"The Pervasive Role of Electromagnetism in the Next Generation of Electronics and Photonics Devices for Communications Systems"

Leda Lunardi
(Email: leda_lunardi@ncsu.edu)

North Carolina State University

Wireless communications services have been rapidly assimilated by our fast moving driven society. The challenge for designing any next generation of communications systems is to meet the demand for more bandwidth while keeping connectivity and higher data rate while allowing a seamless deployment. An ideal approach could be a network without boundaries, able to integrate different communications systems into a "hybrid" configuration.

Hybrid communications systems could also increase the data capacity while providing an integration scheme for an agile network to an embedded infrastructure or vice-versa. In addition, as new or improved devices or integration technologies are realized and evolve, they could be implemented and tested for efficient systems or upgrades. Nevertheless the majority of enabling technologies for communications systems still rely on traditional optical/electrical components and devices, RF and microwave devices, and semiconductor materials. Tailored design of devices structures, improved semiconductor materials and optimized RF/microwave device performance have constantly contributed for the overall enhancement of the communications systems.

Yet recent progress in engineered materials has given a different perspective on future system applications. Engineered materials, referred to as metamaterials, artificially designed to exhibit specific magnetic properties such as negative permittivity and/or negative permeability in order to intentionally interact with electromagnetic waves. Some potential applications include but are not limited to "optical cloaking" for shielding (presenting significant reduction of total scattering from objects when engineered materials are designed with negative or near-zero permittivity), antennae (miniature devices with higher gain for biological sensing), and "super lens" (focusing light in an area smaller than its own wavelength unlike the limitations of conventional optical counterparts).

This talk will review and discuss some results on hybrid communications systems. The speaker served as Program Director at the Integrated Hybrid Cyber Systems (IHCS) Program of the Electrical, Cyber and Communications Systems Division of the Engineering Directorate at the National Science Foundation and started a new initiative on hybrid communications systems to support the basic research of the next generation of enabling devices and technologies.