ICT PHD

Research project for a PhD curriculum in ICT – Electronics and Telecommunication

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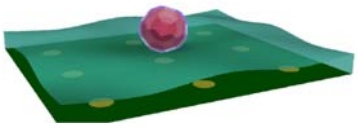
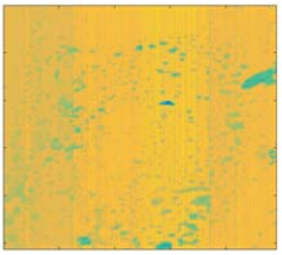


Proposed Title of the research:
Simulation and Characterization of Massively Parallel Electronic Sensing Nano-Devices for the Internet of Things / Internet of Health



Keywords:

Internet of Things, Internet of Health, Nanoelectronics, Electron Devices, Biosensor arrays

Research objectives:

The Internet of Things / Health scenarios predict the future deployment of trillions miniaturized low-power sensors monitoring physico-physiological and environmental data to improve the understanding and prevention of undesirable conditions of the humans and the environment. In this framework, large-scale integrated nanoelectronic platforms that offer massively parallel, label-free biosensing can be created by combining all-electrical detection with low-cost integrated circuits (e.g., micro-/nano-electrode and ion sensitive field effect transistor arrays). Pioneering examples are currently used for mapping neuronal signals and sequencing DNA, and pave the way to extensive statistical analysis instrumental to understand the inherent large variability and fluctuations of biological processes. Modeling and simulation of the sensor transduction processes in presence of disturbances plays an often overlooked but essential role in enabling new insights for designing better, more sensitive and selective devices with improved performance.

Proposed research activity:

The objective of the PhD is the experimental investigation, modelling and simulation of innovative integrated nanoelectronic sensor platforms based on arrays of ion-sensitive field effect transistors (ISFETs) and/or impedance sensing nanoelectrodes for the detection of biological analytes (cells, viruses, biomolecules). The activity includes development of the in-house finite elements ENBIOS simulator to include complex geometries of biomolecules, the study of detection limits set by Debye screening at physiological conditions as well as electronic and biological noise, the investigation of sensor selectivity and sensitivity to different ionic species and biological entities. Activities are carried out in collaboration with research groups of the IUNET consortium, with NXP Semiconductors and major European Universities.

Supporting research projects (and Department)
The activity will be carried out at the DIEF, Università degli Studi di Modena e Reggio Emilia and it is connected to the FLAG-ERA CONVERGENCE project

Possible connections with research groups, companies, universities.

NXP Semiconductors
Technical University of Munich (TUM)
Technical University of Vienna (TUWien)
EPFL Lausanne
IUNET Research Consortium (www.iunet.info)