INTELLIGENT SIGNAL PROCESSING FOR OPTICAL COMMUNICATION

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In this invited paper, we present powerful statistical signal processing methods, used by machine learning community, and link them to current problems in optical communication. In particular, we will look into iterative maximum likelihood parameter estimation based on expectation maximization algorithm and its application in coherent optical communication systems for linear and nonlinear impairment mitigation. Furthermore, the estimated parameters are used to build the probabilistic model of the system for the synthetic impairment generation.

It is shown numerically and experimentally that iterative parameter estimation based on expectation maximization algorithm is a powerful tool in combating system impairments such as non-linear phase noise, inphase and quadrature (I/Q) modulator imperfections and laser linewidth. We show experimentally that for a dispersion managed polarization multiplexed 16-QAM system at 14 Gbaud a gain in the nonlinear system tolerance of up to 3 dB can be obtained. For, a dispersion unmanaged system this gain reduces to 0.5 dB. Moreover, we show that joint estimation of carrier frequency, phase, signal means and noise covariance, can be performed iteratively by employing expectation maximization. Using experiential data we show that joint carrier synchronization and detection offers an improvement of 0.5 dB in terms of input power compared to hard decision digital PLL based carrier synchronization and demodulation.

Darko Zibar received the M.Sc. degree in telecommunication and Ph.D. degree in optical communications from the Technical University of Denmark, Lyngby, Denmark, in 2004 and 2007, respectively. He was a Visiting Researcher with Optoelectronic Research Group, University of California, Santa Barbara, January 2006 to August 2006, and in January 2008 where he worked on coherent receivers for phase-modulated analog optical links. From February 2009 to July 2009, he was a Visiting Researcher with Nokia-Siemens Networks where he worked on 112 Gb/s polarization multiplexed systems. He is currently Associate Professor at DTU Fotonik, Technical University of Denmark. His research interests include coherent optical communication, statistical signal processing and Bayesian inference. Darko Zibar is the recipient of the Best Student Paper Award at the IEEE Microwave Photonics Conference 2006, the Villum Kann Rasmussen Postdoctoral Research Grant in 2007 and Villum Foundation Young Investigator Program in 2012.