OPTICAL COMMUNICATIONS AND NETWORKS


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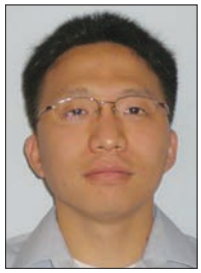
Zuqing Zhu

In 2021, as optical technologies continue to demonstrate their advantages in telecom and data-center networks, we are also witnessing the attractive and promising progress on free-space optical communications and new technologies for fiber optic communications. Therefore, in this last issue of the Optical Communications and Networks Series in 2021, we have selected three contributions that address the (i) intelligent reflecting surface-assisted free-space optical communications, (ii) routing techniques for elastic optical networks with space division multiplexing, and (iii) non-orthogonal frequency-division multiplexing in optical networks.

In the first article, entitled "Intelligent Reflecting Surface-assisted Free-space Optical Communications," V. Jamali *et al*. present the potential role of intelligent reflecting surfaces (IRSs) in free-space optical (FSO) communication systems. These smart surfaces allow the relaxation of the requirement of a line-of-sight between transmitter and receiver, which despite the substantial advancement of FSO systems over the past decades, has remained a key limiting factor for their deployment. The authors first introduce the main technologies for the realization of optical IRSs and discuss their basic operating principles, advantages, and limitations. Subsequently, important similarities and differences between optical and radio frequency (RF) IRSs are highlighted and the pros and cons of optical IRSs and optical relays are discussed. The authors conclude by presenting a comprehensive list of potential directions for future research on IRS-assisted FSO systems.

In the second article, entitled "Multipath Routing in Elastic Optical Networks with Space Division Multiplexing," P. Moura and N. Fonseca introduce four multipath routing, core and spectrum assignment algorithms based on image processing techniques for fast identification of allocable slots, with low computational complexity. The algorithms reduce spectrum fragmentation by splitting lightpath allocation with several parallel routes. Numerical results show that multipath routing can decrease blocking probability by one order of magnitude in relation to its single path counterpart, yet produce acceptable differential delay values, which improves the throughput of the core network by better utilizing the optical spectrum resources in it.

In the third article, entitled "Non-Orthogonal Discrete Multi-Tone: Toward a Higher Spectral Efficiency for Optical Networks," J. Zhou *et al*. present non-orthogonal discrete multi-tone (NODMT) by integrating the high spectral efficiency of non-orthogonal frequency-division multiplexing (NOFDM) and the adaptive bit allocation of discrete multi-tone (DMT), which has the potential to achieve improved spectral efficiency and performance for future optical networks. This article introduces practical digital signal processing for NODMT, including fast multiplexing and de-multiplexing, bit and power allocations, and successive interference cancellation (SIC). Finally, NODMT is experimentally demonstrated for 50G optical access networks based on low-cost 10G-class commercial devices to verify its superiority for bandwidth-limited optical networks.

As the Editors of the Optical Communications and Networks Series, we hope that *IEEE Communication Magazine* readers will find these articles interesting and informative. We will continue to do our best to select similarly outstanding articles for future issues. We would like to thank all the authors for submitting their important results to this Series, the reviewers for their high-quality reviews that provide valuable feedback and comments to the authors, and the publication staff members and Editor-in-Chief of *IEEE Communications Magazine* for their support.

BIOGRAPHIES

MOHAMED-SLIM ALOUINI [F'09] (slim.alouini@kaust.edu.sa) received his Ph.D. degree in electrical engineering from the California Institute of Technology (Caltech), Pasadena, CA, USA in 1998. He served as a faculty member at the University of Minnesota, Minneapolis, and then at Texas A&M University at Qatar, Education City, Doha, before joining King Abdullah University of Science and Technology (KAUST), Thuwal, Makkah Province, Saudi Arabia, as a professor of electrical engineering in 2009. His current research interests include the modeling, design, and performance analysis of wireless communication systems.

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