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Reducing energy and increasing capacity – new directions for integrated optics in information interconnection, communications, sensing and processing

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Information processing is increasingly limited by the energy required for interconnections and by the need for greater density of communications. Optics and photonics are the only approaches that allow us both to increase density and to reduce energy for communications on and off electronic chips and for all longer distances [1]. Fortunately, recent advances and future possibilities show that integrated photonics can provide the necessary technical solutions; indeed, such advanced photonics technology will be essential if our use of information is to continue to increase at current rates [1]. This talk will summarize the arguments for why we need such photonics and also some of the surprising directions we will need to consider; for example, for short distance interconnects inside and possibly between machines, to reduce energy we may need to avoid any time-multiplexing and exploit parallel free-space optics instead. Fortunately, technologies like silicon photonics could help us do this. Such integrated technologies also offer radical possibilities such as self-configuring optics [2] that can help increase communication density and that also offer many exciting opportunities in sensing and in information processing with optics itself.

[1] D. A. B. Miller, "Attojoule Optoelectronics for Low-Energy Information Processing and Communications: a Tutorial Review," IEEE/OSA J. Lightwave Technology **35**, 343-393, 2017
[2] A. Annoni, E. Guglielmi, M. Carminati, G. Ferrari, M. Sampietro, D. A. B. Miller, A. Melloni, and F. Morichetti, "Unscrambling light – automatically undoing strong mixing between modes," Light Science & Applications **6**, 2017

Biography

David Miller (B.Sc., St. Andrews, Ph.D., Heriot-Watt) is the W.M. Keck Professor of Electrical Engineering, and Professor by Courtesy of Applied Physics at Stanford University. He was with Bell Laboratories from 1981 to 1996, as a department head from 1987. His interests include nanophotonics, quantum-well optoelectronics, and optics in information sensing, interconnects, and processing. He has published over 270 scientific papers, holds 74 patents, is the author of the textbook Quantum Mechanics for Scientists and Engineers (Cambridge, 2008), and has taught open online quantum mechanics classes to over 30,000 students.

He was President of IEEE LEOS (now Photonics Society) in 1995, and has served on Boards for various societies, companies, and university and government bodies.

He was awarded the OSA Adolph Lomb Medal and the R. W. Wood Prize, the ICO International Prize in Optics, the IEEE Third Millennium Medal, and the 2013 Carnegie Millennium Professorship. He is also a Fellow of APS, OSA, IEEE, the Electromagnetics Academy, the Royal Society of London and the Royal Society of Edinburgh, holds two Honorary Doctorates, and is a Member of the US National Academies of Sciences and of Engineering.

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