Duration: 13:50 – 17:50
Room: N109

WW-01
Relevance of Electromagnetics in Communication System Design

Organisers:
Tapan K. Sarkar[1], Miguel Ángel Lagunas Hernández[2]
[1]Dept. of Electrical Engineering and Computer Science, College of Engineering and Computer Science, Syracuse University, NY, [2]Centre Tecnològic de Telecomunicacions de Catalunya (CTTC), Castelldefels, Barcelona

Abstract
Current research on wireless radiofrequency (RF) and Microwave systems often makes unphysical simplifying assumptions and treats the associated signal-processing and electromagnetic (EM) analyses independently, resulting in the improper inclusion of the underlying physics (EM theory) of such systems and consequently leading to inaccurate and erroneous performance predictions of various microwave systems. To achieve accurate modeling and predictions, EM theory and signal processing must be intelligently merged. Examples of such errors commonly appear in both fields: not including the platform on which an antenna is mounted leads to completely erroneous predictions of antenna coverage, a serious issue for designing relevant antennas for RF systems; optimizing transmitted waveforms without including proper differentiability requirements imposed by Maxwellian electromagnetics yields inaccurate and physically unrealizable waveforms. This presentation will also discuss the different concepts of channel capacity and their implications and the antenna and its relationship to the Maximum Power Transfer Theorem. Although the discussion addresses communication systems, much of it is applicable to non-communication systems. A future of improved performance and better spectral harmony requires coding at RF for microwave transmission and receive systems, initially envisioned by Shannon and subsequently investigated by Viterbi, which is similar to the coding in GPS and satellite communication. Such a methodology can also be carried out in radar, where, for example, a radar can transmit coded waveforms, such as a Barker code, to increase detection capabilities. In summary, the objective of this workshop will be to illustrate that certain issues need to be factored into the design of microwave radiofrequency systems (communication, radar, navigation, countermeasures, etc.). For example, the exclusive use of communication principles in the design of the physical layer of such systems may not be sufficient in the proper design of a microwave system. Three specific topics will be treated in detail: the different concepts of channel capacity and their implications; the antenna and its relationship to the Maximum Power Transfer Theorem and the S-parameters used in conventional Microwave system design and, ultra wideband (UWB) wireless transmission of microwave signals without any distortion. Examples will be presented to illustrate these issues.

Programme

Importance of Implementing the Proper Physical Concepts of Electromagnetics
Magdalena Salazar Palma[1]
[1]Dept. Signal Theory and Communications, Universidad Carlos III de Madrid, Leganés, Madrid

Integration of Information Theory into Physics
Miguel Ángel Lagunas Hernández[1]
[1]Centre Tecnològic de Telecomunicacions de Catalunya (CTTC), Castelldefels, Barcelona

Relevance of MIMO
Ana Isabel Pérez Neira[1]
[1]Centre Tecnològic de Telecomunicacions de Catalunya (CTTC), Castelldefels, Barcelona / Dept. Signal Theory and Communications, Universitat Politècnica de Catalunya, Barcelona

Energy and Information in Electromagnetics
Marco Donald Migliore[1]
[1]Università di Cassino e del Lazio Meridionale, DIEI

Statistics, Electromagnetics and Small RF Systems
Frank Robey[1]
[1]MIT Lincoln Laboratory

Why is Electromagnetics Relevant in System Design?
Tapan K. Sarkar[1]
[1]Dept. of Electrical Engineering and Computer Science, College of Engineering and Computer Science, Syracuse University, NY