



## ELEctromagnetic DIAgnostics Research Center

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### PHD COURSE:

## Artificial electromagnetic materials and metamaterials

**Speaker:** Prof. Filiberto Bilotti, Prof. Alessandro Toscano  
(Università Roma TRE, Roma)

**Dates:** 15-16-17-18-19 June 2015

**Location:** ICT International Doctoral School, University of Trento

**Duration:** 20 Hours

**Note:** The lessons will be held in English

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Since 2000, metamaterials have attracted the interest of the scientific community. They are engineered materials presenting an anomalous interaction with the electromagnetic field, resulting in physical properties not otherwise obtainable through the use of natural materials. The new properties enabled by electromagnetic metamaterials initiated a process of reviewing the whole classical electrodynamics from original perspectives, with important implications for science and technology. The use of metamaterials, in fact, allows on one hand to improve the performance of conventional electromagnetic devices and, on the other hand, to design conceptually new devices such as perfect and hyper-lenses, cloaking devices, etc. Ultimately, metamaterial concept is considered today as an intermediate layer between the classical concepts of material and device in the so-called technological stack. Metamaterials, in fact, allow overcoming the conventional concept of material intended as a mere support and is getting closer to being a functionalizing layer integrated into the device. Starting from these concepts, the course will cover the theoretical background of artificial electromagnetic materials and metamaterials, the historical evolution of the concept, and the most recent and interesting applications in microwave and optical devices and systems. Particular focus will be given to miniaturized components, electrically small and multi-functional antennas, radar absorbing materials, electromagnetic invisibility devices, active metamaterials for overcoming the intrinsic limitations (operation bandwidth and losses).

### • About the Speaker

**Prof. Filiberto Bilotti** received the laurea and Ph.D. degrees both in electronic engineering from “Roma Tre” University, Rome, Italy, in 1998 and 2002, respectively. Since 2002, he has been with the Department of Engineering, “Roma Tre” University, where he works as an Associate Professor of electromagnetic field theory. His main research interests are in microwave and optical applications of artificial electromagnetic materials, metamaterials and metasurfaces. He is the author of more than 370 papers in international journals, conference proceedings, and book chapters. Prof. Bilotti served as a member of the Technical Program, Steering, and Organizing Committee of several national and international conferences, as organizer and chairman of special sessions focused on the applications of metamaterials at microwave and optical frequencies, as an Associate Editor of the IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION (2013–present) and Metamaterials Journal (2007–2013), as a member of the Editorial Board of the journals EPJ Applied Metamaterials (2013–present) International Journal on RF and Microwave Computer-Aided Engineering (2009–present), Scientific Reports – Nature (2013–present), and as a Technical Reviewer of the major international journals related to electromagnetic field theory and metamaterials. He was an elected member of the Board of Directors (2007–2013) and currently is the President (2013–2016) of the Virtual Institute for Artificial Electromagnetic Materials and Metamaterials (METAMORPHOSE VI, the International Metamaterials Society). He is a member of the Optical Society of America. He was the recipient of the Raj Mittra Travel Grant Senior Researcher Award in 2007. From 2004 to 2008, he was a member of the governing bodies of METAMORPHOSE, the European Network of Excellence on Metamaterials. He is a member of the Steering Committee of the European Doctoral School on Metamaterials and the organizer of several international school events and international workshops and conferences in the field of metamaterials. He has been the local organizer of the First International Congress on Advanced Electromagnetic Materials and Metamaterials in Microwaves and Optics-Metamaterials 2007 (Rome, Italy, October 2007), served as the Chairman of the Steering Committee and has been elected General Chair of the same conference for the period 2008–2014 and 2015–2018, respectively.

**Prof. Alessandro Toscano** was born in Capua, Italy, on June 26th 1964. He received the Laurea and Ph.D. degrees in electronic engineering from “La Sapienza” University, Rome, Italy, in 1988 and 1993, respectively. In January 2012, as the winner of a public contest, he became Full Professor of Electromagnetic Field Theory at the Department of Engineering of “Roma Tre” University where he is now member of the Academic Senate. His research activity is focused on metamaterials and nonconventional media with the ultimate aim to respond to the need to develop new technologies making use of the electromagnetic fields to design new components and to protect the environment and human health. His contributions include: 1) analysis and design of innovative antennas loaded with chiral and bi-anisotropic materials; 2) development of finite element-boundary integral methods to bear concepts in mathematical physics and applied electromagnetics to solve long-standing problems involving nonconventional materials; 3) design of metamaterial inclusions and metamaterial-based components to solve practical problems in electromagnetics. His work to date has resulted in more than 100 journal papers, and more than 200 conference papers. Of these, around 150 have appeared in the IEEE journals and conferences.