SHORT CV

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Luca Pierantoni received the 'Laurea' degree (summa cum laude) in Electronics Engineering in 1988 and the Ph.D. degree in 1993 in Electromagnetics from the Department of Electronics and Automatics at the University of Ancona, Italy. From 1989 to 1995, he was with the Department of Electronics and Automatics of the University of Ancona, as a Research Fellow.

From 1996 to 1999 he worked at the Technical University of Munich, Germany, in the Institute of High-Frequency Engineering as Senior Research Scientist. In 1999 he joined the Department of Electromagnetics at the Polytechnic University of Marche, Ancona, Italy as Assistant Professor. Presently, he is with the Department of Information Technology at the Polytechnic University of Marche. His current research interests are in the investigation of the combined Maxwell-quantum transport problem in nanomaterials, the analysis of electrodynamics in nanostructures, and the development of computational techniques for the multi-physical modeling of meso- and nano-scale devices.

- IEEE MTT-S Distinguished Microwave Lecturer (DML)
- IEEE MTT-S & EuMA European Microwave Lecturer (EML)
- Chair of the IEEE MTT-S "RF Nanotechnology" technical committee;
- Member of the Italian Institute of Nuclear Physics (INFN).
- Associate Editor of the IEEE Microwave and Wireless Component Letters (MWCL).
- Member of the IEEE Nanotechnology Council (NTC) AdCom.
- Author or co-author of more than 200 research papers in leading journals and international conferences.

RESEARCH AREA

The research activity focuses on the development of full-wave techniques in the frequency (energy)- and in the time-domain for the investigationand global multiphysics modeling of new devices based on carbon materials, namely carbon nanotubes (CNT), graphene, and graphene nanoribbons (GNR). The quantum transport is described by the Schrödinger equation or its Dirac-like counterpart, for small energies. The electromagnetic field provides sources terms for the quantum transport equations, that, in turn, provide charges and currents for the electromagnetic field. In the frequency-domain, a rigorous Poisson-coherent transport equation system is provided, including electrostatic sources (bias potentials).
Interesting results involve new concept-devices, such as GNR nano-transistors and multipath/multilayer GNR circuits, where charges are ballistically scattered among different ports under external electrostatic control. Further examples are given by the simulation of cold-cathodes for field emission based on graphene and by the analysis of optical emission/absorption by single or few layer GNR.
In the time-domain, a full-wave approach is introduced: the Maxwell equations, discretized by the transmission line matrix (TLM) method are self-consistently coupled to the Schrödinger/Dirac equations, discretized by a proper finite-difference time-domain scheme.
In the non-ballistic regime, the quantum effects are modeled in terms of dispersive surface conductivities, and incorporated into Maxwell equations. Equivalent dyadic Green's functions are derived.
Several examples are reported of the electromagnetics/transport dynamics in realistic environments. It is highlighted that the self-generated electromagnetic field may affect the dynamics (group velocity, kinetic energy etc.) of the quantum transport. This is particularly important in the analysis of time transients and in the describing the behavior of high energy carrier bands, as well as the onset of non-linear phenomena due to impinging external electromagnetic fields.

We are working on:

- i) CNT/graphene field effect transistors;
- ii) the carbon-metal transition, and its equivalent circuit;
- iii) carbon nano-antennas;
- iv) plasmonics propagation;
- v) THz carbon-based emitters/detectors;
- vi) non-linear effects and frequency multiplication;
- vii) photoconductive effects;
- viii) Quantum circuit theory.