

# PhD in ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

## Research Title: MICROWAVE IMAGING SYSTEMS FOR MEDICAL APPLICATIONS

<b>Funded by</b>	Dipartimento di Elettronica e Telecomunicazioni (DET) Proff. F. Vipiana, M. Graziano, G. Vecchi
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<b>Contact</b>	<a href="http://www.det.polito.it/focus/research/activities/electromagnetism/microwave_imaging_systems_for_medical_applications">http://www.det.polito.it/focus/research/activities/electromagnetism/microwave_imaging_systems_for_medical_applications</a>
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<b>Context of the research activity</b>	<p>The exploitation of Microwave Imaging (MWI) for medical purposes is an emerging multidisciplinary research field, which is gaining an ever-increasing attention worldwide.</p> <p>MWI has been used extensively to image dielectric bodies due to the fact that microwave radiation can penetrate into many optically opaque mediums such as living systems. In particular MWI can be used to exploit the differences in dielectric properties of human tissues. The tissues are illuminated with low-power electromagnetic (EM) waves at microwave frequencies, radiated by a set of antennas surrounding the tissues. The resulting scattered EM waves are recorded by the same antennas and processed with suitable algorithms to translate them into an image, which allows to locate targets and/or distinguish tissues (based on their estimated dielectric properties).</p> <p>Historically, the main medical application of MWI has been breast cancer diagnostics, which has indeed reached a good level of development and is now undergoing clinical trials in Europe and in the US. The potential exhibited by MWI (namely, low cost, portability, non-invasiveness) and the interest it gained in breast cancer diagnostics have stimulated research activities on other diagnostic applications.</p>
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<b>Objectives</b>	<p>The main objective of this PhD grant is to investigate novel medical applications of the microwave imaging technique.</p> <p>The research activity will start with the use of MWI to image the human brain tissues in order to be able to identify the presence of a haemorrhagic and ischemic strokes or tumour masses. The technology will be implemented also to measure the brain volume variations that, related to patient's age, are an indicator of neurological diseases such as Alzheimer's disease.</p> <p>The PhD student will be involved in the development and prototyping of the microwave imaging system. The research activities will include electromagnetic 3-D modelling, antenna design and prototyping, and the development and experimental testing of microwave imaging reconstruction algorithms. The microwave imaging system will be constituted of the antenna array, a proper switching matrix and all the radiofrequency (RF) front-end electronics. Finally, an extensive experimental testing of the prototypal system via anthropomorphic head phantoms realized with 3-D printed technology is planned.</p>
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<b>Skills and competencies for the development of the activity</b>	<ul style="list-style-type: none"> <li>- Basic knowledge of electromagnetic fields and antennas</li> <li>- Good knowledge of image processing techniques</li> <li>- Good programming skills (C, C++, Matlab)</li> </ul>
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