The IEEE Ottawa Antennas and Propagation Society and Microwave Theory & Techniques Society (AP/MTT) Joint Chapter, Electromagnetic Compatibility (EMC) Chapter, Electron Devices Society, Circuits and Systems Society, and Solid-State Circuits Society (EDS/CAS/SSCS) Joint Chapter, Components, Packaging and Manufacturing Technology (CPMT) Chapter, Computer Society (CompSoc), Communications Society, Broadcast Technology Society, and Consumer Electronics Society (ComSoc/BTS/CES) Joint Chapter, Engineering in Medical and Biology Society (EMBS) Chapter, IEEE Ottawa Section (OS), and Department of Electronics at Carleton University (DoE Carleton) are inviting all interested IEEE members and other engineers, technologists, and students to the IEEE AP Distinguished Lecture.

DATE: Friday, April 13, 2012.
TIME: 12:00 pm – 2:00 pm.
Seminar: 12:00 pm – 1:00 pm.
Discussion, Refreshments, Networking and Activity of AP/MTT Joint Chapter: 1:00 pm – 2:00 pm.
PLACE: Carleton University, Department of Electronics (DoE), Mackenzie Engineering Building, Room ME 4124, 1125 Colonel By Drive, Ottawa, Ontario, Canada.
ADMISSION: Free. Registration required. To ensure a seat, please contact
Qingsheng Zeng (qingsheng.zeng@crc.gc.ca), or
Syed Bokhari (Syed.Bokhari@ieee.org), or
Ram Achar (achar@doe.carleton.ca), or
Qi-Jun Zhang (qjz@doe.carleton.ca), or
Rami Abielmona (rabielmo@ieee.org), or
Eric Karmouch (ekarmouch@ieee.org), or
Wahab Almuhtadi (almuhtadi@ieee.org), or
Sreeraman Rajan (sreeraman@ieee.org)

Scattering by Load-Modulated Antennas Background, RFID and Sensing Applications

by

Dr. Jean-Charles Bolomey
Emeritus Professor
Paris-Sud University, Paris, France

Abstract

While transmitting and receiving properties of antennas are fully formulated and well understood, scattering issues remain more mysterious, even if they have been extensively exploited for a while in the antenna engineer practice for shaping radiation patterns, adjusting input impedances, or for characterization purposes. This presentation is more specifically focused on modulated scattering-based systems, which have been successfully developed during the last decades. Operating an antenna in a scattering mode allows avoiding any RF front-end, resulting in very simple and compact passive or battery-assisted transponders. These advantages are now widely exploited in low-cost RFID tags, as well as in low-invasive MST (Modulated Scatterer Technique) probes for EM-field.

This presentation consists of two major parts. The first one consists of a short tutorial review of the minimum engineering background required for a comprehensive approach to modulated scattering systems. Small antennas will be more particularly considered because low-invasiveness and high spatial resolution constitute significant advantages in many sensing applications. The power budget, a key issue for such systems, is derived from a very simple reciprocity-based formulation. The advantage of this analytical formulation is to apply, whatever the distance, for arbitrarily complex scenarios. In addition, the influence of various parameters can be clearly identified, paving the way for optimizing the antenna design in terms of global system performance. Examples of both active and passive scatterers illustrate the efficiency of this approach.

The second part is more speculative and aims to identify transfer opportunities between RFID's and MST technologies for sensing applications. As compared to existing MST probes, passive RFID tags offer, at a glance, the indisputable advantage of being modulated from their own, without any wire or fiber. However, they may suffer autonomy/life time limitations and are constrained by standard regulations in terms of frequency range and power level. Furthermore, they exhibit specific technical difficulties, such as non-linearity of the IC chips loading the antenna. Various solutions to these drawbacks are addressed. Focusing on the case of systems involving arrays of modulated scatterers for its growing relevance in rapid imaging and wireless sensing (e.g. antenna measurement, industrial testing, medical diagnostic…), it is explained how the architecture of MST systems has conceptually changed during the last decades, primarily to face the critical sensitivity issue. Extrapolating such an evolution suggests promising solutions based on either RFID-derived or breakthrough technologies. To conclude, it is remembered that, while microwaves suffer no competition in the field of communications, they are loosing this comfortable privilege for Industrial Scientific Medical (ISM) applications where they must compete with many other efficient and already well-established modalities. In this competition, new modulated scattering technologies are reasonably expected contributing to valorize the specific advantages already recognized to RF- and microwave-based sensing modalities.

Speaker's Bio

Jean-Charles Bolomey (M'99–SM'05–F'08) graduated from the Ecole Supérieure d'Electricité (Supelec), France, in 1963, and received the Ph.D. degree on a hybrid numerical-experimental approach to scattering in resonance domain from Paris-Sud University, France, in 1971.

He is currently an Emeritus Professor at Paris-Sud University. Since 1981, his research, conducted in the Laboratoire des Signaux et Systèmes, has been devoted to Near-Field techniques in a broad sense, including antenna measurement, EMC testing, as well as Industrial-Scientific-Medical (ISM) applications. His contributions have mostly concerned measurement techniques. He has more particularly promoted the modulated probe array technology and has coauthored with Prof. F. Gardiol a reference book on principles and applications of the Modulated Scattering Technique (MST). He is holder of several patents covering various MST probe array arrangements for microwave sensing and imaging systems. In 1986, he founded the company SATIMO. He has been also involved in industrial applications of microwave heating, as a Chairman of the Microwave Group of Electricité de France (EDF), and was appointed as a Consultant by the Délégation Générale de l'Armement (DGA) in the field of High Power Microwave (HPM) metrology. He has actively contributed to several cooperative European programs ranging from medical hyperthermia to industrial process tomography and has contributed to various prototype transfer and evaluation procedures in these areas. He has obtained the 2006 H.A. Wheeler Best Application Prize Paper Award of the IEEE AP-Society for his coauthored paper on "Spherical Near-Field Facility for Characterizing Random Emissions". Recently, his research was related to RF dosimetry and rapid SAR measurements for wireless communication devices. He is now continuing his research on load-modulated scattering antennas, and, more particularly, novel sensing applications of RFID-based technology. He is also contributing as a member of several Scientific Advisory Boards of European Institutions and startup companies. He has been appointed as Distinguished Lecturer of the IEEE Antennas and Propagation Society (2011–2013).

Prof. Bolomey is Fellow of the IEEE (2008). He has received several awards, including the Blondel Medal of the Société des Electriciens et des Electroniciens (1976), the Général Ferrié Award of the French Academy of Sciences (1984), the Schlumberger Stitching Fund Award for his contribution to inverse scattering techniques in microwave imagery (1994), the Distinguished Achievement Award of the Antenna Measurement Technique Association (AMTA) for his pioneering activity in the field of modulated probe arrays (1991), the Medal of the French URSI Chapter (2004) and has been elected as Edmond S. Gillespie Fellow for AMTA (2007).