

ECE Distinguished Lecture

Optics à la mode – a new way of making, using and understanding optics



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Engineering
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Abstract

Modern micro and nano fabrication now let us make complex and highly functional optics. Examples include sophisticated metasurfaces and highly programmable and even self-configuring silicon photonic interferometer meshes, with many potential applications in areas such as imaging, sensing and communications. Such systems are, however, quite unlike the previous optics of lenses, mirrors and prisms, so we also need new ways to think about them, physically and mathematically. Fortunately, there is a very powerful new “modal” approach for these and other complex wave systems, one that is both mathematically straightforward and physically directly meaningful. It leads to new fundamental physical laws and limits, gives new understanding of old optics, such as why your mobile phone camera needs thickness and where diffraction limits really come from, correctly counts channels for communication and sensing, and opens new design approaches and classes of optical systems and applications. Programmable circuits based on such ideas can also exploit convenient new architectures, topologies and algorithms that allow simple control and even direct optical solution of difficult problems in real time. The talk will introduce these ideas, showing how these lead to new systems, applications, understanding, and limits in optics and waves generally.

Bio

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. Before Stanford, 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 300 scientific papers, holds over 75 patents, has a Google h-index of over 110, is the author of the textbook *Quantum Mechanics for Scientists and Engineers* (Cambridge, 2008), and has taught open online quantum mechanics classes to over 80,000 students. He was President of the 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 AAAS, 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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