**TEACHING MODULE Announcement**

## PhD in Information and Communication Technology for Health

## Università degli Studi di Napoli Federico II

# Ultra High Field Magnetic Resonance Imaging

## Dates and Locations

| Date | Hours | Room | Lecturer |
|---|---|---|---|
| Jan., 17 2022 | **9.30-12.30** | **TEAMS/ room T3** | **G. Ruello, Unina** |
| Jan., 18 2022 | **9:30-12:30** | **TEAMS/ room ES** | **G. Ruello, Unina** |
| Jan., 20 2022 | **15.00-17.00** | **TEAMS/ room ES** | **A. Brunetti, Unina** |
| Jan., 25 2022 | **15.30-17.30** | **TEAMS/ room I3** | **C. Collins, NYU** |
| Jan, 26 2022 | **15.30-17.30** | **TEAMS/ room ES** | **R. Lattanzi, NYU** |
| Jan. 31 2022 | **9.30-12.30** | **TEAMS/ room ES** | **R. Massa, Unina** |

Rooms **T3** and **I3** are in **Via Claudio (Biennio)** // Room **ES** (**ex-softel**) is in Via Claudio Building 3 Floor 1
TEAMS Code: 09992vu

## Content

**I Lesson – Introduction and basic principles**: Physical basis of the Magnetic Resonance Phenomenon. The Bloch equation and the Larmor frequency. Effect of static field B0 and RF field B1 on the magnetization of the hydrogen nucleus. The relaxation phenomenon. The spin-spin and the spin-lattice relaxations. Reciprocity.

**II Lesson – MRI signal and image formation**: Signal to noise ratio in MRI. Intrinsic SNR and ultimate intrinsic SNR. Gradient fields and their use for localization. Definition and comprehension of the k-space for image creation purposes. Electromagnetic description in canonical and actual problems. Numerical and analytical approaches. Advantages and limitations of the presented methodologies.

**III Lesson – MRI in clinical applications**: Lesson III will be dedicated to clinical applications of MRI with reference to the multiparametric characterization of normal and abnormal structures using different acquisition sequences. Conventional as well as "advanced" applications will be covered

**IV Lesson – Ultra High field MRI**: Why Ultra High field MRI. Challenges in Ultra high field MRI. Field inhomogeneity and patient safety. Solutions to control the field distribution in the scanner.

**V Lesson – High permittivity materials in MRI**: Introduction of high permittivity materials (HPM) in MRI. Experimental evidences and actual knowledge on the underlying phenomena. Discussion, concluding remarks and learning assessment.

**VI Lesson – Exposure limits in MRI and Conclusions**: Scientific principles. International Guidelines. Italian law. Occupational limits.

## Lecturers


### Arturo Brunetti

**University of Napoli Federico II**
**Department of Advanced Biomedical Sciences (DSBA)**
**brunetti@unina.it**


**CV:** Arturo Brunetti is Full Professor of Diagnostic Imaging and Chief of Diagnostic Imaging and Radiotherapy at the Federico II University Hospital . His current research interests include quantitative, functional and structural characterization of demyelinating, degenerative and neoplastic disorders of the Central Nervous System using MRI and nuclear imaging, imaging of animal models of human diseases and applications of "AI" procedures for diagnostic characterization.


### Christopher Collins

**New York University**
**Department of Radiology**
**C.Collins@nyulangone.org**


**CV:** Christopher Collins is Full Professor of radiology at the New York University. His primary interest is in the interactions of electromagnetic fields with the human body. This has led him to research in engineering the fields in MRI to ensure image quality and patient safety, and to the development, demonstration, and application of the numerical simulation tools necessary for performing this work. Through the years his interests have evolved from making 3D numerical electromagnetic field simulations relevant to the MRI community to developing new methods for extremely rapid calculations of temperature throughout the human body during the MRI examination with consideration of the field/tissue interactions and numerous physiological phenomenon.


### Riccardo Lattanzi

**New York University**
**Department of Radiology**
**Riccardo.Lattanzi@nyulangone.org**


**CV:** Riccardo Lattanzi is an associate professor of radiology, electrical and computer engineering at the New York University. His research work lies at the boundary between physics, engineering and medicine. He investigates fundamental principles involving the interactions of electromagnetic fields with biological

tissue in order to improve the diagnostic power of magnetic resonance imaging. His honors include an ISMRM Young Investigator Award and an NSF CAREER Award. He holds a degree in electronic engineering from University of Bologna and a Ph.D. in medical and electrical engineering from the Harvard-MIT Division of Health Sciences and Technology.

## Rita Massa

**University of Napoli Federico II**
**Department of Physics Ettore Pancini**
**massa@unina.it**

**CV:** Rita Massa is an Associate Professor of electromagnetic Fields at the Department of Physics "Ettore Pancini", University of Naples Federico II, Italy. She is currently the Director of the Interuniversity Center for the Study of Interactions between Electromagnetic Fields and Biosystems (ICEmB, headquarters at University of Genoa). Her main research interests are in the framework of the interactions of electromagnetic fields and materials, dealing with the biological effects of Electromagnetic Fields, electromagnetic dosimetry/exposure assessment, therapeutic and industrial applications of Electromagnetic Fields, and nondestructive testing of materials.

## Giuseppe Ruello

**University of Napoli Federico II**
**Department of Electrical Engineering and Information Technology (DIETI)**
**ruello@unina.it**

**CV:** Giuseppe Ruello is an Associate Professor of electromagnetic Fields at the Department of Electrical and Information Technology Engineering, University of Naples Federico II, Italy. His main research interests include SAR remote sensing, modelling of electromagnetic scattering from natural surfaces, fractal models, SAR raw signal simulation, modelling of electromagnetic field propagation in urban environment, modelling of electromagnetic field propagating in Magnetic resonance scanners.

## ECTS Credits: 3

## Notes

**Participants to the Module are requested to e-mail to prof. Giuseppe Ruello the following: Student name, name of the PhD course and cycle.**

Info: **Prof. GIUSEPPE RUELLO -** tel. 081 7683512– ruello@unina.it