



# DIAGNOSTIC AND THERAPEUTIC APPLICATIONS OF ELECTROMAGNETICS

September 9-13, 2019 Napoli, Italy



## Lecturers

**Prof. C. L. Brace**, Wisconsin University  
Madison (WI)

**Prof. O.M. Bucci**, Federico II  
University of Naples (IT)

**Dr. L. Crocco**, IREA-CNR (IT)

**Prof. R. Massa**, Federico II University  
of Naples (IT)

**Prof. M. Paulides**, Eindhoven  
University of Technology (NL)

**Dr. S. Romeo**, IREA-CNR (IT)

**Prof. G. Vecchi**, Politecnico di Torino  
(IT)

Electromagnetic (EM) technologies are nowadays an essential part of clinical practice: RF minimally-invasive tools and ablation treatments have drastically changed surgery rooms; Magnetic Resonance Imaging (MRI) is the gold standard of medical diagnostics and EM Hyperthermia is growing as an effective adjuvant anticancer treatment. In addition, other applications are rapidly emerging, such as microwave imaging, and the advent of nanotechnologies can lead to completely new developments, including remote control of drug delivery and biological processes.

This course aims at introducing this vibrant and interdisciplinary area into the Antenna (and Electromagnetic) Community, providing the ability to understand the issues of medical applications of EM fields. It is primarily conceived for Doctoral students and researchers with an engineering or physics background. In this cross-disciplinary course, instructors from EM engineering, physics, biology and clinical communities will be involved.

## Main Facts

### Course Coordinators:

Dr. L. Crocco, IREA-CNR (IT)

Prof. G. Vecchi, Politecnico di Torino (IT)

### Course location:

School of Polytechnic and Basic  
Sciences - College of Engineering -  
Federico II University, Napoli, Italy

### Registration fee:

440€ Universities and non-profit

880€ for business companies

**Grants** for selected PhD candidates

**Credits:** PhD students 3 ECTS

### For registration and details:

<http://esoabio2019.irea.cnr.it/>  
esoabio2019@irea.cnr.it

## Course Topics

The course starts by reviewing the basics of the interaction between EM fields and bio-systems, from both the points of view of the engineer and of the biologist; it also addresses the specific technological challenges that diagnostic and therapeutic applications of EM fields pose, owing to their multi-physics nature. Safety and regulatory aspects are also discussed.

The second part of the course deals with selected clinical applications in both therapy and diagnostics. A specific focus of this year will be on thermal EM therapies for cancer treatment.

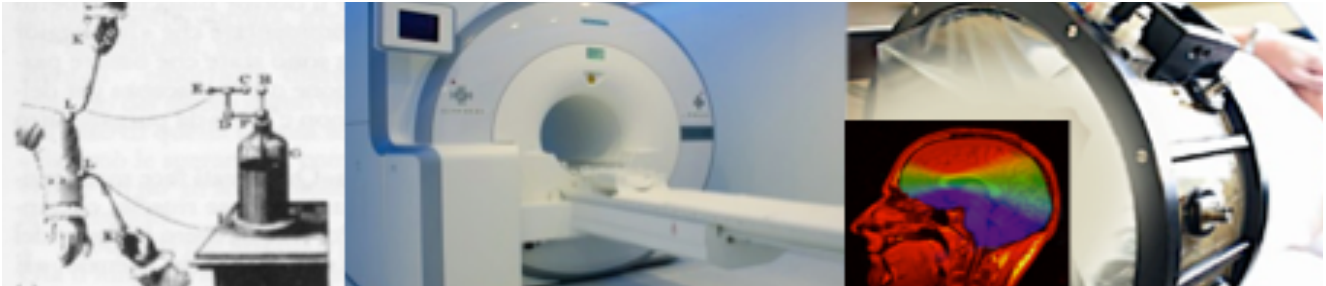
The course is complemented with on-site visits at a clinical MRI facility and at the Bio-electromagnetism laboratory of the Institute for Electromagnetic Sensing of the Environment (IREA-CNR).





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## Detailed Course Breakdown

### Fundamentals of EM fields and biological systems

Fields, waves and matter

Bio-heat equation and thermal effects

Basics of antennas design for medical applications

Electromagnetic characterization of biological tissues

### Introduction to Bioelectromagnetism

Bioelectromagnetics: methods and exposure systems

Review of known effects of EM fields and interaction mechanisms

Safety and open issues

### Regulatory aspects

Radio-protection legislation (exposure and SAR)

### EM in the Clinical Practice

Overview of main clinical EM applications

Focus on EM thermal therapies

Clinical challenges in microwave and RF Ablation

EM hyperthermia in radiation oncology

Magnetic resonance imaging

### Emerging applications and future trends

Microwave imaging for medical diagnostics

Nano-inspired applications

Electroporation based-therapy

### Complementary activities

Visit at MRI clinical facility

Visit at Bioelectromagnetics lab @ CNR-IREA

