PhD Offer - Wearable conformal arrays on flexible substrates for real-time obstacle detection

Supervisors: G. Sacco (IETR CNRS UMR 6164) and D. Nikolayev (IETR CNRS UMR 6164)
Keywords: wearable radar, conformal antennas, reconfigurable array, real-time obstacle detection.

Context: The portability and reliability of electronic travel aids (ETA) have been and remain a fundamentally new and interdisciplinary challenge to tackle. ETA should be at the same time minimally invasive, lightweight and should help visually impaired people both to navigate in the environment and interact with the surrounding objects/elements. However, conventional ETA solutions require to carry one or multiple cumbersome and sometimes heavy objects (engineered glasses, smart white canes, etc.). Therefore, to solve the portability issue, it would be necessary to replace the actual generation of rigid bulky sensors by wearable and flexible devices integrated with clothes or fixed on any arbitrary object. Radars, in contrast to other technologies, are a well-established technique that allows to distinguish target position and velocity and even provide a 3D image of the environment in real time, do not affect the user privacy, and do not depend on external light conditions.

Objective addressed: This PhD project will build on our group's ongoing research into wearable radars. With this thesis, we aim to advance this research form two complementary viewpoints.

1. Investigate low-power, conformable antenna arrays that can be seamlessly integrated into the user's clothing (Fig. 1). This approach will enable 3D environmental scanning, enhancing the wearer's situational awareness.
2. Develop real-time reconstruction algorithms for portable devices, that address the challenges arising from the user's movements.

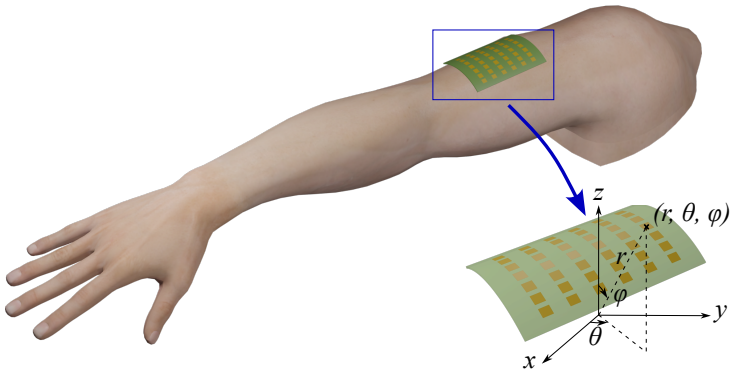

Figure 1: Example of a wearable conformal antenna array.

The PhD student will be expected to tackle the problem through a comprehensive approach, incorporating theoretical, numerical, and experimental techniques. Upon completion of this PhD project, we anticipate significant innovation potential, including the development of a functional prototype.

Candidate

- Education: MS or equivalent degree in biomedical engineering, electrical engineering, or physics.
- Background: knowledge in electronics, signal processing, bioelectromagnetics, numerical modelling. Experience with commercial or open-source numerical solvers (e.g., CST, Ansys, SIM4LIFE, COMSOL Multiphysics) and programming skills (e.g., MATLAB, Mathematica) are welcome but not mandatory.
- Fluency in English: the candidate should be conversant and articulate in English and must have strong writing skills. Knowledge of French is not required but would be appreciated.

Research environment: The PhD student will join Electromagnetic Waves in Complex Media Team (eWAVES) of the IETR/CNRS. IETR is one of the leading EU research laboratories in electronics, wireless communications, and digital technologies. Our research activities in biomedical electromagnetics cover a wide spectrum of fundamental and applied research spreading from multi-physics and multi-scale modelling to biomedical radars, and advanced

Université de Rennes 1, Campus de Beaulieu, Bât. 11D, 35042 Rennes cedex, France
Tél : +33 (0)2 23 23 58 49 giulia.sacco@univ-rennes.fr https://www.ietr.fr/ https://www.giuliasacco.eu/

technologies for body-centric wireless communications. The team was at the origin of pioneering innovations in biomedical electromagnetics, including the first millimeter-wave (mmWave) tissue-equivalent phantoms, novel reflectivity based surface phantom concept, new broadband multi-physics characterization technique for Debye-type materials, innovative mmWave textile antennas for smart clothing, ultra-robust miniature implantable UHF antennas, first mmWave reverberation chamber.

Duration: 36 months

Funding: Full 3 years scholarship provided.

Application deadline: May 15, 2025

Starting date: October 01, 2025

How to apply: please provide your CV, transcripts, motivation letter, and reference letters (optional) to:

- Giulia SACCO, CNRS (giulia.sacco@cnrs.fr)
- Denys NIKOLAYEV, CNRS (denys.nikolayev@cnrs.fr)

Relevant references:

[1] M. Mercuri, G. Sacco, R. Hornung, *et al.*, "Enhanced technique for accurate localization and life-sign detection of human subjects using beam-steering radar architectures," *IEEE Transactions on Biomedical Engineering*, pp. 1–13, 2024, ISSN: 0018-9294, 1558-2531. DOI: 10.1109/TBME.2024.3463199.

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