

# DIAGNOSTIC AND THERAPEUTIC APPLICATIONS OF ELECTROMAGNETICS

June 13-17, 2022 Rome, Italy



## Course Coordinators

**M. Cavagnaro**, Sapienza University of Rome (IT)

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

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

## Lecturers

**H. Creeze**, Amsterdam Medical Center (NL)

**L. Farina**, Endowave Ltd (IE)

**P. Pavoni**, Medlogix srl (IT)

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

**G. Ruvio**, Endowave Ltd (IE)

**N. Tosoratti**, HS HospitalService SpA (IT)

Electromagnetic (EM) fields are increasingly used in the clinical practice both in diagnostics and therapeutic applications. Examples include Magnetic Resonance Imaging (MRI) for the diagnosis, and electromagnetic hyperthermia and thermal ablation for therapies. Additionally, new applications are under developments, as e.g., radar-based monitoring of respiratory and cardiac activities. All these applications need a complete knowledge of the dielectric properties of human tissues, both healthy and diseased ones, and of the behaviour of the electromagnetic field in the human body.

This course aims at introducing this interdisciplinary area to the interested audience in the electromagnetic community, providing the ability to understand the issues of medical applications of EM fields. It is primarily conceived for Doctoral students and early-career 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 location:

Faculty of Engineering, Sapienza University of Rome, Italy

### Registration fee:

440€ Universities and non-profit

880€ for business companies

**Grants** for selected PhD candidates

**Credits:** PhD students 3 ECTS

### Registration and details:

<http://esoabio2022.irea.cnr.it/>

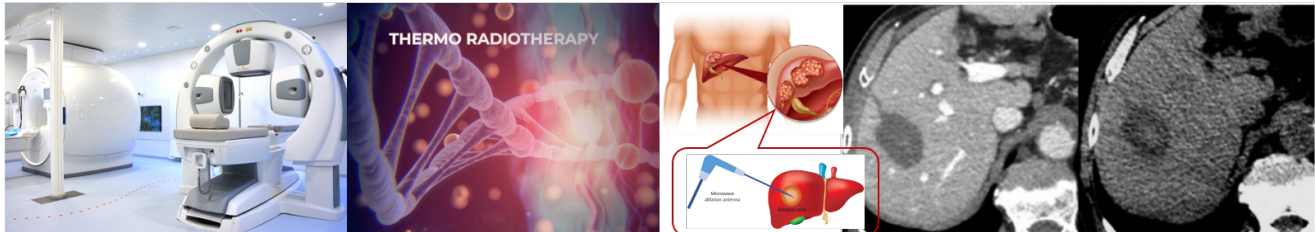
[esoabio2022@irea.cnr.it](mailto:esoabio2022@irea.cnr.it)

## Course Topics

The course is focused on therapeutic applications of EM fields at microwave frequencies. To lead the students towards such applications, it starts by reviewing the basics of the interaction between EM fields and bio-systems. Then, a general overview of the effects of EM fields at different frequencies, and underlying mechanisms, is given followed by the presentation of the dielectric properties of tissues. Following, microwave hyperthermia and thermal ablation are discussed, from the engineer, clinical and industrial point of view. In particular the path from the idea to the clinic, with focus on the industrial perspective, will be evidenced. The course is complemented with on-site visit at a clinical hyperthermia facility. An outlook to future medical applications of EM fields will complete the course.

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## Detailed Course Breakdown

### Fundamentals of EM fields and biological systems

Fields, waves and matter

Bio-heat equation and thermal effects

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

### Microwave hyperthermia

Overview of clinical applications of hyperthermia

Hyperthermia applicator design

Hyperthermia treatment planning, optimization SAR-based and temperature-based

Hyperthermia from the perspective of the industry

### Microwave thermal ablation

Overview of clinical applications of thermal ablation

Thermal ablation applicator design and simulation studies

Thermal ablation: from research bench to clinic

Thermal ablation from the perspective of the industry

### Regulatory aspects

The process to achieve the CE and FCC marks

### Emerging applications and future trends

Nano-inspired applications

### Complementary activities

Visit at hyperthermia clinical facility