Cutaneous Wireless Haptic Interfaces Based on Unconventional Flexible Materials

PhD Position

Summary

Wearable smart electronic devices offer compelling biomonitoring capabilities: they can detect, analyze, and transmit information concerning vital signs and ambient data as well as provide immediate biofeedback to the wearer. The qualified candidate will work towards improving the physical-layer wireless performances of cutaneous (i.e. on-skin) haptic interfaces. This interdisciplinary PhD project builds on synergies between the IETR laboratory of CNRS and the IRISA laboratory of Inria / CNRS (RAINBOW team). Research at IETR focuses on complex radiating systems, metasurfaces, and bioelectromagnetics. Research at IRISA covers the fields from computer and network architecture to artificial intelligence, including software engineering, distributed systems, and virtual reality.

Background and Mission

Haptic feedback for wearables is receiving growing attention in consumer electronics, wireless biotelemetry, and virtual reality applications but still suffer from many limiting factors, among which are: (1) limited wearability (bulky and heavy actuators, uncomfortable straps, cumbersome wiring for signal and power transfer); (2) poor perceptual transparency (a user feels the haptic devices and actuator as much or even more than the stimulus to be delivered). Developing wireless solutions for signal (and even power) transmission could significantly improve wearability and transparency of wearable haptic interfaces.

The PhD student will work towards the development of a fully wireless, miniature haptic unit, which can be worn on multiple parts of the body in a highly comfortable and wearable manner. Such device could be realized as, for instance, a flexible adhesive patch that contains sensing (pressure, temperature, sweat composition, etc.), actuation (e.g., a vibrotactile motor or a skin stretch tactor), and communication units. Many of required technological advancement is already in place thanks to advances in a variety of disciplines. However, efficient and flexible radiating structures for data and power transfer remain an open challenge. To address this challenge, the successful candidate will have access to the unique interdisciplinary know-how of IETR in the field of complex radiating structures and bioelectromagnetics as well as the IRISA experience in haptics and wearable interfaces. Last generation of high-performance workstations with GPU accelerators and advanced numerical solvers will be used to handle computationally large multi-scale and multi-physical problems. State-of-the-art manufacturing and measurement facilities will help with the experimental characterization of the prototypes.

Main Duties Include

— Conduct a systematic review and develop original research ideas in the field of adaptive wireless powering of miniature implantable bioelectronics.
— Publish sections of the work in high-profile journals, attend and present key results at conferences.
— Become an active member of the professional community, national and international.
Required Skills

We seek highly engaged and motivated candidates with an M.Sc. (or equivalent) degree in electromagnetics, electrical engineering, electronics, computational science, applied mathematics or physics.

— Strong background in antennas and microwave engineering.
— Knowledge of numerical modeling and experience with commercial or open-source numerical solvers (e.g. COMSOL, CST, Ansys); programming skills (Python or MATLAB).
— 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.
— Good communication skills are important.

Advantages

The qualified candidate will be part of a dynamic multidisciplinary team in a highly collaborative and stimulating environment. He/she will have access to state-of-the-art laboratories, high-performance computing facilities and receive a competitive salary.

In addition:

— Possibility of subsidized housing (student residencies) and meals in university restaurants,
— Partial reimbursement of public transport costs,
— Approx. 7 weeks of annual leave + possibility of exceptional leave (moving home, etc.),
— Social, cultural and sports events and activities,
— Social security coverage.

Funding: Full scholarship provided by the University of Rennes 1. Possibility of funded international mobility (if eligible; require a separate application).

Duration: 36 months, expected starting date is Oct. 2020.

Location: Rennes, France. Laboratories IETR CNRS (75%) and IRISA (25%).

How to Apply

Please send your applications to:
Dr. Denys Nikolayev (denys.nikolayev@univ-rennes1.fr),
Dr. Claudio Pacchierotti (claudio.pacchierotti@irisa.fr),
Dr. Maxim Zhadobov (maxim.zhadobov@univ-rennes1.fr).

Each application should consist of (PDF format would be appreciated):

— a CV [incl. the contact details of academic references (mail, address, position)],
— a motivation letter,
— a copy of the student’s university transcripts (with ranking, if available).

In the motivation letter, the applicant is encouraged to include the following details:

— An explanation of interest in the research we conduct and why he/she believes he/she is suitable for the position,
— Details of undergraduate and MSc projects,
— Details of any relevant courses previously taken (if applicable),
— Details of any relevant work experience (if applicable).