:00	17:30	**Invited Speaker 7 (Room 1)** VLC/RF Hybrid Positioning and Monitoring System for a Mining Tunnel	

Start	End	Nov. 25th, 2020	
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13:45	15:30	**Oral Session 6 (Room 1)** Application of Optical Wireless Communications	**Oral Session 7 (Room 1)** Applications of VLC: Positioning, Localization and Emerging Trends
15:30	17:30	**Workshop (Room 1)** Introduction to MATLAB Without the Use of Toolboxes	
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Keynote Speakers

24 November, 2020 – Room 1 – 16:00 - 16:30

Prof. Beatriz Ortega Tamarit

Instituto de Telecomunicaciones y Aplicaciones Multimedia (iTEAM), Universitat Politècnica de València, Spain

Microwave Photonics Signal Generation for 5G Networks

Enabling technologies for 5G networks includes the use of millimeter waves (MMW) between 30-100 GHz to overcome spectral congestion and increase bandwidth; small cells to allow frequency reuse with a large number of base stations and also massive multiple-input multiple-output (MIMO) full-duplex transmission and beamforming techniques.

A major challenge in the 5G mobile radio access network is the efficient integration of a large number of small cells into the existing network. A fully centralized Cloud Radio Access Network (C-RAN) approach shifts the signal processing from the remote radio heads (RRHs) to a base band unit (BBU) in a central unit and therefore leads RRHs as based on opto-electrical converters, electrical amplifiers, and antennas. In a C-RAN architecture for 5G networks deployment, the data will be carried by an MMW signal and delivered from a central station (CS) to an optical distribution network (ODN).

Transportation of radio signals over large distances makes advantage of the low optical fiber losses but, moreover, the inclusion of free-space optics
(FSO) links is a promising solution to meet future capacity and coverage challenges while reducing the infrastructure costs, especially in rural or remote areas, as well as crowded urban segments.
One of the most challenging stages in these systems is the generation of the MMW signals due to the limited frequency response of electronic components. During the last two decades, a large variety of microwave photonic (MWP) solutions for MMW signal generation have been proposed in the literature including phase control, sideband injection locking, frequency multiplication, or nonlinear mechanisms, amongst others. However, the role of MWP signal generation in future 5G networks deployment will be properly defined according to the requirements of future mobile networks and also considering other practical issues, such as cost and complexity of these systems.

Biography: **Prof. Beatriz Ortega** received the M.Sc. degree in Physics in 1995 with distinction from the Universidad de Valencia, and the Ph.D. in Telecommunications Engineering in 1999 from the Universidad Politécnica de Valencia (UPVLC). She joined the Departamento de Comunicaciones at the Universidad Politécnica de Valencia in 1996, where she was engaged to the Optical Communications Group and her research was mainly done in the field of fibre gratings. From 1997 to 1998, she joined the Optoelectronics Research Centre, at the University of Southampton (United Kingdom), where she was involved in several projects developing new add-drop filters or twin-core fibre-based filters. In 1999 she got an Associate Lectureship at the Telecommunications Engineering Faculty in the Universitat Politécnica de Valencia and she is a Full Professor since 2009. She has published more than 130 international papers in IEEE and OSA high impact journals about fiber devices, optical networks, and microwave photonic systems with an H factor of 27 according to the SCOPUS database. She also has more than 120 contributions at the most relevant international conferences in the Optical Communications field, with more than 20 invited conferences. She owns 3 patents and is co-founder of the company EPHOOX Technology, S.L., founded in 2016 as a spin-off of the UPV. She has participated in several European Networks of Excellence, many research projects funded by the European Union, and more than 25 national research projects. Since 2015, she is the Director of the Master on Communication Technologies, Systems, and Networks at the Universitat Politécnica de València. Most of her work over the last 20 years has been oriented towards optical fiber devices, photonic microwave filters, and advanced modulations for high performance and low cost networks. Currently, her research activity at the Photonics

Research Laboratory Group at UPVLC focuses on the development of reconfigurable and scalable 5G networks based on microwave photonics technology and also on developing converged fiber-wireless optical indoor networks.

24 November, 2020 – Room 1 – 11:15 – 11:45

Prof. Min Zhang

Beijing University of Posts and Telecommunications (BUPT), China

Towards Practical VLC Applications

After a surge of research on key technologies of VLC systems, considerable bitrate has been achieved through various schemes, such as DMT, OFDM, MIMO, DPD... To promote the VLC technologies, attention should be paid also to its practical application scenarios, such as broadband access, optical networking, and indoor positioning. This talk will introduce the recent work in the State Key Laboratory of Information Photonics and Optical Communications. We designed and implemented a VLC networking system, with one VLC access point (VLC-AP) and several VLC user equipment models (VLC-UEs), operating through the self-developed protocol which maintains a simple mechanism of time division multiple address (TDMA). The user terminals (such as PADs and laptops) are connected to VLC-UEs via Ethernet interface and they can access the Internet through the VLC-AP and also they can perform peer-to-peer communication. Various files (such as txt, mp3, mp4, and so on), are able to be transmitted through real-time uplinks and downlinks in this network, including real-time voice and real-time video. The interrupted services are restored automatically. However, a dynamic TDMA mechanism is

to be implemented in the future and the flexibility at VLC-UEs is to be improved to support seamless handover from one VLC-AP to another.

Biography: **Prof. Min Zhang** received the Ph.D. degree in optical communications from the Beijing University of Posts and Telecommunications (BUPT), China, where he is currently a Professor, the Deputy Director of the State Key Laboratory of Information Photonics and Optical Communications, and the Deputy Dean of the School of Optoelectronic Information. He holds 45 China patents. He has authored or coauthored over 300 technical papers in international journals and conferences and 12 books in the area of optical communications. His main research interests include optical communication systems and networks, optical signal processing, and optical wireless communications.

Invited Speakers

24 November, 2020 – Room 1 – 11:45 – 12:15

Prof. Marcos Katz

University of Oulu, Finland

Demonstrating the Concept of Light-based IoT (LIOT)

Biography: **Prof. Marcos Katz** is a Professor at the Centre for Wireless Communications, University of Oulu, Finland, since Dec. 2009. He received the B.S. degree in Electrical Engineering from Universidad Nacional de Tucumán, Argentina in 1987, and the M.S. and Ph.D. degrees in Electrical Engineering from the University of Oulu, Finland, in 1995 and 2002, respectively. He worked in different positions at Nokia, Finland between 1987 and 2001. In 2001–2002 he was a Research Scientist at the Centre for Wireless Communications, University of Oulu. In the years 2003–2005 Dr. Katz was the Principal Engineer at Samsung Electronics, Advanced Research Lab., Telecommunications R&D Center, Suwon, Korea. From 2006 to 2009 he worked as a Chief Research Scientist at VTT, the Technical Research Centre of Finland. Prof. Katz served as the chair of Working Group 5 (on short-range communications) for the Wireless World Research Forum (WWRF) in 2008-2012.

Prof. Katz has written and edited six books in different areas of mobile and wireless communications. He has written more than 170 publications and holds more than 50 patents.

24 November, 2020 – Room 1 – 14:15 – 14:45

Prof. Rafael Pérez Jiménez

Universidad de Las Palmas de Gran Canaria, Spain

Optical Camera Communications, A Solution to Integrate VLC on Smartphones

Biography: **Prof. Rafael Pérez Jiménez**, Born in Madrid in 1965. Eng & MSc (UPM-1991) PhD (ULPGC 1995, Honors), and recently PhD in History (ULL, 2020). Full Professor at the School of Telecommunication Engineering of the ULPGC (University of Las Palmas de Gran Canaria) from 2003, Chairman of IDeTIC (University Institute for Technological Development and Innovation in communications) from 2010-2020. Currently, he coordinates the Communication Technologies & Photonics area in the Spanish Research Agency. He has participated or directed 12 transnational projects, over 25 official national projects in competitive calls, and a score of relevant contracts with companies and administrations. He has published 4 teaching books, 5 book chapters, and over 250 peer-reviewed papers on journals and international technical conferences.

He is a frequent reviewer in different international magazines and symposia. Its main area of specialization corresponds to the development of wireless optical communication systems, especially for IoT sensor networks and medium/low speed links, including both the vehicular and domestic environment, and the characterization of optical channels in indoor and mobile systems. He is also working on applications of OWC and the internet of things over Smart Cities, especially those known as tourism destinations.

24 November, 2020 – Room 1 – 16:30 – 17:00

Dr. Wasiu O Popoola

Edinburgh University, UK

Advanced Signal Processing for Enhancing Optical OFDM Systems

Biography: **Dr. Wasiu O. Popoola** is currently a University Senior Lecturer and Deputy Director of Learning and Teaching in the School of Engineering, University of Edinburgh, U.K. He has published over 100 journal articles/conference articles/patents and over seven of those are invited articles. He co-authored the book Optical Wireless Communications: System and Channel Modeling with MATLAB and many other book chapters. His primary research interests include digital and optical communications, including VLC, FSO, and fiber communication. One of his journal articles ranked No. 2 in terms of the number of full text downloads within IEEE Xplore, in 2008, from the hundreds of articles published by IET Optoelectronics, since 1980. Another article co-authored with one of his Ph.D. students received the Best Poster Award at the 2016 IEEE ICSAE Conference. Popoola is a science communicator appearing in science festivals and on the 'BBC Radio 5live Science' program in Oct. 2017. His publications have over 5000 citations and an h-index of over 30 on Google Scholar.

He is a senior member of IEEE and an associate editor of the IEEE Access journal. He was an Invited speaker at various events including the 2016 IEEE Photonics Society Summer Topicals. He currently leads the Optical Communication Research Group at Edinburgh University.

24 November, 2020 – Room 1 – 17:00 – 17:30

Prof. Ismael Soto Gómez

University of Santiago, Chile

VLC/RF Hybrid Positioning and Monitoring System for a Mining Tunnel

Biography: **Prof. Ismael Soto Gómez** was born in Punta Arenas, Chile. He received an Engineering degree from the University of Santiago of Chile, in 1982, the M.Eng. degree from University Federico Santa Maria, in 1990, and the Ph.D. degree from the University of Staffordshire, U.K., in 1997, respectively. He has taught in the Departments of Computer Science, Industrial Engineering, and Electrical Engineering, University of Santiago of Chile. He is currently an Associate Professor of Telecommunications and Signal Processing with the Electrical Engineering Department, Universidad de Santiago de Chile. He has been the National Director of IEEE and a member of the International Speech Communication Association. He has participated in several national and international research projects on radio and visible light communication technology.

He registers patents in several countries and innovation award from the Association of Electrical Engineers (AIE). His research interests include security, DSP, visible light communications, and Big Data. He

has been the ITC of CSNDSP and the Chairman of the organizing committee of the SACVLC. He has been a reviewer for multiple journals such as Optimization, IET communications, OPTIK, among others.

24 November, 2020 – Room 2 – 14:15 – 14:45

Dr. Hamdi Torun

Northumbria University, UK

Microsystem-Based Detectors and Sensors Operating at Microwave, THz, and Infrared Bands

Biography: **Dr. Hamdi Torun** is an associate professor at the University of Northumbria at Newcastle. Before joining the university in 2017, he was an associate professor at the Department of Electrical and Electronics Engineering and affiliated with the Center for Life Sciences and Technologies at Bogazici University, Istanbul, Turkey. Also, he is a co-founder and a board member of GlakoLens, a biomedical spinoff company. He received his B.S. degree from Middle East Technical University, Ankara, Turkey, in 2003, his M.S. degree from Koc University, Istanbul, Turkey, in 2005, and his Ph.D. degree from the Georgia Institute of Technology, Atlanta, the USA in 2009, all in electrical engineering. He was a postdoctoral fellow in the Department of Mechanical Engineering, Georgia Institute of Technology during 2009-2010. He received Technology Award from Elginkan Foundation, Turkey in 2016, Young Scientist Award from The Science Academy, Turkey in 2016, Innovator Under 35 Award

from MIT Tech Review in 2014, and Marie Curie Fellowship (MC-IRG Grant) in 2011.

24 November, 2020 – Room 2 – 11:45 – 12:15

Prof. Abdolali Abdipour

Amirkabir University of Technology, Iran

Electromagnetic Active Device Modeling in mm-wave and THz Frequency Range

Biography: **Prof. Abdolali Abdipour** was born in Alashtar, Iran, in 1966. He received his B.Sc. degree in electrical engineering from Tehran University, Tehran, Iran, in 1989, his M.Sc. degree in electronics from Limoges University, Limoges, France, in 1992, and his Ph.D. degree in electronic engineering from Paris XI University, Paris, France, in 1996. He is currently a professor with the Electrical Engineering Department, Amirkabir University of Technology (Tehran Polytechnic), Tehran, Iran. He has authored five books, Noise in Electronic Communication: Modeling, Analysis, and Measurement (Amirkabir University Press, 2005, in Persian), Transmission Lines (Nahre Danesh Press, 2006, in Persian), Active Transmission Lines in Electronics and Communications: Modeling and Analysis (Amirkabir University Press, 2007, in Persian-top selected book of the year), Communication Circuits (Nonlinear Analysis, Design and Simulation (Nass Press, 2013) and High Frequency Field Effect Transistors

(Electronic-electromagnetics Modeling & analysis, Amirkabir University Press, 2013, in Persian). His research areas include wireless communication systems (RF technology and transceivers), RF/microwave/ millimeter-wave/THz circuit and system design, electromagnetic (EM) modeling of active devices and circuits, high-frequency electronics (signal and noise), nonlinear modeling, and analysis of microwave devices and circuits. He has authored or coauthored over 360 papers in refereed journals and local and international conferences.

24 November, 2020 – Room 2 – 16:30 – 17:00

Dr. Hamzeh Beyranvand

Amirkabir University of Technology, Iran

The Role of Optical Wireless Communications in Future Access Networks

Biography: **Dr. Hamzeh Beyranvand** is an assistant professor at the Electrical Engineering Department, Amirkabir University of Technology, Tehran, Iran. He received his PhD in Electrical Engineering from the Sharif University of Technology in 2014. He received the 14th Iran National Khwarizmi Youth Award, Dec. 2012 (Ranked 2 in Applied Research), and the best PhD thesis award from IEEE Iran Section, 2015. His research interests are: fiber optic communications and networking, elastic optical networks, optical wireless communications, broadband access networks, and network planning and optimization.

Detailed Program

Tuesday, Nov. 24th

Opening Session (Room 1) 10:30 – 11:15

Quran 10:30 – 10:35

WASOWC2020 Opening Clip 10:35 – 10:40

Welcome from Prof. Vahid Ahmadi 10:40 – 10:45
Scientific Chair and Chair of LOC

Welcome from Prof. Zabih Ghassemlooy 10:45 – 10:50
General Chair

Prof. Mohammad Taghi Ahmadi 10:50 – 11:00
Chancellor of Tarbiat Modares University

Dr. Bijan Abbasi Arand 11:00 – 11:15
CEO of Irancell Company

Keynote Talk 1 (Room 1) 11:15 – 11:45

Prof. Min Zhang
Beijing University of Posts and Telecommunications (BUPT), China

Title: Towards Practical VLC Applications
Chair: Prof. Zabih Ghassemlooy

Invited Talk 1 (Room 1) 11:45 – 12:15

Prof. Marcos Katz
University of Oulu, Finland

Title: Demonstrating the Concept of Light-based IoT (LIOT)
Chair: Prof. Zabih Ghassemlooy

Invited Talk 2 (Room 2) 11:45 – 12:15

Prof. Abdolali Abdipour
Amirkabir University of Technology, Iran

Title: Electromagnetic Active Device Modeling in mm-wave and THz Frequency Range
Chair: Prof. Mohammad Kazem Moravvej-Farshi

Oral Session 1 (Room 1) 12:15 - 13:15

FSO and RF-FSO: Applications, Coding, Signaling, and Detection (1)

Chairs: Prof. Zabih Ghassemlooy
Dr. Seyed Mohammad Sajad Sadough

Paper No. A-10-50-1 12:15 - 12:30
"Achieved Throughput of Hovering UAV-Based Optical Wireless Communications"

Mohammad Taghi Dabiri, Seyed Mohammad Sajad Sadough, and Himan Savojbolaghchi

Paper No. A-10-51-3 12:30 - 12:45

"A Deep Learning based Detector for FSO System Considering Imperfect CSI Scenario"

Mohammad Ali Amirabadi, Mohammad Hossein Kahaei, S. Alireza Nezamalhosseini

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"On N-PAM and M-QAM Implementation within the Hybrid RoF-FSO-PON

Dong-Nhat Nguyen, Jan Bohata, Luis Vallejo, Stanislav Zvanovec, Beatriz Ortega, Zabih Ghassemlooy

Paper No. A-10-54-1 13:00 - 13:15

"Free Space Optical (FSO) Channel Estimation and Tracking using the Incremental Adaptive Networks"

Hosein Abdavinejad, Ehsan Mostafapour, Reza Fazli Garaboghloo, Changiz Ghobadi, Javad Nourinia, Ali Soleimani

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Photonic Devices & Components

Chairs: Prof. Mohammad Kazem Moravvej-Farshi
Dr. Sara Darbari

Paper No. A-10-30-1 12:15 - 12:30

"Design and Analysis of Asymmetric Graphene-coated Nanowire Pair for Second Harmonic Generation"

Babak Janjan, Vahid Ahmadi

Paper No. A-10-56-2 12:30 - 12:45

"Tapered Plasmonic Waveguide for Terahertz Interconnects: an FDTD Method"

Mohsen Heidari, Vahid Ahmadi

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"Efficient LED Light Converter based on Perovskite Nanocrystals for Visible Light Communication"

Meysam Saeedi, Tahereh Ashjari, Farzaneh Arabpour, Vahid Ahmadi

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"Free Space Beam Shaping Using Phase-change Reconfigurable Metasurfaces"

Omid Abed, Leila Yousefi

Break 13:15 - 14:15

Invited Talk 3 (Room 1) 14:15 – 14:45

Prof. Rafael Pérez Jiménez
Universidad de Las Palmas de Gran Canaria, Spain

Title: Optical Camera Communications, a Solution to Integrate VLC on Smartphones
Chair: Dr. Seyed Mohammad Sajad Sadough

Invited Talk 4 (Room 2) 14:15 – 14:45

Dr. Hamdi Torun
Northumbria University, UK

Title: Microsystem-Based Detectors and Sensors Operating at Microwave, THz, and Infrared Bands
Chair: Prof. Nosrat Geranpayeh

Oral Session 3 (Room 1) 14:45 – 16:00

FSO and RF-FSO: Applications, Coding, Signaling, and Detection (2)

Chairs: Prof. Rafael Pérez-Jiménez
Dr. Seyed Mohammad Sajad Sadough

Paper No. A-10-55-1 14:45 – 15:00

"Investigation of a WDM M-QAM RoF-RoFSO System"

Ehsan Hamidnejad, Asghar Gholami, Stanislav Zvanovec

Paper No. A-10-61-1 15:00 - 15:15

"Analysis of Downlink Satellite Free Space Optical Communications Systems Using State-Space Method for the Rate Equations of the Semiconductor Laser Diode"

Sina Ahadi, Gholamreza Baghersalimi, Saeed Ashouri

Paper No. A-10-112-1 15:15 - 15:30

"64-QAM LTE signal transmission at 25 GHz over hybrid SSMF and non-uniform turbulent FSO channel"

Luis Vallejo, Dong-Nhat Nguyen, Stanislav Zvanovec, Beatriz Ortega, Jan Bohata

Paper No. A-10-126-1 15:30 - 15:45

"Implementation and Evaluation of a 10 Gbps Real-time FSO Link"

Zun Htay, Nithin Mohan, Mojtaba Mansour Abadi, Zabih Ghassemlooy, Andrew Burton and Stanislav Zvanovec

Oral Session 4 (Room 2) 14:45 – 16:00

Photonic, Microwave & mm-wave Devices & Components

Chairs: Prof. Vahid Ahmadi
Prof. Nosrat Geranpayeh

Paper No. A-10-35-1 14:45 – 15:00

"Synthesis of Nano-Antennas for desired Far-Field Radiation Patterns Using Vector Spherical Wave Functions"

Seyed Sina Vaezi, Saeid Nikmehr, Ali Pourziad

Paper No. A-10-37-1 15:00 - 15:15

"Design and Fabrication of Microwave Circulators based on Ferromagnetic Nanowires"

Babak Mousaeei, Mehri Hamidi, Esfandiar Mehrshahi

Paper No. A-10-60-1 15:15 - 15:30

"An MSM 2D Ruddlesden Popper Perovskite Photodetector for Visible Light Communication"

Parsa Darman, Amin Yaghoobi, Sara Darbari

Paper No. A-10-68-1 15:30 - 15:45

"Dual-band Near-Perfect Optical Absorption by Graphene-Coated Core-Shell Spherical Nanoparticles"

Shiva Hayati Raad, Zahra Atlasbaf

Paper No. A-10-84-1 15:45 - 16:00

"An Energy Efficient Demodulation Scheme for Dual Ring Star QAM Constellations"

Mir Mahdi Safari, Jafar Pourrostam, Rolf Kraemer

Keynote Talk 2 (Room 1) 16:00 – 16:30

Prof. Beatriz Ortega Tamarit
Instituto de Telecomunicaciones y Aplicaciones Multimedia (iTEAM), Universitat Politècnica de València, Spain

Title: Microwave Photonics Signal Generation for 5G Networks
Chair: Dr. Mohammad Ali Khalighi

Invited Talk 5 (Room 1) 16:30 – 17:00

Dr. Wasiu O Popoola
Edinburgh University, UK

Title: Advanced Signal Processing for Enhancing Optical OFDM Systems
Chair: Dr. Mohammad Ali Khalighi

Invited Talk 6 (Room 2) 16:30 – 17:00

Dr. Hamzeh Beyranvand
Northumbria University, UK

Title: The Role of Optical Wireless Communications in Future Access Networks
Chair: Prof. Zabih Ghassemlooy

Invited Talk 7 (Room 1) 17:00 – 17:30

Prof. Ismael Soto Gómez
University of Santiago, Chile

Title: VLC/RF hybrid positioning and monitoring system for a mining tunnel
Chair: Dr. Mohammad Ali Khalighi

Wednesday, Nov. 25th

Oral Session 5 (Room 1) 10:30 – 11:30

VLC -Modulation Coding and Detection Schemes Diversity Techniques

Chairs: Prof. Asghar Asgari,
Prof. Saeed Olyaee

Paper No. A-10-41-1 10:30 – 10:45
"Performance Evaluation of a MIMO VLC System Employing Single Carrier Modulation with Frequency Domain Equalization"
Tayebeh Ganjian, Gholamreza Baghersalimi, Zabih Ghassemlooy

Paper No. A-10-50-2 10:45 - 11:00

"Outage Probability Improvement through Optimal LED Placement for Visible Light Communications"

Mahmoud Mohammadi, Seyed Mohammad Sajad Sadough

Paper No. A-10-59-1 11:00 - 11:15

"Evaluation of Fog Effects on Optical Camera Communications Link"

Vicente Matus, Shivani Rajendra Teli, Victor Guerra, Cristo Jurado-Verdu, Stanislav Zvanovec, Rafael Perez

Paper No. A-10-62-1 11:15 - 11:30

"Performance Evaluation of Polar Channel Coding on a Practical VLC Link: A Comparison Study"

Hooman Hematkhah, Yousef Seifi Kavian

Forum 1 (Room 1) 11:30 – 12:45

Prof. Mohamad Javad Rasaee
School of Medical Sciences, Tarbiat Modares University, Iran
Prof. Rafael Pérez Jiménez
Universidad de Las Palmas de Gran Canaria, Spain
Prof. Stanislav Zvanovec
Czech Technical University, Czech Republic
Dr. Hadi Moradi
University of Tehran, Iran

Title: Covid-19 and Wireless Communication Technology
Chair: Prof. Zabih Ghassemlooy

Break Time 12:45 - 13:45

Oral Session 6 (Room 1) 13:45 – 15:30

Application of Optical Wireless Communications

Chairs: Prof. Stanislav Zvanovec
Dr. Hamid Saeedi

Paper No. A-10-40-1 13:45 – 14:00
"A Parametric Study On Gauss-Newton Iterations for Wireless Sensor Network Localization"
Alireza Jahangiri, Meysam Mohammadi-Amin, Ghasem Kahe

Paper No. A-10-42-1 14:00 – 14:15
"Optimal SCL Decoding Algorithm for Polar Codes in Extremely Attenuated Optical Wireless Channel"
Tongyao Li, Min Zhang, Danshi Wang, Jingsuo He

Paper No. A-10-47-2 14:15 - 14:30
"Performance Analysis of Turbo Code Concatenated with STBC Over Land Mobile Satellite Communication Channels"
Sanaz Baradaran Rowhani, Iman Ahadi Akhlaghi

Paper No. A-10-58-1 14:30 – 14:45
"Neuron-Like Signal Propagation for OWC Nanonetworks"
João Pandeirada, Luis Nero Alvez, Zabih Ghassemlooy

Paper No. A-10-87-1 14:45 - 15:00

"Different Models of the Refractive Index Structure Constant Calculation"

Pasha Bekhrad, Erich Leitgeb

Paper No. A-10-124-1 15:00 – 15:15

"On The Performance of Optical Wireless Cooperative Systems Over The DGG Fading Channel"

Ehsan Soleimani-Nasab, Zabih Ghassemlooy

Paper No. A-10-129-1 15:15 - 15:30

"Comparative Analysis of Successive Cancellation and List Decoders Using Distinct Combinations of LLRs for Polar Codes"

Rafee Al Ahsan, Lunchakorn Wuttisittikulkij, Sunita Khichar, Pruk Sasithong, Ambar Bajpai, Pisit Vanichchanunt, Amir Parnianifard, Muhammad Saadi, Irfan Ullah, Sushank Chaudhary

Oral Session 7 (Room 2) 13:45 – 15:30

Applications of VLC: Positioning, Localization and Emerging Trends

Chairs: Prof. Luis Nero Alves
Dr. Hamzeh Beyranvand

Paper No. A-10-39-1 13:45 – 14:00

"Investigation of the Impact of Number of LEDs on an OCC Based Indoor Positioning System"

Khadijeh Aalimahmoodi, Asghar Gholami, Zabih Ghassemlooy

Paper No. A-10-50-3 14:00 - 14:15

"Adaptive Equalization for Visible Light Communications with Power Over Ethernet Backhaul"

Mahdi Ataee, Seyed Mohammad Sajad Sadough, Zabih Ghassemlooy

Paper No. A-10-92-1 14:15 – 14:30

"Bandwidth Dependency of (O)LEDs On Bias Current"

Andrew Burton, Paul Anthony Haigh, Petr Chvojka, Zabih Ghassemlooy, Stanislav Zvánovec

Paper No. A-10-107-1 14:30 - 14:45

"Performance Investigation of OCC-Based Vehicle to Vehicle Communications"

Negar Masjedi Esfahani, Asghar Gholami, Negar Shirvani Kordavani, Stanislav Zvanovec, Zabih Ghassemlooy

Paper No. A-10-123-1 14:45 – 15:00

"A Hybrid Variable M-CAP-Based Indoor Visible Light Communications and Fingerprint Positioning System"

Mahdi Nassiri, Atiyeh Pouralizadeh, Gholamreza Baghersalimi, Zabih Ghassemlooy

Workshop (Room 1) 15:30 – 17:30

Prof. Zabih Ghassemlooy
Northumbria University, UK
Dr. Paul Anthony Haigh
Newcastle University, UK

Dr. Andrew Burton
ISOCOM Limited, UK
Dr. Mojtaba Mansour Abadi
Northumbria University, UK

Title: Introduction to MATLAB Without the Use of Toolboxes
Chair: Prof. Zabih Ghassemlooy

Forum 2 (Room 1) 17:30 – 18:30

Dr. Bijan Abbasi Arand
CEO of Irancell Company
Prof. Beatriz Ortega Tamarit
Universitat Politècnica de València, Spain
Prof. Luis Nero Alves
University of Aveiro, Portugal

Title: 5G Technology Trend
Chair: Dr. Mohammad Ali Khalighi

Closing Session (Room 1) 18:30 – 19:00

Clip	18:30 – 18:35
Prof. Vahid Ahmadi	18:35 – 18:40
Prof. Zabih Ghassemlooy	18:40 – 18:45
Best Papers Prizes	18:45 – 19:00

Abstracts

Session 1	FSO and RF-FSO: Applications, Coding, Signaling, and Detection (1)
November 24, 2020 –12:15-13:15 – Room 1	

Achieved Throughput of Hovering UAV-Based Optical Wireless Communications

Mohammad Taghi Dabiri, Seyed Mohammad Sajad Sadough, Himan Savojbolaghchi*

Department of Electrical Engineering, Shahid Beheshti University, G. C., 1983969411 Tehran, Iran
**m_dabiri@sbu.ac.ir*

Abstract: Free-space optical (FSO) communication systems have recently gained a wide popularity for data transfer between unmanned aerial vehicles (UAVs) because they offer several benefits compared with the traditional radio frequency data transmission systems. The channel capacity of UAV-based FSO links is impaired by atmospheric turbulence-induced fading, pointing error due to the position and orientation deviations of hovering UAVs along with interruption probability due to the joint effect of angle-of-arrival fluctuations and receiver field-of view limitations. To investigate the performance of UAV-based
FSO systems in terms of achievable data rates, we derive the exact closed-form expression for the mean achievable rates of UAV-to-UAV transmission. Our results may serve to investigate the interaction between different FSO system parameters and the average data rates achieved by UAV-based optical wireless communications.

Keywords: *Optical wireless communications, free-space optics, unmanned aerial vehicles, atmospheric channel capac*

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The 3rd West Asian Symposium on Optical and Millimeter-wave Wireless Communication (WASOWC2020)
Tarbiat Modares University, Tehran, Iran, Nov. 24-25, 2020

A Deep Learning based Detector for FSO System Considering Imperfect CSI Scenario

Mohammad Ali Amirabadi, Mohammad Hossein Kahaei, and S. Alireza Nezamalhosseini*
School of Electrical Engineering
Iran University of Science and Technology
Tehran, Iran.
**m_amirabadi@elec.iust.ac.ir*

Abstract: In free space optical (FSO) communication system, the maximum likelihood (ML) is the optimum detector considering perfect channel state information (CSI) at receiver. However, the ML does not provide a proper performance in imperfect CSI scenario. Therefore, a deep learning based detection method is proposed in this paper. In this paper, we use deep neural network to get a mapping function of a received signal and transmitted symbol streams. Moreover, the end-to-end approach using deep learning with the conventional ML method is compared for both perfect and imperfect scenarios. Simulation results show that our method presents a better performance compared to the conventional ML method in imperfect CSI. Moreover, our proposed method reaches the same performance as the ML detector in perfect CSI.

Keywords - *Deep learning, free space optical communication, imperfect channel state information*

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The 3rd West Asian Symposium on Optical and Millimeter-wave Wireless Communication (WASOWC2020)

Tarbiat Modares University, Tehran, Iran, Nov. 24-25, 2020

On *N*-PAM and *M*-QAM implementation within the hybrid RoF-FSO-PON system

Dong-Nhat Nguyen*,[1], Jan Bohata[1], Luis Vallejo[2], Stanislav Zvanovec[1], Beatriz Ortega[2], Zabih Ghassemlooy[3]

1-Department of Electromagnetic Field Czech Technical University in Prague, Prague, Czech Republic

2- Instituto de Telecomunicaciones y Aplicaciones Multimedia, ITEAM Universitat Politècnica de València Valencia, Spain

3- Optical Communications Research Group, Faculty of Engineering and Environment, Northumbria University, Newcastle upon Tyne, UK

Abstract: This paper investigates an optical transmission architecture of a passive optical network (PON), which is compatible with the millimeter-wave radio-over-fiber and free-space optics systems (RoF-FSO) under weak-to-strong atmospheric turbulence (AT) regimes to enable seamless connectivity as part of next-generation broadband wireless access networks. We first analyze and evaluate in simulation the transmission performance of the integrated system at 40 GHz for 10 Gb/s *N*-pulse amplitude modulation (*N*-PAM) with $N = 2, 4$. Link performance shows that, 4-PAM outperforms 2-PAM in terms of tolerance to the combined impairment of fiber chromatic dispersion and AT. We then experimentally demonstrate the proof-of-concept integrated RoF-FSO-PON at 25 GHz using 20 MHz *M*-quadrature amplitude modulation (*M*-QAM) signals with $M = 4, 16, 64$. We show that, for QAM with a higher-order *M*, the link performance is being more affected by the combined impairments.

Keywords: *radio-over-fiber, free-space optics, passive optical networks, turbulence, millimeter-wave*

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Tarbiat Modares University, Tehran, Iran, Nov. 24-25, 2020

Free space optical (FSO) channel estimation and tracking using the incremental adaptive networks

Hosein Abdavinejad[1*], Changiz Ghobadi[1], Ehsan Mostafapour[1], Javad Nourinia[1], Reza Fazli Garaboghloo[2], Ali Soleimani[2]

1. *Dept. Electrical Engineering, Urmia University, Urmia, Iran*
2. *Dept. Electrical Engineering, Shahrood University of Technology, Shahrood, Iran.*

**h.abdavinejad@urmia.ac.ir*

Abstract: Channel estimation is necessary for almost every communication system. Its importance becomes clear when the links between the transmitter and receiver become highly unstable. The channels of the free space optical (FSO) communication systems suffer from optical turbulence and there are several statistical models to explain this phenomenon. In this paper, we consider the FSO channel estimation with adaptive incremental networks and examine their performance in estimating the channels modeled with the Log-normal and Gamma-Gamma distributions. This is the first attempt to estimate FSO channels with adaptive shames and the results show that as the turbulence level of the considered FSO channel rises, its estimation becomes harder and with more error. Therefore, estimating Log-normal modeled FSO channels is more accurate than the Gamma-Gamma modeled channels because the coefficients of the Gamma-Gamma model tend to change more rapidly in time than the coefficients of the Log-normal model.

Keywords: *Channel estimation, Incremental strategy, adaptive networks, Free space optical communication (FSO), Gamma-Gamma distribution.*

Session 2	Photonic Devices & Components
November 24, 2020 –12:15-13:15 – Room 2	

Design and analysis of asymmetric graphene-coated nanowire pair for second harmonic generation

Babak Janjan*, Vahid Ahmadi, Davood Fathi
Dept. of Electrical and Computer Engineering,
Tarbiat Modares University, Tehran, Iran
**b.janjan@modares.ac.ir*

Abstract: we present a design and analysis symmetric graphene-coated nanowire pair for second harmonic generation (SHG) operating in the mid-infrared regime. The phase-matching condition is fulfilled using higher-order modes at the second harmonic frequency by properly adjusting the waveguide parameters. We show that the asymmetric structure provides a more flexible design for SHG. An efficiency of 0.25 % with only 0.5 mW input power along the waveguide length of 6 μm is estimated. Also, our simulations reveal that the structure has wide bandwidth and high tolerance with respect to fabrication errors.
Keywords— *Graphene, Second-harmonic generation, Terahertz frequency range.*

Tapered Plasmonic Waveguide for Terahertz Interconnects: an FDTD Method

Mohsen Heidari, Vahid Ahmadi*

Department of Electrical and Computer Engineering
Tarbiat Modares University, Tehran, Iran

**v_ahmadi@modares.ac.ir*

Abstract- An ultra-compact interconnect is demonstrated using tapered dielectric-loaded graphene plasmonic structure. The proposed interconnect can squeeze Terahertz (THz) wave to sub-wavelength which is promising for ultra-compact THz integrated circuits. Calculations are performed using the finite-difference time-domain method. The power density and power transmittance are calculated for two structures, a tapered interconnect and an ordinary uniform interconnect. The results show that the tapered structure can eliminate the effect of propagation losses by increasing the power density at the end of the tapered section. Moreover, the proposed structure can couple THz wave to a device with a sub-wavelength dimension of about $\lambda_{air}/20$.

Keywords: *Graphene, interconnect, dielectric-loaded, surface plasmon, Terahertz integrated circuits*

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The 3rd West Asian Symposium on Optical and Millimeter-wave Wireless Communication (WASOWC2020)

Tarbiat Modares University, Tehran, Iran, Nov. 24-25, 2020

Efficient LED Light Converter based on Perovskite Nanocrystals for Visible Light Communication

Meysam Saeedi[1], Tahereh Ashjari[1], Farzaneh Arabpour Roghabadi[2,*], Vahid Ahmadi[1,*]

1- Optoelectronic and Nanophotonic Research Group, Faculty of Electrical and Computer Engineering, Tarbiat Modares University, Tehran, Iran

2- Faculty of Chemical Engineering, Optoelectronic and Nanophotonic Research Group, Faculty of Electrical and Computer Engineering, Tarbiat Modares University, Tehran, Iran

** Arabpour@modares.ac.ir, v_ahmadi@modares.ac.ir*

Abstract- To provide the white light source in a visible light communication (VLC) system, light-emitting diodes (LEDs) are frequently used as light sources that are converted into green, yellow, and red emissions using light converters. In this work, perovskite quantum dots ($CH_3NH_3PbI_3$) with a photoluminescence quantum yield (PLQY) as high as 90% are synthesized via a facile solution process method and used as the light converter for VLC applications. Through this conversion, the emission light from the LED with a wavelength of 400 nm and full width at half maximum (FWHM) of 25 nm is converted to green light with a wavelength of 530 nm and FWHM of 23 nm.

Keywords: *Light emitting diode, Perovskite quantum dots, Visible light communication, photoluminescence quantum yield*

Free Space Beam Shaping Using phase-change Reconfigurable metasurfaces

Omid Abed*, Leila Yousefi

School of Electrical and Computer Engineering
University of Tehran, Tehran, Iran

** omid.abed@ut.ac.ir*

Abstract- Metasurfaces are planar structures that enable us to manipulate electromagnetic wavefronts by using subwavelength elements. Here, we propose a new tunable metasurface based on phase change materials and graphene heaters to operate in the near-IR regime. In the proposed structure, by incorporating electrical heaters, the optical properties of the phase change material layer and, consequently, the metasurface response can be adjusted. Finally, to investigate the potential capability of the proposed metasurface as a free space beam shaper, its beam steering capability is investigated.

Keywords: *Tunable metasurfaces, Phase Change Materials, Optical beam steering*

Session 3	FSO and RF-FSO: Applications, Coding, Signaling and Detection (2)
November 24, 2020 – 14:45 – 16:00 – Room 1	

Investigation of a WDM M-QAM RoF-RoFSO System

Ehsan Hamidnejad*,[1], Asghar Gholami[1], Stanislav Zvanovec[2], Zabih Ghassemlooy[3]

1. *Department of Electrical and Computer Engineering, Isfahan University of Technology, Isfahan, Iran*
2. *Department of Electromagnetic Field Czech Technical University in Prague, Prague, Czech Republic*
3. *Optical Communications Research Group, Faculty of Engineering and Environment, Northumbria University, Newcastle upon Tyne, UK*

**ehsan.hamidnejad@ec.iut.ac.ir*

Abstract- The radio over fiber (RoF) technology combines the advantages of radio frequency (RF) and optical communication systems. Hybrid RoF and radio over free space optics (RoFSO) is a solution for the last mile access networks in urban areas and in areas where installation of RoF links is impractical and costly. In this work we introduce a 4-, 16- and 64- quadrature amplitude modulation (QAM) hybrid RoF-RoFSO communication system and investigated the inter-channel interference and the effects of atmospheric turbulence on the FSO section of the link.

Keywords: *radio over fiber (RoF), radio over free space optics (RoFSO), inter-channel interference*

Analysis of Downlink Satellite Free Space Optical Communications Systems Using State-Space Method for the Rate Equations of the Semiconductor Laser Diode

Sina Ahadi*, Gholamreza Baghersalimi, Saeed Ashouri

Department of Electrical Engineering University of Guilan, Rasht, Guilan, Iran
** sina.ahadi1994@gmail.com*

Abstract- Performance analysis of a single carrier satellite optical communication system using laser rate equations by employing state-space technique is carried out in this research. First, a DC analysis is performed in order to determine threshold current and operating region of the semiconductor laser to find a proper quiescent point. Afterward, small-signal characteristics of the laser are derived using a linearized version of the rate equations using the state space technique. Also, Gamma-Gamma distribution is used to model the atmospheric effect of the optical channel. Results demonstrates that the system performance degrades for higher modulation orders, lower bias points and higher zenith angles.

Keywords: *Free Space Optical Communication, Satellite Communication, Rate Equations, Pulse Amplitude Modulation- Gamma-Gamma distribution, Bit Error Rate*

64-QAM LTE signal transmission at 25 GHz over hybrid SSMF and non-uniform turbulent FSO channel

Luis Vallejo, Dong*,[1]-Nhat Nguyen[2], Stanislav Zvanovec[2], Beatriz Ortega[1], Jan Bohata[2]

1-Instituto de Telecomunicaciones y Aplicaciones Multimedia Universitat Politecnica de Valencia,Valencia, Spain

2-Department of Electromagnetic Field Czech Technical University in Prague, Prague, Czech Republic

**luivalc2@iteam.upv.eso*

Abstract- This contribution describes the impact of non-uniform thermal-induced turbulence on 64-QAM LTE signal transmission at 25 GHz millimeter wave (mmW) signal along hybrid RoF/RoFSO links. Microwave photonic signal generation has been employed by using the optical frequency doubling with intensity modulator biased at the minimum transmission point. The optical and electrical power budgets of different scenarios have been defined and error vector magnitude (EVM) performance has been measured. It is shown that the uniform scenario with high turbulence in the middle of the link is the one with greater impact on the quality of the received data.

Keywords: *Free space optics communications, hybrid RoF/RoFSO, thermal turbulence, millimetre-wave*

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Tarbiat Modares University, Tehran, Iran, Nov. 24-25, 2020

Implementation and Evaluation of a 10 Gbps Real-time FSO Link

Zun Htay*,[1], Nithin Mohan[1], Mojtaba Mansour Abadi[1], Zabih Ghassemlooy[1], Andrew Burton[2] and Stanislav Zvanovec[3]

[1] *Optical Communications Research Group, Faculty of Engineering and Environment, Northumbria University, Newcastle upon Tyne, NE1 8ST, UK*

[2] *Isocom Limited, 2 Fern Court, Bracken Hill Business Park, Peterlee, SR8 2RR, UK*

[3] *Department of Electromagnetic Field, Faculty of Electrical Engineering, Czech Technical University in Prague, Prague 16627, Czech Republic*

Abstract- In this paper, we present and experimentally evaluate a real-time 10 Gbps free-space optical (FSO) link under varying atmospheric conditions. In bandwidth-craving wireless technologies due to the ubiquitous consumption by internet of things devices and requiring high data rate online services, unlicensed FSO systems can be a promising candidate to satisfy the network capacity of the existing data communications technologies. In this work, we verify the experiment using small form-factor pluggable transceivers mounted FPGA as a FSO transmitter and receiver. Here, a high-speed single FSO link is proposed and its performance under turbulence and fog conditions using the dedicated indoor atmospheric chamber is evaluated. We show that, the proposed system under the turbulence condition with a scintillation index of 0.35 offers the same data rate as the link under a clear channel, while the bit error rate increases from 10^{-12} to 5×10^{-4}.

Keywords: *FSO, Fog, Turbulence, Last Mile Access*

Session 4	Photonic, Microwave & mm-wave Devices & Components
November 24, 2020 – 14:45 – 16:00 – Room 2	

Synthesis of Nano-Antennas for desired Far-Field Radiation Patterns Using Vector Spherical Wave Functions

Seyed Sina Vaezi *, Saeid Nikmehr, Ali Pourziad

Electrical and Computer Engineering Department, Tabriz University
Tabriz, Iran

** s.vaezi@tabrizu.ac.ir*

Abstract- a method is proposed to synthesize a set of dielectric nano-spheres in order to scatter the incident plane-wave in an arbitrary pattern. Two known pencil-beam and end-fire radiation patterns are considered as desired patterns. Also, a radiation pattern suitable for solar cell applications is synthesized. The permittivity and electrical size of spheres are chosen to be similar for all spheres. An incident plane-wave is illuminated on spheres. Multiple scattering is occurred between spheres. Finally, total scattering is calculated using boundary conditions. All calculations are based on expansion of all electromagnetic waves into vector spherical wave functions. As the method of analyzing the scattering of small dielectric spheres is proposed, particle swarm optimization tool is implemented to optimally find the positions of spheres. The optimization tool is applied to have approximately desired scattering pattern. It is shown that increasing number of iterations of optimization tool, increases the accuracy of scattering pattern of spheres.

Keywords: *Nano-antenna, end-fire, pencil-beam, solar cell, multiple scattering, vector spherical wave functions, particle swarm*

Design and fabrication of microwave circulators based on ferromagnetic nanowires

B. Mousaeei[1,*], *S. M. Hamidi*[1], *E. Mehrshahi*[2]

1- *Laser and Plasma Research Institute, Shahid Beheshti University, Tehran, Iran*

2- *Department of Electrical and Computer Engineering, Shahid Beheshti University, Tehran, Iran*

**B.mousaeei@ut.ac.ir*

Abstract- Microwave circulators based on magnetic nanowires have attracted so much attention due to smaller sizes, fast manufacturing process, low cost and ability to adjust absorption frequency in a wide range in zero fields. Microwave circulators based on magnetic nanowires are designed using the scattering matrix method and are built using chemical electrodeposition in anode aluminum oxide membrane. After nanowires synthesis, a microstrip transmission line is prepared using the sputtering coating method and the final test of the device is done by vector network analyzer. Our results show high isolation of -20 dB with good agreement between simulation and measured data.

Keywords: *Microwave circulators, Magnetic nanowires, Scattering matrix method*

A MSM 2D Ruddlesden Popper perovskite photodetector for visible light communication

Parsa Darman*, Amin Yaghoobi, Sara Darbari

Department of Electrical and Computer Engineering
Tarbiat Modares University, Tehran, Iran

** darmanparsa@modares.ac.ir*

Abstract- Two dimensional Ruddlesden Popper Perovskite (RPP) has attracted optoelectronic research groups in recent years because of their photoabsorption coefficient as high as 3D counter parts while they are much more stable and durable. In this work, a metal-semiconductor-metal photodetector was fabricated. The metals were aluminum and the semiconductor was $(BA)_2PbI_4$. Photoresponsivity and detectivity of this device were 2.16mA/W and 1.6×10^9 jones respectively. Its fall time and rise time were 1.25 and 3 ms. The results showed that this device can be used in fast visible light communication (VLC) systems.

Keywords: *MSM photodetector, Hot cast, Ruddlesden popper perovskite, visible light communication*

Dual-band Near-Perfect Optical Absorption by Graphene-Coated Core-Shell Spherical Nanoparticles

Shiva Hayati Raad*, Zahra Atlasbaf

Department of Electrical and Computer Engineering
Tarbiat Modares University, Tehran, Iran

**shiva.hayati@modares.ac.ir*

Abstract- In this paper, a dual-band optical absorber is designed using graphene-coated core-shell nanoparticles. The performance of the proposed structure is based on the excitation of localized surface plasmon resonances (LSPRs) in the dual graphene sheets wrapped around the core and shell. Since the excited LSPRs are in the deep sub-wavelength regime, each core-shell sphere can be considered as a polarizable particle in the quasi-static regime and it exhibits high absorptivity when arranged in a periodic lattice. By proper choice of geometrical, optical, and material properties, it is feasible to reach complete optical absorption in the dual operating bands after residing the patterned particles on top of a reflecting mirror. Due to the spherical symmetry, the proposed absorber is not sensitive to the incident angles of TE and TM waves up to around 55º in both frequencies.

Keywords: *absorber, graphene, dual-band, core-shell, absorber, localized surface plasmon resonance (LSPR)*

An Energy Efficient Demodulation Scheme for Dual Ring Star QAM Constellations

Mir Mahdi Safari[1,*], Jafar Pourrostam[1], Rolf Kraemer[2]

1- *Faculty of Electrical and Computer Engineering, University of Tabriz, Tabriz, Iran*

2- *IHP Microelectronics, Frankfurt (Order), Germany*

**safari@tabrizu.ac.ir*

Abstract- Designing energy efficient mixed-signal devices like analog -to-digital converter (ADC) in multi-giga (or tera)-bit-per second wireless communications beyond millimeter wave (mm-wave) frequencies leads to great challenges in systems employing digital signal processing. Realization of such ultra-high speed systems is sophisticated with intensified power consumption. In this paper, we propose an uncomplicated and energy efficient fully analog dual ring *M*-ary star QAM demodulator for mm-wave communications based on amplitude threshold estimation and phase detection, that omits the need for ultra-high speed ADC. The robustness of the proposed scheme against analog processing errors has been analyzed completely. It is shown that for dual ring 16 star QAM with R_1=2 and R_2=4, at 10^{-3} BER, the associated threshold estimation implementation loss is about $\delta = 0.14$ dB.

Keywords- *Multi giga bit per second, energy efficiency, dual ring star QAM, analog signal processing, ADC, demodulator*

Session 5	VLC – Modulation Coding and Detection Schemes Diversity Techniques
November 25, 2020 – 10:30 – 11:30 – Room 1	

Performance Evaluation of a MIMO VLC System Employing Single Carrier Modulation with Frequency Domain Equalization

Tayebeh Ganjian *,[1], Gholamreza Baghersalimi [1], Zabih Ghassemlooy[2]

1-Department of Electrical Engineering
University of Guilan, Rasht, Iran.

2-Optical Communications Research Group, Faculty of Engineering and Environment, Northumbria University, Newcastle, England,

** tganjian@msc.guilan.ac.ir*

Abstract- In this paper, a multiple input – multiple output (MIMO) visible light communications utilizing single-carrier modulation combined with frequency domain equalization is investigated. We study the repetition coding (RC) and spatial multiplexing (SMP) schemes and show that MIMO with RC offers improved performance compared with single input – single output system, however MIMO with SMP increases the spectral efficiency at the cost of bit error rate degradation.

Keywords: *MIMO, VLC, Equalization, SCFDE, OOK*

Outage Probability Improvement Through Optimal LED Placement for Visible Light Communications

Mahmoud Mohammadi *, Seyed Mohammad Sajad Sadough

Department of Electrical Engineering, Faculty of Electrical Engineering, Shahid Beheshti University, Tehran, Iran
** mahm_mohammadi@sbu.sc.ir*

Abstract- We address optimal light-emitting diode (LED) placement on ceiling for indoor visible light communications (VLC) with the aim of minimizing the outage (blockage) probability at the location of the mobile receiver. More precisely, in the considered scenario, several LEDs (transmitters) are placed on the ceiling and a mobile user device (receiver) with random position is distributed over the width and height of a corridor where the instantaneous received signal-to-noise ratio (SNR) is random. First, we derive the expression for instantaneous received SNR of the underlying non-directed line-of-sight (NLOS) channel. Second, we propose an algorithm to determine the optimal position of the transmitters by minimizing the outage probability at the position of the mobile receiver. Finally, we characterize the interactions between number and height of LEDs and the total optical power at their optimum location. Our results show that by increasing the height of ceiling mounted LEDs or by decreasing the total emission power (leading to a decrease of the instantaneous received SNR), the optimal location is tilted toward the center of the ceiling.

Keywords: *Visible light communication, outage probability, mobile user, optimal LED placement*

Evaluation of Fog Effects on Optical Camera Communications Link

Vicente Matus[1,*], Shivani Rajendra Teliy[2], Victor Guerra[1], Cristo Jurado-Verdu[1], Stanislav Zvanovecy[2], Rafael Perez-Jimenez[1]

1- IDeTIC-ULPGC, Las Palmas de Gran Canaria, Spain

2- Czech Technical University in Prague, Czech Republic

vmatus@idetic.eu

Abstract- The applications of Optical Camera Communications (OCC) have been tested for vehicular communications, Internet-of-things (IoT), and other outdoor scenarios due to the vast availability of standard camera equipment. The outdoor channel is, however, affected by atmospheric conditions, ranging from the presence of particles or water drops in the air to thermally induced fluctuations of the refractive index (turbulence). In this work, we experimentally investigate the influence of fog on an OCC link exploiting rolling shutter cameras and using red-green-blue (RGB) channels inside a laboratory chamber featuring
a fog machine. The analysis is performed using the Pearson's correlation coefficient between test and reference signals as a measure of similarity or decay of the signal attenuation of fog associated with atmospheric visibility.

Keywords: *Optical camera communications (OCC), fog meteorological visibility, experimental outdoor OCC*

Performance Evaluation of polar Channel Coding on a practical VLC Link: A Comparison Study

Hooman Hematkhah*, Yousef Seifi Kavian

Department of Electrical Engineering, Shahid Chamran University of Ahvaz, Ahvaz, Iran

**hooman.hematkhah@gmail.com*

Abstract- In this paper, we investigate the performance of Polar codes, Turbo and Low-Density Parity-Check (LDPC) codes on a practical Visible Light Communication (VLC) link, in terms of the Bit-Error-Ratio (BER) vs. SNR separately. The considered parameters are the number of iterations in Turbo and LDPC and list size in the Polar codes respectively. Then, we compare three methods together with the best value of parameters of each one. To give a fair comparison, we use the same length of code as input and the rate of all codes is 1/2. The results show that the Polar codes perform better than Turbo and LDPC codes on VLC based applications.

Keywords: *Visible Light Communication, Polar Channel coding, Performance Evaluation, LDPC, Turbo*

Session 6	Application of Optical Wireless Communications
November 25, 2020 – 13:45 – 15:30 – Room 1	

A Parametric Study on Gauss-Newton Iterations for Wireless Sensor Network Localization

Alireza Jahangiri[1], Meysam Mohammadi-Amin*,[2],

Ghasem Kahe[2]

1-Physics Department, Science & Research Branch, Islamic Azad University, Tehran, Iran

2-Aerospace Research Institute, Tehran, Iran

**mmohammadi@ari.ac.ir*

Abstract- High performance computing has opened up the possibility of increased accuracy in mobile devices such as wireless sensor networks, thanks to increased availability of processing power and network access. In spite of the advances made, the low power footprint acts as a constraint on which is a challenge. In order to address this challenge, optimization of the algorithm can provide a solution. In this study, we present a wireless sensor network and demonstrate how Gauss-Newton algorithm iterations can be balanced for optimum accuracy and lower computational effort towards a final goal of improving localization accuracy. Special attention is made to the effect of network size and Gaussian error on the Root Mean Square Error (RMSE) and computational time with respect to differing iterations. The results can be utilized in order to make better use of low speed parallel and distributed microprocessors for high performance wireless sensor network localization.

Keywords: *Gauss-Newton Method, Wireless Sensor Network, Localization*

Optimal SCL decoding algorithm for Polar Codes in extremely attenuated optical wireless channel

Tongyao Li[1], Min Zhang[1], Danshi Wang*, Jingsuo He[2]

1-Sate Key Lab. of Information Photon. and Opt. Comm Beijing Univ. of Posts and Telecom.Beijing, China

2-Physics Department of Capital Normal University, Beijing, China
**wang_danshi@163.com*

Abstract- The polar codes (PCs) has been shown to effectively enhance the transmission distance of optical wireless communication (OWC) systems, however, an optimized decoding algorithm for PCs is required to reduce the interference and the path-loss propagation attenuation in extremely attenuated optical wireless channel. In this paper, a successive cancellation list (SCL) decoder scheme is proposed and implemented over the classic successive cancellation (SC) decoding algorithm through extending decoding path with the path loss particle model. Simulation experiments are performed under attenuation channel (in ultra violet spectrum) to show the improvement of the decoding scheme of PCs that combined with cyclic redundancy check (CRC) joint detection decoding. Meanwhile, a path metric value threshold is introduced to conduct a path pruning operation on SCL decoding to lower the additional computational complexity.

Keywords: *Polar Codes, SC Decoding Algorithm, SCL Decoder, Path Pruning*

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The 3rd West Asian Symposium on Optical and Millimeter-wave Wireless Communication (WASOWC2020)

Tarbiat Modares University, Tehran, Iran, Nov. 24-25, 2020

Performance Analysis of Turbo Code Concatenated with STBC Over Land Mobile Satellite Communication Channels

Sanaz Baradaran Rowhani *, Iman Ahadi Akhlaghi

Faculty of Electrical Engineering Sadjad University of Technology

Mashhad, Iran

**sanazrowhani@yahoo.com*

Abstract- In this paper, Turbo code concatenated with STBC has been employed in land mobile satellite communications characterized by Lutz model deemed to be one of the most significant statistical approaches of communication. Land mobile satellite communication massively requires considerable reduction in bit error rate for low SNRs as well as great diversity and coding gains due to the fact that transmitted signals have to overcome great amount of turbulence effects as well as other destructive effects through communication. Initially, we have presented an overall review of Turbo, Space time block codes (STBC) and Lutz model, the former as two different coding schemes which could be taken in to account to combat the fading effects in the satellite communications and the latter as a two-state Markov model applied in land mobile satellite communication channels. Employing foregoing structure could lead to reliable transmission as well as considerable bit error reduction.

Keywords: *Turbo, STBC, MIMO, Lutz model*

Neuron-like Signal Propagation for OWC Nanonetworks

João Pandeirada *,[1], Luis Nero Alves [1], Zabih Ghassemlooy[2]

1- Instituto de Telecomunicações University of Aveiro Aveiro, Portugal
2- Optical Comm. Research Group Northumbria University Newcastle-upon-Tyne, UK
** joao.pandeirada@ua.pt*

Abstract- Neuron-inspired signal propagation is proposed for communication in networks of nanodevices. Nanodevices should be able to interpret and forward signals inside the network in order to transport the information between two endpoints. Applications at the nano level demand processing systems that are very power efficient and simple. To achieve that, a brain inspired spiking neural network with pattern recognition and relaying capabilities is presented. The neural network learns the desired features using STDP, a power efficient and biologically plausible learning method. Finally, several nanonetworks are simulated, communicating using OWC. The results obtained show that signal similarity between the emitted and received signal highly depends on the design space of the neurons. It is possible to create networks with NDs capable of transporting information between two endpoints.

Keywords: *Nanotechnology, Nanonetworks, Molecular, communication, SNN, STDP, Relay*

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The 3rd West Asian Symposium on Optical and Millimeter-wave Wireless Communication (WASOWC2020)

Tarbiat Modares University, Tehran, Iran, Nov. 24-25, 2020

Different models of the refractive index structure constant calculation

Pasha Bekhrad*, Erich Leitgeb

IHF, TUGraz, Graz, Austria
**bekhrad@tugraz.at*

Abstract- The intensity of the optical turbulence is measured by refractive index structure parameter, C_n^2. A number of models have been formulated to describe C_n^2 profiles. There are three different parametric models, Dewan, Trinquet-Vernin and Marzano, for deriving vertical turbulence profiles of C_n^2 present in this paper. Parametric models depend on a number of parameters not just the altitude in order to define the evolution of C_n^2. Furthermore, we outline comparison of models presented.

Keywords: *Turbulence profile, Seeing,* C_n^2

On the Performance of Optical Wireless Cooperative Systems over the DGG Fading Channel

Ehsan Soleimani-Nasab*,[1], Zabih Ghassemlooy[2]

1- *Department of Electrical and Computer Engineering, Graduate University of Advanced Technology, Kerman, Iran*

2- *Faculty of Engineering and Environment, Northumbria University, Newcastle, United Kingdom*

**ehsan.soleimani@kgut.ac.ir*

Abstract- There is a growing research interests in hybrid optical and microwave wireless communications, which could be adpted in the next generation wireless networks. In this paper, based on the decode-and-forwardrelaying protocol and statistical behavior of the overall link's signal-to-noise-ratio, we consider five different practical scenarios by dering closed-form expressions for the outage and the bit error probabilities. Using Monte Carlo simulation we verify the predicted results. It is demonstrated that, decreasing the semi-angle of LED or increasing the filed of view of VLC receiver enhance the performance.

Keywords: *Free space optical (FSO) communications, visible light communications (VLC), radio frequency (RF) communications, outage probability*

Comparative Analysis of Successive Cancellation and List Decoders Using Distinct Combinations of LLRs for Polar Codes

Rafee Al Ahsan*,[1], Lunchakorn Wuttisittikulkij[1], Sunita Khichar*,[1], Pruk Sasithong[1], Ambar Bajpai[2], Pisit Vanichchanunt[3], Amir Parnianifard[1], Muhammad Saadi[4], Irfan Ullah[1], Sushank Chaudhary[5]

1- *Department of Electrical Engineering, Chulalongkorn University, Bangkok, Thailand*

2- *Department of Electronics and Communication, Atria Institute of Technology, Bangalore, India*

3- *Department of Electrical and Computer Engineering, King Mongkut's University of Technology North Bangkok, Thailand*

4- *Department of Electrical Engineering, University of Central Punjab, Lahore, Pakistan*

5- *Quanzhou Institute of Equipment Manufacturing, Chinese Academy of Sciences*

* *ahsanrafee123@ieee.org, sunitakhichar1433@gmail.com*

Abstract- Under the 3rd Generation Partnership Project (3GPP) New Radio (NR), polar codes have been chosen as one of the methods of channel coding. Polar codes are used for the control channel in 5G wireless communication deployment. So, the channel decoding schemes used to decode the received codeword must be properly analyzed for efficient utilization of 5G. This paper performed a comparative analysis of the distinct channel state-based capabilities of decoding of the two different contenders of polar code decoders: 1) Successive Cancelation (SC) decoder and 2) Successive Cancellation List (SCL) decoder. Here we have analyzed both the decoders in terms of the various combinations of high and low Log-Likelihood Ratios (LLRs) of the received codewords from the channel. This investigation has revealed that even the SCL decoder always explores more decodable candidates than the SC counterpart, under some specific received codewords the SC may decode better.

Keywords: *5G, Successive Cancellation (SC) decoder, Successive Cancellation List (SCL) decoder, Log-Likelihood Ratio (LLR)*

Session 7	Applications of VLC: Positioning, Localization and Emerging Trends
November 25, 2020 – 13:45 – 15:30 – Room 2	

Investigation of the Impact of Number of LEDs on an OCC based Indoor Positioning System

Khadijeh Aalimahmoodi[1,*], Asghar Gholami[1], Zabih Ghassemlooy[2]

1. *Departement of Electrical and Computer Engineering, Isfahan University of Technology, Isfahan 8415683111, Iran*

2. *Optical Communications Research Group, Faculty of Engineering and Environment, Northumberia University Newcastle, U.K*

**Khadijeh1371@gmail.com*

Abstract—Optical camera communications (OCCs) technology, which utilizes lighting infrastructure for both illumination and data transmission and camera as the receiver, recently has drawn a lot of attention and luckily it can be used for indoor positioning as well. We consider an indoor environment with a number of light emitting diodes (LEDs) lighting access points for positioning and estimate the location using the view angles between LEDs' images mapped onto the image plane. The impact of the number of LEDs, which are varied from 3 to 9, on the positioning accuracy is investigated theoretically and validated experimentally. We show that increasing the number of LEDs has a significant effect on the performance of the OCC-based indoor positioning systems (IPSs).

Keywords— *Indoor positioning, Optical camera communication, LEDs.*

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The 3rd West Asian Symposium on Optical and Millimeter-wave Wireless Communication (WASOWC2020)

Tarbiat Modares University, Tehran, Iran, Nov. 24-25, 2020

Adaptive Equalization for Visible Light Communications with Power over Ethernet Backhaul

Mahdi Ataee*,[1], Seyed Mohammad Sajad Sadough[1], Zabih Ghassemlooy[2]

1- Department of Telecommunication, Faculty of Electrical Engineering, Shahid Beheshti University G. C., 1983969411, Tehran, Iran

2- Faculty of Engineering & Environment, University of Northumbria at Newcastle, UK

** m_ataee@sbu.ac.ir*

Abstract- The advent of fast-switching light emitting diodes (LED)s has enabled visible light communications (VLC) as a mean to implement optical wireless communications (OWC) over the visible light spectrum. It is of great importance to move the technology forward to widespread its adoption. One proposed solution is by integrating VLC with pre-existing Ethernet local area network (LAN) backbones. In this paper, we investigate the implementation of analog transmission of 100Base-Tx over VLC in an amplify-and-forward approach. An adaptive equalization technique is proposed to improve the performance of the overall system. This VLC-LAN solution is proved to be a practical alternative for providing a wireless broadcast link wherever LEDs are used for illumination in an indoor situation**.**

Keywords: *Optical wireless communications, visible light communications, adaptive equalization, power over Ethernet*

Bandwidth Dependency of (O)LEDs on Bias current

Andrew Burton[1,*], Paul Anthony Haigh[2], Petr Chvojka[3], Zabih Ghassemlooy[4], Stanislav Zvánovec[3]

1. ISOCOM ltd., 2 Fern Court, Bracken Hill Business Park, Peterlee, County Durham, SR8 2RR, UK

2. Intelligent sensing and Communications Group, Faculty of Science, Agriculture and Engineering, Newcastle University, Newcastle upon Tyne, NE1 7RU, UK

3. Wireless and Fibre Optics Group, Department of Electromagnetic Filed, Faculty of Electrical Engineering, Czech Technical University in Prague, Prague 16627, Czech Republic

4. Optical Communications Research Group, Department of Electrical and Electronic Engineering, Faculty of Engineering and Environment, Northumbria University, Newcastle upon Tyne, NE1 8ST, UK

*aburton@isocom.uk.com

Abstract— This work investigates the modulation bandwidth (B_{mod}) dependency of organic and non-organic light emitting diodes (OLED\LED) on the applied bias current (I_B). The equivalent lumped element transient circuit models are shown with the critical components empirically extracted for both types of device. Four OLEDs of varying sizes are tested in addition to four high power LEDs (white phosphor, red, green and blue). Through analysis of the current-voltage characteristics, the device and dynamic diode resistances are determined as well as the ideality factors. We show that OLEDs have higher ideality factors to the traditional LEDs (almost double) hence the increased turn-on voltage, however have similar AC drive voltage characteristics across the emitting portion of the device between 8-12%. Furthermore, both devices exhibit an increase in B_{mod} with an increase in I_B. It is shown that the OLEDs B_{mod} increases linearly in relation to I_B, reaching ≥80% of the maximal B_{mod} at ≥60% of their maximum I_B rating. Conversely, the LEDs display an exponential rise in B_{mod} in relation to I_B, with ≥80% of the maximal B_{mod} at ≥35% of their maximum I_B rating, with the red LED showing the greatest results at just 17%.

Keywords — *visible light communications; OLED; LED; transient analysis; modulation bandwidth.*

Performance Investigation of OCC-based Vehicle to Vehicle Communications

Negar Masjedi Esfahani*,[1], Asghar Gholami [1], Negar Shirvani Kordavani [1], Stanislav Zvanovec [2], Zabih Ghassemlooy [3]

1- Department of Electrical and Computer Engineering, Isfahan University of Technology, Isfahan 8415683111, Iran

2- Department of Electromagnetic Field, Czech Technical University in Prague, Prague, 166 28, Czech Republic

3 Optical Communications Research Group, Northumbria University, Newcastle-upon-Tyne, UK

** n.masjedi@ec.iut.ac.ir*

Abstract- This paper presents a model for a camera-based vehicle-to-vehicle visible light communications system for investigating the impact of different parameters on the link performance. The model includes a number of key system parameters including light source radiation pattern, camera noise sources, exposure time and atmospheric attenuation. The effect of the camera's exposure time, the link length, the data rate, different weather conditions and the transmitted power on the system signal to noise ratio are represented. Results show that, at the communications distance of 100 m, with a signal to noise ratio of 20 dB, a data rate can be increased up to 200 kbps.

Keywords: *OCC, VLC, V2V, camera, image sensor*

A Hybrid Variable m-CAP-Based Indoor Visible Light Communications and Fingerprint Positioning System

Mahdi Nassiri[1,*], Atiyeh Pouralizadeh[1], Gholamreza Baghersalimi[1], Zabih Ghassemlooy[2]

1. *Department of Electrical Engineering*

University of Guilan, Rasht, Iran

2. *Optical Communications Research Group, Faculty of Engineering and Environment, Northumbria University, Newcastle, UK*

**nassiri@msc.guilan.ac.ir*

Abstract— A variable multi-band carrier-less amplitude and phase (*m*-CAP)-based indoor hybrid visible light link for data communications and positioning is investigated in this paper. Here, we have adopted the fingerprinting algorithm for positioning. Both the link performance in terms of the bit error rate (BER) and the positioning error (PE) are evaluated for a range of E_b/N_0 and step sizes for the data communications and localization, respectively. Results show that, the best PE value and the spectral efficiency of the proposed system are ~2 cm and 6.15 b/s/Hz with respect for a step size of 2 cm and a 7% forward error correction BER limit of 3.8×10^{-3}, respectively.

Keywords—*visible light communications, indoor positioning, variable m-CAP, fingerprinting*

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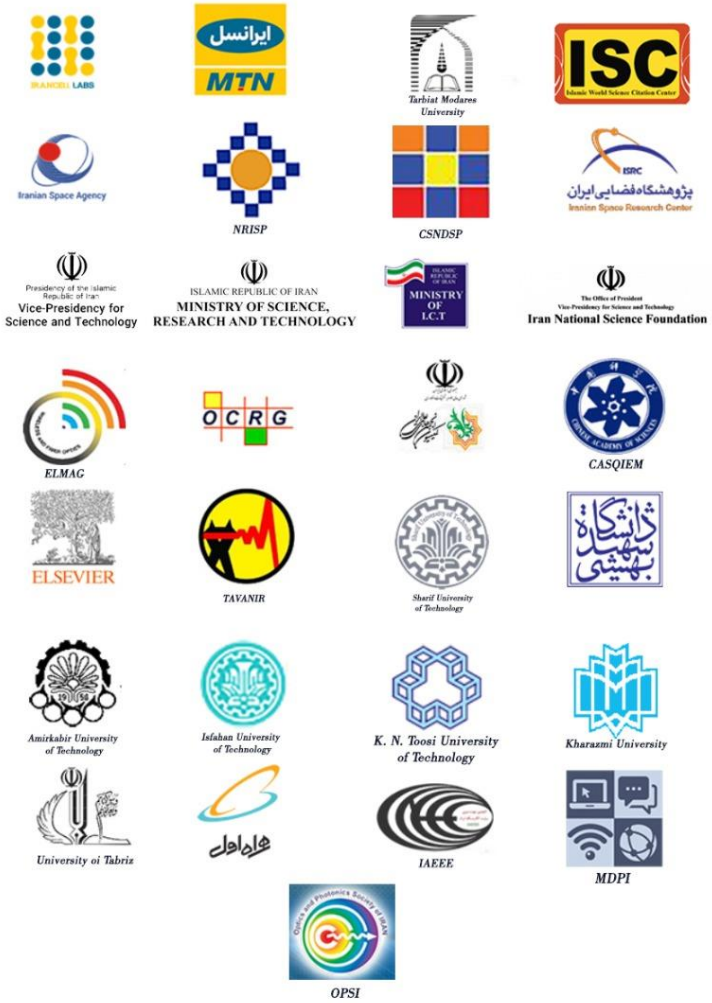
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Contact Us

Tel/Fax: +98-21-82884906
Email: wasowc2020@modares.ac.ir
Website: wasowc2020.modares.ac.ir
Address: Faculty of Electrical and Computer Engineering, Tarbiat Modares University, Tehran, Iran.
P.O. Box: 14115-194