



**PhD in Information Technology and Electrical Engineering**  
Università degli Studi di Napoli Federico II

**PhD Student: Vincenzo Miranda**

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**Cycle: XXXVIII**

**Training and Research Activities Report**

**Year: First**

student signature Vincenzo Miranda

tutor signature Giuseppe Ruello

**Tutor: Prof. Giuseppe Ruello**

**Co-Tutor:**

**Date: October 13, 2023**

# Training and Research Activities Report

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Author: Vincenzo Miranda

## 1. Information:

- **PhD student: Vincenzo Miranda**
- **DR number: DR996639**
- **Date of birth: 23/02/1995**
- **Master Science degree: biomedical engineering University: Federico II of Naples**
- **Doctoral Cycle: XXXVIII**
- **Scholarship type: PNRR - DM 351 Pubblica Amministrazione**
- **Tutor: Giuseppe Ruello**
- **Co-tutor:**

## 2. Study and training activities:

Activity	Type <sup>1</sup>	Hours	Credits	Dates	Organizer	Certificate <sup>2</sup>
OPEN DIGITAL FRAMEWORK -CRASH COURSE	Seminar	3	0,6	17/01/23	Alberto Curcio and Valeria Crimaldi	Y
PRINCIPI ARCHITETTURALI - TOGAF I	Seminar	3	0,6	30/01/23	Alberto Curcio and Pietro Boscolo	Y
Embracing Data Imperfections Via Domain Enriched Visual Task Learning	Seminar	1	0,2	13/02/23	Vishal Monga	Y
Algorithm Unrolling: Efficient, Interpretable Deep Learning for Signal and Image Processing	Seminar	1	0,2	14/02/23	Vishal Monga	Y
How to public open access with IEEE	Seminar	1	0,2	05/04/2023	Francesca Rossi, Eszter Lukacs	Y
Dagli acceleratori di particelle alla musica digitale	Seminar	1	0,2	20/04/2023	Di Giugno	Y
Tecniche di	Seminar	2	0,4	22/05/23	Clinica	Y

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Elettrofisiologia e Mappaggio ad alta densità e Ablazione a RF con l'utilizzo del Carto					Mediterranea	
Matlab Fundamentals	Seminar	2	0,4	24/05/23	Salvatore Capuozzo	N
Presentation of company activities and possible collaborations	Seminar	2	0,4	26/05/23	Teoresi Group	Y
Electric Regularized Maxwell Equations with Singularities ERMES software	Seminar	5	1	8/05/23	Center for Numerical Methods in Engineering (CIMNE)	Y
Tecniche di elettroporazione	Seminar	1	0,2	06/06/23	Francesca Lodato	Y
Electromagnetic Characterisation of Coatings and Structured Surfaces for Particle Accelerators	Seminar	2	0,4	13/06/23	Andrea Passarelli	Y
Insights into the Design of Transmit and Receive Coils for Ultra-High Field MRI	Seminar	2	0,4	29/06/2023	Riccardo Lattanzi	Y
Ricerca e formazione nella società della transizione digitale	Seminar	5	1	22/09/23	CINI	Y
How to boost your Ph.D.	Course	16	4	11/01/23 – 01/03/23	Antigone Marino	Y
Corso formazione rischi specifici ingegneria	Course	12	//	08/03/2023 15/03/2023	Ludovico Pontoni	N
Statistical Data Analysis for Science and Engineering Research	Course	12	4	06/02/23- 16/02/23	Roberto Pietrantuono	Y
Surface Electromagnetics Ph.D. school in Trento	Doctoral School	25	4		Eledia Research Center	Y

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Antenna Modeling on Ansys and Simulation Made Easy Fundamentals and Hands-On Exercises	Course	8	//	01/07/23 – 26/07/23	Eledia Research Center	Y
Electrodynamics of continuous media	Course	72	9	03/2023 – 05/2023	Claudio Serpico	Y
Formazione sulla progettazione europea: Modulo 1 – FONDI EUROPEI E PROGRAMMAZIONE	Course	2	0,4	14/09/23	Direzione Generale della Ricerca del Ministero dell'Università	Y
Formazione sulla progettazione europea: Modulo 2 – PANORAMICA DELLE OPPORTUNITA' DI FINANZIAMENTO	Course	3	0,6	28/09/23	Direzione Generale della Ricerca del Ministero dell'Università	Y
Formazione sulla progettazione europea: Modulo 3 – TECNICHE E METODI PER LA REDAZIONE DEI PROGETTI (LEZIONE 1)	Course	3	0,6	12/10/23	Direzione Generale della Ricerca del Ministero dell'Università	Y

1) Courses, Seminar, Doctoral School, Research, Tutorship

2) Choose: Y or N

## 2.1. Study and training activities - credits earned

	Courses	Seminars	Research	Tutorship	Total
Bimonth 1	0	0	5	0	5
Bimonth 2	0	1,6	6	0	7,6
Bimonth 3	4	0,4	4	0	8,4
Bimonth 4	8	2,2	5	0	17,2
Bimonth 5	0	1	3	0	4

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Bimonth 6	10,6	1	6	0	10
<b>Total</b>	<b>22,6</b>	<b>6,2</b>	<b>29</b>	<b>0</b>	<b>57,8</b>
<b>Expected</b>	<b>30 - 70</b>	<b>10 - 30</b>	<b>80 - 140</b>	<b>0 - 4.8</b>	

### 3. Research activity:

*In the current year I have been involved in the study of high permittivity materials (HPM) in ultrahigh field magnetic resonance imaging (MRI) applications.*

*These materials are used in clinical practice as helmets or water pads, which surround the biological tissue or transmitting antenna in order to improve radiofrequency field homogeneity and Signal-to-Noise Ratio of medical images. However, such approaches are purely experimental or numerical, leaving little room for physical interpretation of the phenomenon and it is not possible to explain why the improvement was achieved under certain circumstances.*

*Therefore, an analytical model was developed, based on the old interpretation of Mie Scattering. This new one, allows the problem of electromagnetic scattering from a layered object (either in spherical or cylindrical coordinates) to be schematized as propagation in nonhomogeneous transmission lines.*

*In this way it is possible to introduce scalar parameters such as reflection coefficient and impedance, such scalar quantities make it possible to interpret Mie Scattering in a simpler way and allows the role of HPMs in MRI to be studied analytically.*

*With the new description of the phenomenon, it is possible to control the shape of the radiofrequency field within the biological sample by selectively amplifying the mode of interest (fields are expressed as superposition of spherical harmonics) and filtering out all others that contribute to the noise. This is achieved by selecting the appropriate permittivity value for the HPM material surrounding the tissue, a value that is derived from a simple matching condition about the impedance at outer sphere boundary.*

*To validate the results obtained, numerical simulations were performed with Ansys HFSS software. In addition, in collaboration with the Ettore Pancini Physics Department, solid phantoms mimicking the electrical properties of the brain were designed and fabricated. The next step is to expose these in MRI scanner so that the experimental data can be obtained and compared with those predicted by the newly developed model.*

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## 4. Research products:

### *Conference paper*

**Title:** *A new physical framework to investigate scattering suppression from coated spheres.*

**Authors:** *Vincenzo Miranda, Daniele Riccio, Giuseppe Ruello, Riccardo Lattanzi*

**Status:** *Published*

**Conference:** *SPIE 12568, Metamaterials XIV, 125680N (6 June 2023)*

**Scopus or ISI Web of Science** *YES*

### *Conference paper*

**Title:** *An Analytical and Numerical Approach to Investigate the Role of High Permittivity Materials in Magnetic Resonance Imaging*

**Authors:** *Giuseppe Carluccio, Christopher Collins, Riccardo Lattanzi, Vincenzo Miranda, Daniele Riccio, Giuseppe Ruello*

**Status:** *Published*

**Conference:** *IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting*

**Scopus or ISI Web of Science** *NO*

### *Journal paper*

**Title:** *A Theoretical Framework to Investigate the Effect of High Permittivity Materials in Magnetic Resonance Imaging using Anatomy-Mimicking Cylinders*

**Authors:** *Vincenzo Miranda, Giuseppe Ruello, Riccardo Lattanzi*

**Status:** *Submitted*

**Journal:** *Magnetic Resonance in Medicine (MRM)*

**Scopus or ISI Web of Science** *NO*

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## 5. Conferences and seminars attended

## 6. Activity abroad:

## 7. Tutorship