Department of Engineering, Macquarie University
IEEE Macquarie University Student Branch/MTT-S Chapter
IEEE NSW AP/MTT Joint Chapter

IEEE APS Distinguished Lecture

Dr. Christophe Caloz

Date : **Friday, 6 November 2015**

Time : **11:00 am to 12:00 pm**

Location : **Building E5A, Room 150,**
Macquarie University, NSW 2109

Further Information:
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Metamaterials: Past, Present and Future

In the history of humanity, scientific progress has frequently been associated with the discovery of novel substances or materials. Metamaterials represent a recent incarnation of this evolution. As suggested by their prefix “meta”, meaning “beyond” in Greek, metamaterials (artificial materials owing their properties to sub-wavelength but supra-atomic scatterers) even transcend the frontiers of nature, to offer unprecedented properties with far-reaching implications in modern science and technology. This talk presents some research highlights in electromagnetic metamaterials over the past decade, with emphasis on applications providing performances or functionalities that outperform state-of-the-art technologies.

The first part of the talk reviews some history, principles and properties of metamaterials from a global perspective. The second part presents a series of microwave metamaterial applications exploiting these properties, in particular negative refraction, near-zero index propagation, coupling amplification, full-space scanning leakage radiation, and agile temporal and spatial dispersions. This part culminates with the introduction of the concept of radio real-time signal processing, enabled by “phasers” (components with fully designable group delay versus frequency responses), which might play a central role in tomorrow’s radio. The third part introduces magnet-less non-reciprocal metamaterials (MNMs), which have been recently invented and developed in the speaker’s group.

While non-reciprocal gyrotropic materials, first reported by Faraday in 1845, have always required a biasing magnet to date, MNMs, which are composed of transistor-loaded rings mimicking electron-spin precession in ferrites, only require a biasing voltage, and are therefore fully compatible with semiconductor technology. This new class of metamaterials might therefore be considered a breakthrough and seem to have a strong potential for commercial electronic and photonic applications. Finally, the talk explores perspectives for next-generation of metamaterials, which will arguably be muli-scale (micro, nano, atomic) and multi-substance (e.g. semiconductors, ferroelectrics, magnetic nanoparticles, multiferroics, carbon nanotubes, graphene, etc.) in nature.

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Dr. Caloz's Biography

Christophe Caloz received the Diplôme d'Ingénieur en Électricité and the Ph.D. degree from École Polytechnique Fédérale de Lausanne (EPFL), Switzerland, in 1995 and 2000, respectively. From 2001 to 2004, he was a Postdoctoral Research Fellow at the Microwave Electronics Laboratory, University of California at Los Angeles (UCLA). In June 2004, Dr. Caloz joined École Polytechnique of Montréal, where he is now a Full Professor, the holder of a Canada Research Chair (CRC) in Metamaterials and the head of the Electromagnetics Research Group.

He has authored and co-authored over 500 technical conference, letter and journal papers, 12 books and book chapters, and he holds many patents. His works have generated over 11,000 citations. In 2009, he co-founded the company ScisWave, which develops CRLH smart antenna solutions for WiFi.

Dr. Caloz received several awards, including the UCLA Chancellor's Award for Post-doctoral Research in 2004, the MTT-S Outstanding Young Engineer Award in 2007, the E.W.R. Steacie Memorial Fellowship in 2013, the Prix Urgel-Archambault in 2013, and many best paper awards with his students at international conferences. He is an IEEE Fellow. His research interests include all fields of theoretical, computational and technological electromagnetics, with strong emphasis on emergent and multidisciplinary topics, including particularly metamaterials, nanoelectromagnetics, exotic antenna systems and real-time radio.