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

PhD Student: Sonia Zappia

Cycle: XXXV

Training and Research Activities Report

Year: First

Sonia Zappia

Tutor: Prof. Giuseppe Ruello

Co-Tutor: Dr. Lorenzo Crocco

Date: October 31, 2020

1. Information:

- ➢ **PhD student: Sonia Zappia**
- ➢ **DR number: 994203**
- ➢ **Date of birth: 10/05/1989**
- ➢ **Master Science degree: Biomedical Engineering   University: University of Naples "Federico II "**
- ➢ **Doctoral Cycle: XXXV**
- ➢ **Scholarship type:** *no scholarship*
- ➢ **Tutor: Prof. Giuseppe Ruello**
- ➢ **Co-tutor: Dr. Lorenzo Crocco**

2. Study and training activities:

Activity	Type[1]	Hours	Credits	Dates	Organizer	Certificate[2]
Safety Critical Systems for Railway Traffic Management	Ad hoc courses	20	3.3	10/01/2020 13/01/2020 17/01/2020 20/01/2020 24/01/2020 27/01/2020	DIETI	Y
CYBERSECURITY AND FUZZING FOR ROBOTS, BLOCKCHAIN, AND MORE	Seminar	1	0.2	13/01/2020	-Dr. Roberto Natella	Y
Matlab Foundamentals	Ad hoc courses	20	2	20/02/2020 26/02/2020 2/03/2020 16/03/2020 17/03/2020 18/03/2020 19/03/2020 20/03/2020 24/03/2020 25/03/2020	DIETI / SPSB	Y
Computational Biology: Large scale data analysis to understand the molecular bases of human diseases	Seminar	1	0.2	9/04/2020	DIETI Prof. Michele Ceccarelli	Y
Elettromagnetismo e Salute	Seminar	1	0.2	9/04/2020	DIETI Prof. Rita Massa	N

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How to Get Published with IEEE	Seminar	2	0.4	20/04/2020	Dr. Alessandra Scippa	Y
Innovation management, entrepreneurship and intellectual property.	Ad hoc courses	14	5	5/05/2020 7/05/2020 8/05/2020 11/05/2020 21/05/2020 5/06/2020	Prof Pierluigi Rippa-StartCup Campania	Y
Large Scale Training of Deep Neural Networks	Seminar	2	0.4	6/05/2020	DIETI	N
La programmazione europea e la ricerca. Nuovi scenari della programmazione europea dopo il 2020. La gestione di un progetto di ricerca.	Seminar	2	0.4	13/05/2020	Innovation Village 2020	N
SAS Analytics	Seminar	2	0.4	14/05/2020	SAS Academic Program Manager	N
Campi elettromagnetici pulsati: dal meccanismo d'azione alle applicazioni cliniche	Seminar	1.5	0.3	15/05/2020	Prof. Rita Massa Prof. Giuseppe Ruello UNINA	YES
Realtà Virtuale e Salute reale. Health 4.0 – Dal bit alla mente:spazi virtuali per la salute.	Seminar	2.5	0.5	15/05/2020	Innovation Village 2020	N
Joint Design of Optics and Post-Processing Algorithms Based on Deep Learning for Generatin Advanced Imaging Features	Seminar	2	0.4	19/05/2020	IEEE Computational Imaging Technical Committee	N
Virtual Seminars on 'Sensing'	Seminar	4	0.8	20/05/2020	Plasmonica, Prof. Carlo Forestiere, DIETI	Y
Applicazioni mediche dei campi elettromagnetici basate sull'incremento di	Seminar	1.5	0.3	22/05/2020	Prof. Rita Massa Prof. Giuseppe	Y

temperatura: ipertermia e ablazione.					Ruello UNINA	
Non invasive Mapping of Electrical Properties using MRI	Seminar	1.5	0.3	11/06/2020	Prof. Rita Massa Prof. Giuseppe Ruello UNINA	Y
Exploring Autonomy in Robotic Flexible Endoscopy.	Seminar	2	0.4	12/06/2020	Prof. Fanny Ficuciello	Y
Misure a Microonde e Onde Millimetriche	Course MSc	72	9	II semester a.a 2019/2020	Prof. Claudio Curcio	N
Machine Learning	Ad hoc courses	18	3.6	7/07/2020 8/07/2020 9/07/2020 10/07/2020 13/07/2020 14/07/2020 15/07/2020 16/07/2020 17/07/2020	ITEE - ICTH Prof. Carlo Sansone	Y
How to Publish Open Access with IEEE to Increase the Exposure and Impact of Your Research	Seminar	1.5	0.3	23/09/2020	Dr. Alessandra Scippa	Y
IBM Quantum: i primi computer quantistici per la ricerca e la didattica	Seminar	2	0.4	9/10/2020	Federico Mattei, IBM Q Ambassador	N
Study on electromagnetic imaging systems and modeling in complex environments.	Research	220	6.5	1/01/2020 to 28/02/2020		
- Literature review about diagnostics technology for quality control of food products. - Study on application of Terahertz Waves to Food Science	Research	220	8	1/03/2020 to 30/04/2020		
-Data Processing for	Research	200	1.2	1/05/2020		

Terahertz Imaging -Thz analysis of pistachio samples -Thz analysis of chocolate cream samples				to 30/06/2020		
-Code writing for THz image filtering. -THz analysis of food samples with and without foreign bodies. -State of the art concerning the electromagnetic characterization of THz materials.	Research	220	6.4	1/07/2020 to 31/08/2020		
-Preparation of two conference papers	Research	220	5	1/09/2020 to 31/10/2020		
Estrapolazioni su segnali 4G e 5G	Seminar	1.5	0.3	20/10/2020	Prof. Rita Massa and Prof. Giuseppe Ruello UNINA	N
Misure di segnali complessi nell'ambiente: Sistemi 5G	Seminar	1.5	0.3	20/10/2020	Prof. Rita Massa and Prof. Giuseppe Ruello UNINA	N
Valutazione dei livelli di esposizione e del rispetto dei limiti Antenne e 5G	Seminar	1.5	0.3	20/10/2020	Prof. Rita Massa and Prof. Giuseppe Ruello UNINA	N

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	0	0	0
Bimonth 2	3.3	0.2	6.5	0	10

Bimonth 3	**2**	**0.8**	**8**	**0**	**10.8**
Bimonth 4	**5**	**4.2**	**1.2**	**0**	**10.4**
Bimonth 5	**3.6**	**0**	**6.4**	**0**	**10**
Bimonth 6	**9**	**1.6**	**5**	**0**	**15.6**
Total	**22.9**	**6.8**	**27.1**	**0**	**56.8**
Expected	**30 - 70**	**10 - 30**	**80 - 140**	**0 – 4.8**	

3. Research activity:

In the first year of my Ph.D I focused the research activity on the study of Terahertz imaging as a tool for non-destructive inspection of food quality.

Terahertz (THz) radiation is an electromagnetic wave ranging from 0.1 to 10 THz (0.03 – 3 mm in wavelength) characterized by unique properties [1]. The THz band is advantageous since it includes very short wavelengths and, therefore, provides high resolution compared to traditional electromagnetic techniques. Besides, unlike X-ray radiation, it can be more safely used for applications related to human health because of its nonionizing properties [2]. In addiction, this technology allow us to detect foreign body contamination in food and packaging failures that are the main sources of customers' complaint, resulting in loss of brand loyalty and large recall expenses [3] [5].

In this framework, my research was characterized by two principal activities:

1. Experiments referred to non destructive testing of food samples carried out with the Fiber - Coupled Terahetz Time Domain (FiCO) system developed by Z-Omega and available at CNR-IREA.
2. Adoption of data processing strategy aimed to improve the imaging performance.

The first activity was characterized by the study of several food samples such as pistachio, nut and chocolate cream. Our results indicate the ability of the THz imaging to detect surface defects and foreign body contamination in food samples. An experiment referred to nondestructive testing of sugar bags with and without packaging defects was also carried out. Our results indicate the ability of THz imaging to represent accurately the surface packaging defect.

The second activity has regarded the development of case study oriented algorithms in order to improve the effectiveness of THz imaging. In fact, due to the diversity of samples to be analyzed, the adoption of a single procedure is impractical [4]. This is particularly evident for food inspections, because there is a large variety of products having different properties and characteristics. In this framework, a data processing approach based on the combined use of a Band Pass Filter (BPF) and the Singular Value Decomposition (SVD) filtering procedure, is proposed. This data processing allows us to improve the quality of the final image without reducing the detection capability of surface defect and packaging failure.

Ref.

[1] Ok, Gyeongsik, et al. "High-performance sub-terahertz transmission imaging system for food inspection." _Biomedical optics express_ 6.5 (2015): 1929-1941.

[2] Gowen, A. A., Créidhe O'Sullivan, and C. P. O'Donnell. "Terahertz time domain spectroscopy and imaging: Emerging techniques for food process monitoring and quality control." *Trends in Food Science & Technology* 25.1 (2012): 40-46.

[3] Redo-Sanchez, Albert, et al. "Assessment of terahertz spectroscopy to detect antibiotic residues in food and feed matrices." *Analyst* 136.8 (2011): 1733-1738.

[4] Zhang, Zhengwei, et al. "Terahertz time-domain spectroscopy for explosive imaging." *Optik* 118.7 (2007): 325-329.

[5] Shin, Hee Jun, Sung-Wook Choi, and Gyeongsik Ok. "Qualitative identification of food materials by complex refractive index mapping in the terahertz range." *Food chemistry* 245 (2018): 282-288.

4. Research products:

S. Zappia, G. Ruello, L. Crocco – "Terahertz data processing for food quality inspection : preliminary results" accepted conference paper for the National Electromagnetism Meeting 2020 (RINEM 2020)

R. Scapaticci, S. Zappia, I. Catapano, G. Ruello, G. Bellizzi, N. Pasquino, M. Cavagnano, S. Pisa, E. Piuzzi, F. Frezza, F. Vipiana, J. A. Tobon Vasquez, M. Ricci, L. Crocco – "Broadband Electromagnetic Sensing for Food Quality Control: A Preliminary Experimental Study" submitted conference paper for the 15th European Conference on Antennas and Propagation (Eucap 2021)

5. Conferences and seminars attended

0

6. Activity abroad:

0

7. Tutorship

0