Selected Topics in Ultrafast & Broadband Photonic Signal Processing

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Abstract

Lasers capable of generating picosecond and femtosecond pulses of light are now firmly established and widely deployed. Going beyond simple pulse generation, the programmable shaping of ultrafast laser fields into arbitrary waveforms has resulted in substantial impact, both enabling new ultrafast science and contributing to applications in high-speed signal transmission. The lecture begins with a brief introduction to ultrafast optics and specifically to methods permitting shaping of ultrafast laser fields on time scales too fast for direct electronic control. Examples of recent research in the Purdue University Ultrafast Optics and Fiber Communications Laboratory drawing on ultrafast pulse shaping are then reviewed. As a first example, I discuss photonically-assisted radio-frequency arbitrary waveform generation with application to spatial and temporal focusing of ultrabroadband wireless signals distorted by antennas or multiply scattering indoor propagation environments. A second example pertains to broadband optical frequency comb fields generated via nonlinear wave mixing in chip-scale microresonators pumped by a single-frequency laser. Line-by-line shaping of such fields permits compression into high repetition rate femtosecond pulse trains and furnishes insight into their coherence. In a final example, I describe recent experiments in which pulse shaping is applied in the regime of quantum optics to manipulate the wave packets of correlated photon pairs.

Bio

Andrew M. Weiner graduated from M.I.T. in 1984 with an Sc.D. in electrical engineering. Upon graduation he joined Bellcore, first as Member of Technical Staff and later as Manager of Ultrafast Optics and Optical Signal Processing Research. Prof. Weiner moved to Purdue University in 1992 and is currently the Scifres Family Distinguished Professor of Electrical and Computer Engineering. His research focuses on ultrafast optics signal processing and applications to high-speed optical communications and ultrawideband wireless. He is especially well known for his pioneering work on programmable femtosecond pulse shaping using liquid crystal modulator arrays.

Prof. Weiner is author of a textbook entitled Ultrafast Optics (Wiley, 2009), has published six book chapters and over 250 journal articles, and is inventor of 13 U.S. patents. Prof. Weiner is a Fellow both of the Optical Society of America and of the Institute of Electrical and Electronics Engineers (IEEE) and is a member of the U.S. National Academy of Engineering. He has won numerous awards for his research, including the Hertz Foundation Doctoral Thesis Prize (1984), the Adolph Lomb Medal of the Optical Society of America (1990), the Curtis McGraw Research Award of the American Society of Engineering Education (1997), the International Commission on Optics Prize

(1997), the Alexander von Humboldt Foundation Research Award for Senior U.S. Scientists (2000), and the IEEE Photonics Society Quantum Electronics Award (2011). He is joint recipient, with J.P. Heritage, of the IEEE LEOS William Streifer Scientific Achievement Award (1999) and the OSA R.W. Wood Prize (2008) and has been recognized by Purdue University with the inaugural Research Excellence Award from the Schools of Engineering (2003), with the Provost's Outstanding Graduate Student Mentor Award (2008), and with the Herbert Newby McCoy Award (2013) for contributions in natural science. In 2009 Prof. Weiner was named a U.S. Dept. of Defense National Security Science and Engineering Faculty Fellow.

Prof. Weiner has served as Co-Chair of the Conference on Lasers and Electro-optics and the International Conference on Ultrafast Phenomena, as Secretary/Treasurer of the IEEE Lasers and Electro-optics Society (LEOS), and as a Vice-President of the International Commission on Optics (ICO). Prof. Weiner recently served a three year term as Chair of the National Academy of Engineering's U.S. Frontiers of Engineering Meeting and is currently Editor-in-Chief of Optics Express.