

Introduction to the Issue on Optical Waveguide Technology and Applications

WELCOME to the IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS (JSTQE) issue on Optical Waveguide Technology and Application. It seems a long time ago since Hondros and Debye in the year 1910 published the Cylindrical Dielectric Waveguide Theory and since Charles Kao in the 1960s developed the first breakthroughs of fiber optic technology. Huge steps, however, have been made since then to develop optical fibers into components, systems, and optical fiber networks. Groundbreaking research has allowed access to THz bandwidth from optical fibers carrying today's huge Internet traffic. Advances in lasers, optical fiber amplifiers, and numerous optical fiber types, components, and devices have been developed promising even further strides in pushing performance barriers and the optical fiber as the core medium for the future of human communications and a necessary part of infrastructure for improving quality of human life.

The optical fiber, as a medium of preference for most types of telecommunication devices, requires today new advanced efficient design methods and optimization for specialized applications which have been the purpose of new advanced research. The objective of this issue is to provide a brief overview of recent developments in optical waveguide techniques especially novel type fibers, new designs, and design algorithms for optical fibers, systems, important devices, and application components. We hope that readers will enjoy reading from this issue while getting insight at on-going research. The papers published in this issue cover a broad range of topics such as novel waveguides, for communications, high optical power applications, including the new exciting area of fiber optic accelerators, and even sensors applications. The research topics covered represent the current status and future trends in the field of optical fiber waveguides optimized for certain applications.

The response to our call for this issue has been amazing. We received more than 110 papers of excellent quality, and we had to select only 49. This task was the hardest of all. The issue contains 49 papers, including eight invited papers. The invited papers include extended reviews on recent progress on ultrahigh repetition rate lasers, photonic structures for particle accelerators, multicore, hollow core, large mode area optical fiber designs, stimulated Brillouin scattering for devices and applications, optical fibers for THz generation and transmission, and optofluidics.

We hope you will find this JSTQE issue on optical waveguide technology and applications a useful and stimulating sample from the great progress being made in so many diverse applications, and will broaden your view as to where technology is evolving for the future.

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Anthony C. Boucouvalas (M'81–SM'00–F'02) received the B.Sc. degree in electrical and electronic engineering from Newcastle upon Tyne University, Newcastle upon Tyne, U.K. He received the M.Sc. and D.I.C. degrees in communications engineering from Imperial College, London, U.K., where he also received the Ph.D. degree in fiber optic. He is a Professor in communications networks and applications at the University of Peloponnese, Tripoli, Greece. He has been actively involved with research in various aspects of fiber optic communications, wireless communications, and multimedia and has an accumulated 35 years experience in well-known academic and industrial research centers. Subsequently, he joined the GEC Hirst Research Centre, and became the Group Leader and Divisional Chief Scientist working on fiber optic components, measurements, and sensors, until 1987, when he joined Hewlett Packard (HP) Laboratories as the Project Manager. At HP, he worked in the areas of optical communication systems, optical networks, and instrumentation, until 1994, when he joined Bournemouth University, where in 1996 he became a Professor in multimedia communications and then the Director of the Microelectronics and Multimedia Research Centre. In 2007, he joined the Department of Telecommunication Science, University of Peloponnese where he served for six years as the Head of Department. His current research interests include fiber optic communications, inverse fiber optic problems, optical wireless communications, network protocols, and human–computer interfaces and Internet applications. He has published more than 310 papers, given a number of keynote addresses, and has received the Best Paper Awards. He is a Fellow of the IET and a Fellow of the Royal Society for the Encouragement of Arts, Manufacturers, and Commerce. His interests are on unconventional prediction techniques, focusing on the Stock Market technical analysis, and also on the prediction of earthquakes.



Levi Schächter received the B.Sc. degree in 1983, M.Sc. degree in 1985, and the D.Sc. degree in 1988 from the Department of Electrical Engineering and the B.A. degree in 1985 from the Department of Physics, Technion—Israel Institute of Technology, Haifa, Israel.

He is currently a Professor and Gerard Swope Chair in electrical engineering at the Technion where he established theoretical and experimental activity on advanced acceleration concepts and radiation sources within the framework of the Electrodynamics Laboratory he is heading. He has made many fundamental contributions to the understanding of the interaction of waves and electrons in high-power traveling wave tubes, electron emission from ferro-electric materials, particle acceleration by stimulated emission of radiation (PASER), conceptual design of an optical linear collider relying on Bragg acceleration structure. Throughout the years, he was awarded a number of prizes and fellowships for his research, among them: Guttwirth Prize, Fellowship of Japan Society for the Promotion of Science (JSPS), and Rothschild Fellowship. He is a Fellow of the American Physical Society “For his contributions to particle acceleration at optical wavelength

and in particular for developing the concept of PASER.” Between 1999–2000, he was a Visiting Professor with the School of Electrical Engineering, Cornell University, and between 2006–2007, he was a Visiting Professor with the Laboratory of Elementary Particles Physics of Cornell University. In 2014, he spent a summer Sabbatical at the Stanford Linear Acceleration Center. He has authored about 100 articles in refereed journals and a textbook *Beam Wave Interaction in Periodic and Quasi-Periodic Structures* (first and second edition, New York, NY, USA: Springer-Verlag).



Stuart D. Walker was born in Dover, U.K., in 1952. He received the B.Sc. (Hons.) degree in physics from Manchester University, Manchester, U.K., in 1973, the M.Sc. degree in telecommunications systems, and the Ph.D. degree in electronics from Essex University, Colchester, U.K., in 1975 and 1981, respectively.

From 1981–1982, he was a Postdoctoral Research Assistant at Essex University. From 1982–1987, he was a Research Scientist at BT Research Lab, and from 1987–1988, he was promoted to Group Leader in Submarine Systems Design. He joined Essex University in 1988 as a Senior Lecturer, and was promoted to Reader in 2002 and to Full Professor in 2004. At Essex University, he manages a laboratory concerned with all aspects of access networks. He has been involved in many EPSRC and European Union research projects over the years, recent examples being e-Photon-I and II, BONE, MUSE-I and II, UROOF, STRONGEST, FIVER, and OASE. He has published more than 250 peer-reviewed journal and conference papers and holds four patents. He has served as a Reviewer for IET, IEEE, IOP, and OSA Journals, as well as Dutch, Polish,

American Government, and U.K. EPSRC research proposals. His current work with EU H2020 and U.K. Government projects has kept him closely in touch with photonic and wireless system developments.



Alan Willner received the B.A. degree in physics and an Honorary Degree 2012 from Yeshiva University, New York, NY, USA, in 1982, as well as the Ph.D. degree in 1988 in electrical engineering from Columbia University, New York, NY, USA. He was a Postdoctoral Member of the Technical Staff at AT&T Bell Labs and a Member of Technical Staff at Bellcore. He is currently the Steven and Kathryn Sample Chaired Professor in Engineering in the Ming Hsieh Department of Electrical Engineering, Viterbi School of Engineering, University of Southern California.

He has received the following honors/awards: Member of the U.S. National Academy of Engineering, International Fellow of the U.K. Royal Academy of Engineering, Presidential Faculty Fellows Award from the White House, IEEE Eric Sumner Award, Guggenheim, Packard, and Fulbright Foundation Fellowships, Fellow of National Academy of Inventors, Optical Society (OSA) Paul Forman Engineering Excellence Award, IEEE Photonics Society Engineering Achievement Award, SPIE President's Award, IEEE Photonics Society Distinguished Lecturer Award, OSA Robert Hopkins Leadership Award, 2001 Eddy Paper Award from Pennwell Publications for the

Best Contributed Technical Article, IEEE Globecom Best Paper Award, and Armstrong Foundation Memorial Award (EE Masters student at Columbia University). He is a Fellow of the AAAS, OSA, and SPIE.

Prof. Willner's professional activities have included: Cochair of the U.S. National Academies Committee on the Optics and Photonics Study, President of the Optical Society, President of the IEEE Photonics Society, Cochair of the Science and Engineering Council of the OSA, Chair of the IEEE TAB Ethics and Member Conduct Committee, General Cochair of the Conference on Lasers and Electro-Optics, and Chair of the Unclassified Technical Program for IEEE MILCOM. His editorial positions have included: Editor-in-Chief of the IEEE/OSA JOURNAL OF LIGHTWAVE TECHNOLOGY, Editor-in-Chief of *OSA Optics Letters*, and Editor-in-Chief of the IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS. He has over 1000 publications, including one book and 30 U.S. patents. His research is in various types of optical technologies.



Michalis N. Zervas received the Graduation degree from the Electrical Engineering Department, University of Thessaloniki, Thessaloniki, Greece, in 1984, the M.Sc. degree in applied and modern optics (with distinction), and the Ph.D. degree in fibre optics from the University of Reading, Reading, U.K. in 1985, and University College London, London, U.K., in 1989, respectively.

He joined the Optoelectronics Research Centre, University of Southampton in 1991 as a Research Fellow and was promoted to Research Lecturer in 1995 and a Professor in optical communications in 1999. His research activities include advanced optical fiber amplifier configurations, high-power fiber lasers, fiber DFB lasers, Bragg grating theory and devices, surface-plasmon effects and devices, optical microresonators, and nonlinear fiber optics. He is a cofounder of Southampton Photonics Inc., a University of Southampton spin-off manufacturing high-power fiber lasers, where he is currently serving as a Chief Scientist. He has authored/coauthored more than 250 technical publications, about 30 patents/patent applications (of which 15 are granted)

and has served on various conference program committees. He was the General Program Co-Chair of the 1999 Optical Amplifiers Meeting (OSA) in Japan. He has given a number of invited talks and short courses in fiber amplifiers and fiber Bragg gratings at major international conferences. He was a Coeditor of the journal *Integrated and Fiber Optics* special issue on Fibre Bragg Gratings. In 1996, he shared the prestigious Metrology Award from the Confederation of British Industry for his work on grating measuring systems for characterizing reflection and dispersion performance of fiber Bragg gratings. In 2006, he was the finalist for the Royal Society of Engineering McRobert Award for the development of high-power industrial fiber lasers.