Computationally Empowered Neuroimaging

Francesco P. Andriulli

Abstract – In the words of Nobel winner neurologist Rita Levi-Montalcini: "The study of the brain is the most important challenge that human beings have ever faced and the Socratic motto of our times should become: *know your brain*". Brain and neuroactivity are inarguably characterized by a stunning complexity: several billion neurons at microscopic level matched by strongly varying and fuzzy-behaving material properties at the macroscopic level. This notwithstanding, the challenge of brain analysis, mapping, imaging, and modeling has been embraced by many multidisciplinary scientific communities worldwide, it has been targeted by two of the largest funding schemes in the United States and Europe, and it has become a very popular topic of both Earth and Brain hemispheres. Facing complexity, however, requires complexity itself and it is not surprising that every discipline that tackles its own share of the "brain challenge" is obliged to show-off the best of its arsenal. When it comes to Computational Physics (the discipline investigating algorithmic strategies and computing technologies for complex physical predictions and modelling) this arsenal is peculiarly rich! This is especially true when the target is functional neuroimaging: the mapping and modeling of the electro/chemical neuroactivity and of the associated brain connectivity. This talk will offer a broad overview of Computationally Empowered Neuroimaging strategies, i.e. technologies for brain diagnostics, therapy, and interaction where computational power, advanced algorithmic, and ad-hoc platforms have paved the way for exciting new discoveries, therapeutic advances, and mind-blowing (literally) applications. Without over-indulging in technicalities, the talk will present discoveries at the theoretical and experimental level always in combination with their promising applications in diagnostics, mind-machine interfaces and in therapeutic neurofeedback. The latter (Socrates would love it!) is as near as we can get today to "*knowing our own brain*".

Biography - Francesco P. Andriulli is a Full Professor at the Politecnico di Torino, Italy, since September 2017. Since 2010 he was an Associate and then Full Professor with the École Nationale Supérieure Mines-Télécom Atlantique (IMT-Atlantique), Brest, France, which he joined after a PhD from the University of Michigan at Ann Arbor. His research interests are in Computational Science with a focus on Fields and Waves, on their associated math, and on their impact in bioengineering and medicine. Prof. Andriulli's research and contributions has received several international recognitions including many best paper awards, the 2015 L. B. Felsen Award for Excellence in Electrodynamics, and the Triennium 2014-2016 URSI Issac Koga Gold Medal. Prof. Andriulli is a member of Eta Kappa Nu, Tau Beta Pi, Phi Kappa Phi, and of the International Union of Radio Science (URSI) and he serves as an Associate Editor for several IEEE journals. Finally, he has recently received a 2M euros grant of the European Research Council (ERC) which will support his investigations for the next five years.