



PhD in Information Technology and Electrical Engineering

Università degli Studi di Napoli Federico II

PhD Student: Nicola Moccaldi

XXXIV Cycle

Training and Research Activities Report – First Year

Tutor: Prof. Pasquale Arpaia



UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

1. Information

I received the M.Sc. Degree in Electronic Engineering from University of Napoli 'Federico II' in July 3th 2018 with the thesis "Non invasive monitoring of transdermal drug delivery".

I belong to XXXIV cycle of Information Technology and Electrical Engineering (ITEE) PhD. My fellowship is financed by Centro Servizi Metrologici e Tecnologici Avanzati (CeSMA). My tutor is Prof. Pasquale Arpaia.

2. Study and Training activities

In the first year of PhD program, I attended the following seminars and courses:

a. Modules

- Machine Learning (05/2019), Anna Corazza, Francesco Isgrò, Stefano Olivieri, Roberto Prevete, Carlo Sansone, 5 CFU
- Explainable Artificial Intelligence (05/2019), Roberto Prevete, 2,4 CFU
- Instrumentation and measurement Ph.D. School "Italo Gorini 2019" (09/2019), 4 CFU

b. Seminars

- Author Seminar: How to publish a scientific paper (26/11/2018), Aliaksndr Birukou and Elisa Magistrelli, 0.4 CFU
- Matlab and Embedded System (28/03/2019), Stefano Marrone, 0.4 CFU
- From Particles to Light... and from lighth to particles (16/04/2019), Patrizio Antici, 0.2 CFU
- The Future is Now! Robotics, AI and Automation, (04/06/2019) Bruno Siciliano, 0.4 CFU
- Ethics, science & society in Brain Computer Interface (18/10/2019), Pim Haselager, 0.6 CFU

c. External courses

During the 1th year I didn't attend external courses.

3. Research activity

My research activity is about:

a) AR & Brain Computer Interface

Augmented Reality (AR) is a technology for overlapping computer-generated perceptual information with actual world, in order to enhance human perception of the surrounding environment. AR is widely considered as a pillar of the ongoing industrial revolution. AR can help several work aspects, from training on-the-job to product design, and maintenance. According to scientific literature inspections, as other maintenance operations, usually require the user hands to be free from the AR device controller. The combination of AR with a Brain-Computer Interface (BCI) can provide the solution to a hands-free user input, thus providing a novel way of gathering information from the surrounding environment. The research proposes wearable monitoring systems for inspection in the framework of Industry 4.0.

b) Monitoring insulin bioavailability in personalized diabetes therapy by impedance spectroscopy.

Skin alterations, such as lipo-hypertrophic nodules, are the main causes of intra-individual variability in insulin absorption. Different classes of drugs used in insulin therapies have a delayed and variable absorption if injected into lipo-hypertrophic nodules. More generally, the presence of lipo-hypertrophic skin alterations is associated with poor metabolic control and considerable intra-individual glycemic instability. These problems affect also advanced automated diabetic therapy. An accurate insulin bolus administration is guaranteed by a real-

time monitoring of the amount of insulin actually absorbed, namely bioavailable. The research explores the feasibility of insulin absorption assessment based on spectroscopy impedance.

- c) Real-time, non-invasive, accurate, assessment of cardiovascular risk

Development of machine-learning algorithm for cardiovascular risk assessment based on biosignals non-invasively acquired. Electrocardiogram, blood oxygenation, and body temperature, are acquired by means of wearable transducers. They are processed to obtain features that, together with the results from patients' interviews, are input to a classifier to assess the cardiovascular risk.

- d) Innovative Learning methodologies for facing the challenges of I4.0

With the advent of I4.0 companies expect their employees not only to utilize deep knowledge, but also to operationalize this knowledge in unimaginable situations. Research focalizes innovative didactic strategies as Cooperative Project-Based and Scenario-Based learning approaches. A typical place for innovative didactic is the Academic Fablab: peers maybe even more knowledge-able than stewards or teachers, and the line between them is blurred as they learn alongside. This requires new attitudes and competences to teachers.

4. Products

Published (*' = journal papers. Others = proceeding papers)

*Angrisani, Leopoldo, et al. "Single-Channel, Steady State Visually Evoked Potential-based Brain Computer Interface: a Proof of Principle for Biomedical Daily Use." *Journal of Physics: Conference Series*. Vol. 1065. No. 13. IOP Publishing, 2018.

Published online: 13 November 2018

*Angrisani, L., Arpaia, P., Capaldo, G., Moccaldi, N., Salatino, P., & Ventre, G. (2018, August). *Evolution of the academic FabLab at University of Naples Federico II*. In *Journal of Physics: Conference Series* (Vol. 1065, No. 2, p. 022013). IOP Publishing.

Published online: 13 November 2018

Angrisani, L., Arpaia, P., Moccaldi, N., & Esposito, A. (2018, September). *Wearable Augmented Reality and Brain Computer Interface to Improve Human-Robot Interactions in Smart Industry: A Feasibility Study for SSVEP Signals*. In *2018 IEEE 4th International Forum on Research and Technology for Society and Industry (RTSI)* (pp. 1-5). IEEE.

Date Added to IEEE Xplore: 29 November 2018

*Arpaia, P., Cuomo, O., Moccaldi, N., Smarra, A., & Tagliatela, M. (2018, August). *Non-invasive real-time in-vivo monitoring of insulin absorption from subcutaneous tissues*. In *Journal of Physics: Conference Series* (Vol. 1065, No. 13, p. 132008). IOP Publishing.

Published online: 13 November 2018

**Angrisani, Leopoldo, et al. "A Single-Channel SSVEP-Based Instrument With Off-the-Shelf Components for Trainingless Brain-Computer Interfaces." IEEE Transactions on Instrumentation and Measurement (2018).
Date of Publication: 11 December 2018*

**Angrisani, Leopoldo, et al. "A Wearable Brain-Computer Interface Instrument for Augmented Reality-based Inspection in Industry 4.0." IEEE Transactions on Instrumentation and Measurement (2019).
Date of Publication: 03 May 2019*

*Arpaia, P., Cuocolo, R., Donnarumma, F., D'Andrea, D., Esposito, A., Moccaldi, N., ... & Prevete, R. (2019, June). Feasibility of cardiovascular risk assessment through non-invasive measurements. In 2019 II Workshop on Metrology for Industry 4.0 and IoT (MetroInd4. 0&IoT) (pp. 263-267). IEEE.
Date Added to IEEE Xplore: 12 August 2019*

*Angrisani, Leopoldo, et al. "Metrological performance of a single-channel Brain-Computer Interface based on Motor Imagery." 2019 IEEE International Instrumentation and Measurement Technology Conference (I2MTC). IEEE, 2019.
Date Added to IEEE Xplore: 09 September 2019*

**Angrisani, Leopoldo, et al. "A "learning small enterprise" networked with a FabLab: An academic course 4.0 in instrumentation and measurement." Measurement 150 (2020): 107063.
Available online 23 September 2019*

To be submitted

P. Arpaia, R. Cuocolo, F. Donnarumma, A. Esposito, N. Moccaldi, A. Natalizio, R. Prevete "A machine learning-based soft transducer for real-time noninvasive cardiovascular risk measurement", to be submitted to Measurement.

Submitted

P. Arpaia, N. Moccaldi, R. Prevete, I. Sannino, A. Tedesco, "A wearable EEG instrument for real-time frontal asymmetry monitoring in worker stress analysis", submitted to IEEE Transactions on Instrumentation and Measurement.

P. Arpaia, U. Cesaro, M. Frosolone, N. Moccaldi, M. Tagliatela, "A micro-bioimpedance meter for monitoring insulin bioavailability in personalized diabetes therapy", submitted to Nature Scientific Report.

Under revision

P. Arpaia, L. Duraccio, N. Moccaldi, S. Rossi, "Wearable Brain-Computer Interface instrumentation for Augmented Reality telemonitoring of robot-based rehabilitation", under revision by IEEE Transactions on Instrumentation and Measurement.

5. Conferences and Seminars

During my 1th PhD year I participated to: 2019 II Workshop on Metrology for Industry 4.0 and IoT (MetroInd4. 0&IoT), 4-6 June 2019, Naples.

6. Activity abroad

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Antonella Cioffi

During my 1th PhD year I didn't spend time aboard.

7. Tutorship

During my 1th PhD year I spent 26 hours in tutorship activity

	Credits year 1							Summary
	Estimated	1	2	3	4	5	6	
	bimonth	bimonth	bimonth	bimonth	bimonth	bimonth	bimonth	
Modules	18				7,4		4	11
Seminars	13	0,4	0	0,6	0,4	0	0,6	2
Research	34	12	7	7	7	9	7	49
	65	12	7	7,6	15	9	12	62