Presented by your OSA Student Chapter and EM-Photonics Seminars

On Light, Electrons, and Metamaterials

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Metamaterials and Plasmonic optics provide mechanisms for controlling and taming photons and electrons in unprecedented ways. In my group we are exploring various features and characteristics of these concepts and investigate new classes of applications such paradigms may provide. Some of the features of interest include nonlinearity, anisotropy, chirality, non-reciprocity, and non-locality. We have been developing several concepts such as "signal-processing metamaterials", "digital metamaterials", "extreme-parameter metamaterials', "meta-electronics" in which one can tailor the effective mass of electrons for ultrafast response, and "optical metatronics", i.e. metamaterial-inspired optical nanocircuitry, in which the three fields of "nanoelectronics", "nanophotonics" and "magnetics" can be merged together. In such a paradigm, the concept of metamaterials and plasmonics optics can be exploited to bridge the gaps among these fields, to modularize, standardize, and parameterize some of the optical and electronic phenomena, and to transplant concepts from one field into another. In this unified platform of optical metatronics, the nanostructures with specific values of permittivity and permeability may act as the optical lumped circuit elements at the nanoscale, analogous to the circuit elements in RF electronics. We are now extending the concept of metatronics to other platforms such as graphene as as one-atom-thick metamaterials and one-atom-thick transformation optical devices and circuitry. I will present an overview of our most recent results from a sample of these topics and discuss future directions and potentials.

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MP203, McLennan Physical Laboratories

Winner of the 2012 IEEE Electromagnetics Award, Nader Engheta is the H. Nedwill Ramsey Professor at the University of Pennsylvania with affiliations in the Departments of Electrical and Systems Engineering, Bioengineering, and Physics and Astronomy. He received his B.S. degree from the University of Tehran, and his M.S and Ph.D. degrees from Caltech. Selected as one of the *Scientific American Magazine 50 Leaders in Science and Technology* in 2006 for developing the concept of optical lumped nanocircuits, he is a Guggenheim Fellow, an IEEE Third Millennium Medalist, a Fellow of IEEE, American Physical Society (APS), Optical Society of America (OSA), American Association for the Advancement of Science (AAAS), and SPIE-The International Society for Optical Engineering, and the recipient of the 2008 *George H. Heilmeier Award for Excellence in Research*, the *Fulbright Naples Chair Award*, *NSF Presidential Young Investigator award*, the *UPS Foundation Distinguished Educator term Chair*, and several teaching awards including the *Christian F. and Mary R. Lindback Foundation Award, S. Reid Warren, Jr. Award* and *W. M. Keck Foundation Award*. His current research activities span a broad range of areas including metamaterials and plasmonics, nanooptics and nanophotonics, biologically-inspired sensing and imaging, miniaturized antennas and nanoantennas, physics and reverse-engineering of polarization vision in nature, mathematics of fractional operators, and physics of fields and waves phenomena. He has co-edited (with R. W. Ziolkowski) the book entitled "*Metamaterials: Physics and Engineering Explorations*" by Wiley-IEEE Press, 2006. He was the Chair of the Gordon Research Conference on Plasmonics in June 2012.

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