

ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

DET - Advanced computational schemes for high-resolution brain imaging applications within standard and multifrequency settings

Funded By	Dipartimento DET
Supervisor	ANDRIULLI FRANCESCO PAOLO - francesco.andriulli@polito.it
Contact	
Context of the research activity	<p>This PhD project focuses on the development and application of advanced computational electromagnetics (CEM) techniques, specifically based on integral equation formulations, to enhance the accuracy and resolution of Electroencephalography (EEG) imaging systems - where traditional EEG techniques suffer from limited spatial resolution due to the resistive properties of the skull.</p>
Objectives	<p>The research will leverage integral equation methods to accurately model the electromagnetic interactions between the brain, skull, and scalp, offering significant improvements over differential equation-based techniques by naturally incorporating boundary conditions and handling complex geometries with high fidelity. High-performance computing (HPC) techniques will be employed to address the computational complexity associated with large-scale simulations, ensuring efficient and scalable solutions.</p> <p>Through the development of advanced numerical solvers and optimization techniques, this project aims to provide a robust framework for non-invasive brain imaging, achieving resolutions comparable to invasive methods such as Electrocorticography (ECoG) and StereoEEG. The outcomes of this research will contribute to the broader field of biomedical imaging and electromagnetic inverse problems, paving the way for improved diagnostic capabilities in neurological disorders.</p> <p>This project is conducted in collaboration with the CEREBRO project, which aims to revolutionize EEG imaging through innovative contrast media and microfluidic technologies. The integration of computational electromagnetics with these advancements will play a crucial role in achieving high-resolution, whole-brain imaging without invasive procedures.</p>
Skills and competencies for the development of	<p>A background in biomedical engineering is preferred. Past experience with biomedical imaging is a plus.</p>

