

Radiofrequency Identification and sensing as multi-scale Internet of Everything framework: *from the warehouse and the factory to the cyber-prosthesis and skin intelligence.*

Prof. Gaetano Marrocco

Chair of the Medical Engineering Degree- University of Roma Tor Vergata, Rome, IT

Dr. Andrea Michel

University of Pisa, Pisa, IT

16 h (10 h Marrocco + 6 h Michel)

Short Abstract:

This course introduces the basics of Radiofrequency Identification technology (RFID) from its assessed application in the logistics of goods and human-machine cooperation to the most advanced research trends in bio-engineering and in predictive maintenance. Indeed, an RFID system is one of the best scalable infrastructures that can handle a single device, like an implanted sensor and a fruit, but it can, however, be indefinitely replicated to control a multitude of entities in farms and even in process of huge complexity thus becoming an unprecedented source of big-data.

The course will show how low-cost RFID devices, originally devoted to the identification as barcode evolution, can be used as sensors of temperature, humidity, gases, deformations, motion, and can be therefore combined with the emerging epidermal electronics and new bio-compatible materials. The integration of the above components is described to provide sensorized second skins and a new generation of empowered implanted prostheses (orthopedic, cardiovascular and dental) with self-diagnostic capability without using any battery. The related physical security and privacy issues will be also analyzed.

Finally, possible applications to the manufacturing factories are discussed to enable predictive analysis and the management of huge-scale processes like a pandemic emergency.

The theoretical lessons will be complemented by laboratory demonstrations and training.

Course Contents in brief:

1. Basics on Radiofrequency Identifications (RFID)
2. RFID for sensing
3. Epidermal and implantable RFID devices
4. Security and Privacy of RFID framework
5. Applications to IoT systems: wearable devices for the human-machine interaction, predictive maintenance, food ripening, precision medicine, pandemics
6. Laboratory demonstration and training

Schedule:

1. 14/06/2022: 14:00-18:00
2. 15/06/2022: 9:30-12:30, 14.00 -17.00
3. 16/06/2022: 9:30-12:30, 14.00 -17.00

Gaetano Marrocco, Bio

Last update: October 2021



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President and founder of RADIO6ENSE spinoff

CURRENT POSITIONS

BIBLIOMETRIC INDICATORS

Google Sch. h-Index 37, Cit. >6100

Scopus h-Index 32, Cit. >3700

Listed in 2020 PLOS Top 1E5 Scientists in the World

(Rank 60712 for Career, 34238 for year 2019)

Gaetano Marrocco - Laurea in Electronic Engineering and Ph.D. in Applied Electromagnetics at the University of L'Aquila, Italy, in 1994 and 1998, respectively. Researcher at the University of Roma Tor Vergata in 1994-2014. Associate Professor of Electromagnetics in 2013-2017. Guest Professor at the University of Paris-est Marne la Vallée in 2015 and Full Professor at the University of Roma Tor Vergata since 2018. He currently serves as Director of the Medical Engineering School.

His research is mainly directed to the modeling and design of broadband and ultra-wideband (UWB) antennas and arrays as well as of sensor-oriented miniaturized antennas for Biomedical Engineering, Aeronautics, and Radiofrequency Identification (RFID). During the last decade, he carried out pioneering research on the wireless-activated sensors, and in particular on Wearable and Epidermal Electronics, contributing to the move from the labeling of objects to the passive sensor networks in the Internet of Things era. He serves as Associate Editor of the IEEE Journal of Radiofrequency Identification and IEEE Flexible Electronics Journal and was a member of the IEEE Antennas and Propagation Society Awards committee. He is moreover Chair of the Italian delegation URSI Commission D Electronics and Photonics. He was the chair of the Local Committee of the V European Conference on Antennas and Propagation (EUCAP-2011), URSI-GA 2021-22, TPC chair of the 2012 IEEE-RFID TA in Nice, France, TPC track-chair of the 2016 IEEE Antennas and Propagation Int. Symposium, TPC track-chair of IEEE-RFID 2018 USA, track chair of FLEPS-2021/22.

He is listed in the PLOS ranking of Top 1.5% Scientist Worldwide.

Prof. Marrocco is the director of the Pervasive Electromagnetics Lab and the co-founder and president of the University spin-off RADIO6ENSE (www.radio6ense.com) that is active in the short-range electromagnetic sensing for Industrial Internet of Things, Smart Manufacturing, Automotive, Food, and Biotech.

Andrea Michel, Bio

Last update: October 2021



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Andrea Michel received the B.E., M.E. and Ph.D. degrees in Telecommunications Engineering from the University of Pisa, Italy, in 2009, 2011, and 2015, respectively. In 2014, he was a Visiting Scholar with the Electro Science Laboratory, The Ohio State University, Columbus, OH, USA, under the supervision of Prof John Volakis. During this period, he was involved in research on a theoretical analysis on the accuracy of a novel technique for deep tissue imaging. Since 2015, he has been a Post-Doctoral Researcher in Applied Electromagnetism at the Microwave and Radiation Laboratory, Department of Information Engineering, University of Pisa, where he is currently an Assistant Professor. He is involved in the design of antennas for automotive applications, MIMO systems, and wearable communication systems, also in collaboration with other research institutes and companies. His current research interests include the design of integrated antenna for communication systems and smart antennas for near field UHF-RFID readers. Dr. Michel was a recipient of the Young Scientist Award from the International Union of Radio Science (URSI), Commission B, in 2014, 2015, and 2016. In 2016, he received the Best Paper Honorary Mention from the IEEE International Conference on RFID Technology and Applications, Shunde, Guangdong, China. He is Early Career Representative for URSI Commission B (Fields and Waves). He serves as Associate Editor for URSI Radio Science Letters and URSI Radio Science Bulletin journals.