

Thursday, March 5

Scaife Hall Auditorium

Room 125

4:30 p.m.

Refreshments at 4:00 p.m.



Professor Nader Engheta

University of Pennsylvania

Department of Electrical and Systems Engineering

Nader Engheta is the H. Nedwill Ramsey Professor of Electrical and Systems Engineering, and Professor of Bioengineering, at the University of Pennsylvania. He received his B.S. degree in EE from the University of Tehran, and his M.S and Ph.D. degrees in EE 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, IEEE Fellow, American Physical Society Fellow, Optical Society of America Fellow, and the recipient of the 2008 *George H. Heilmeyer Award for Excellence in Research* from UPenn, 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* and *S. Reid Warren, Jr. 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 the book entitled “*Metamaterials: Physics and Engineering Explorations*” by Wiley-IEEE Press, 2006.

Circuits with Light at the Nanoscale

Imagine circuit elements so small that you could fit many of them in a tiny microscale volume (e.g., a cell)! Imagine that such circuits could work with light at the **nanoscale** instead of electricity! What could you do with such optical **nanocircuits**? Would you be able to use them in wireless gadgets at nanoscales, like a “**nanoradio**”, that may connect our nanoworlds? Could these tiny optical nanocircuits be coupled with biological entities and thus provide nanoscale sensors? The fields of metamaterials and plasmonic optics may provide road maps for such futuristic nanocircuits and wireless nanosystems and sensors. We have been developing and investigating some of the fundamental concepts and theories, and key features of such **metaplasmonic** structures, devices, and circuits. These circuit elements and components may be envisioned as a tapestry of nanostructures of sizes much smaller than the wavelengths of light. This field, for which I have coined the term **metactronics**, addresses metamaterial-inspired optical nanocircuits and nanosystems (N. Engheta, *Science*, 317, 1698-1702, 2007). . In my group, a variety of ideas and paradigms for nanocircuit functions, optical antennas and sensors for beam shaping and photonic wireless at the nanoscale, optical nanoscopy, nanospectrometer for molecular spectroscopy, cloaking of particles, **nanotagging** and barcodes based on these optical circuits are being studied. In this talk, I will give an overview of these studies, present insights into these findings, and forecast future ideas and road maps in these areas.

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