Fiber-based Photonic-FPGA Architecture and In-Fiber Computing

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***Abstract*— Hardware implementation of artificial neural networks facilitates real-time parallel processing of massive data sets. Optical neural networks offer low-volume 3D connectivity together with large bandwidth and minimal heat production in contrast to electronic implementation. In this presentation we will present a conceptual design for in-fiber optical neural network, i.e. a fiber-based realization of a photonic-FPGA. Neurons and synapses are realized in two ways: first as individual silica cores in a multi-core fiber and then within a multi-mode fiber.**

In the first realization optical signals are transferred transversely between cores by means of optical coupling. Pump driven amplification in erbium-doped cores mimics synaptic interactions. Simulations and experimental validation show classification and learning capabilities. Therefore, devices similar to our proposed multi-core fiber could potentially serve as building blocks for future large-scale small-volume optical artificial neural networks.

In the second type of realization we propose the design of an optical artificial neural network-based imaging system that has the ability to self-study image signals from an incoherent light source in different colors. Our design consists of a multi-mode fiber realizing a stochastic neural network. We show that the signals, transmitted through the multi-mode fiber, can be used for image identification purposes and can also be reconstructed using artificial neural networks with a low number of nodes.

Keywords- Photonic processors, fibers, in-fibers computing, FPGA

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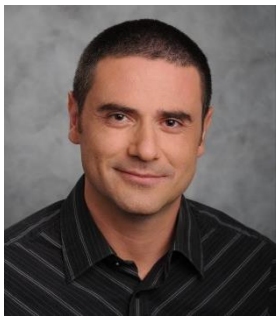
About author



Zeev Zalevsky received his B.Sc. and direct Ph.D. degrees in electrical engineering from Tel-Aviv University in 1993 and 1996 respectively. Zeev is currently a full Professor in the faculty of engineering in Bar-Ilan University, Israel. His major fields of research are optical super resolution, biomedical optics, nano-photonics and fiber-based processing and sensing architectures. Zeev has published more than 480 peer review papers and about 300 conference proceeding papers. He is a fellow of many large scientific societies such as SPIE, OSA, EOS, IOP, IET, IS&T and more. He is also a fellow of the American National Academy of Inventors (NAI). For his work he received many national and international prizes such as the Krill prize, ICO prize, SAOT prize, Juludan prize, Taubelnblatt prize, young investigator prize in nanotechnology, the International Wearable Technologies (WT) Innovation World Cup 2012 Prize, Image Engineering Innovation Award, NANOSMAT prize, SPIE startup challenge prize, SPIE prism award, IAAM Scientist Medal Award, International Photonic Award, Dr. Horace Furumoto Innovations Professional award, The Asian Advanced Materials Award and more. Besides his academic research activity, Zeev is also very active in trying to convert his inventions into practical and applicable approaches by commercializing them into start-up companies that develop products out of those inventions. Zeev was and is involved in

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