



Near-Field Sensing with Antennas for Ingestible Biotelemetry Capsules

Postdoctoral Research Fellowship

Context

This interdisciplinary and intersectoral research project builds on the collaboration between the IETR laboratory of [CNRS](#) and the [BodyCAP](#) company. Our group at IETR interfaces fundamental, computational, and experimental approaches to elucidate the interaction of electromagnetic fields and biological media, to quantify it, and to develop novel biomedical applications. BodyCAP company develops miniaturized wireless physiological monitoring solutions for the healthcare, research, and high-performance sport.



BodyCAP e-Celsius®
ingestible biotelemetry capsule

Background and Mission

Emerging in-body biosensors offer powerful capabilities for medicine, clinical research, and basic science. Apart from direct application in ingestible and implantable biotelemetry (pH, T°, glucose sensors, wireless endoscopes, etc.), they are also useful for neural interfaces and electroceuticals. The sensing capabilities of in-body devices are severely limited by miniaturization and power-budget constraints. This postdoctoral project proposes to study the application of miniature antenna(s) of an in-body device for environment sensing *via* the near-field coupling with surrounding tissues.

The qualified candidate will further develop and contribute to testing of a wireless ingestible biotelemetry capsule with near-field sensing capabilities. He/she will focus on 1) studies of the near-field coupling with surrounding bio-tissues and optimization of in-body antennas for controlled sensitivity; 2) development, testing, and miniaturization of the associated RF measurement circuit; 3) contribution to the design, packaging, and testing of the final wireless system. To achieve these goals, the successful candidate will have access to unique interdisciplinary know-how of IETR in the field of complex radiating structures as well as to practical experience of BodyCAP in full-cycle development of wireless biotelemetry capsules. Last generation of high-performance workstations with GPU accelerators and advanced numerical solvers will be used to handle electromagnetic analysis and optimization. State-of-the-art manufacturing and measurement facilities will help with the prototyping and testing. The final wireless system will be characterized in tissue-equivalent models as well *in vivo* through established collaborations of IETR and BodyCAP. Finally, the successful candidate will be expected to present results of the work in high-profile journals and conferences.

References:

- [1] D. Nikolayev *et al.*, "Optimal radiation of body-implanted capsules," *Phys. Rev. Lett.* **122**(10), 2019.
- [2] D. Nikolayev, M. Zhadobov, and R. Sauleau, "Immune-to-detuning wireless in-body platform for versatile biotelemetry applications," *IEEE Trans. Biomed. Circuits Syst.* **13**(2), 2019.

Required Background

- Ph.D. (or equivalent) degree.
- Full competence in microwave and antenna engineering, miniaturized RF circuits and components; additional experience in signal processing would be a plus.
- Solid experience with numerical electromagnetic solvers (e.g., COMSOL, CST, HFSS), and with measurement equipment incl. its operating principles (VNA, TDR, etc.).
- 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.

Advantages

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

In addition:

- approx. 7 weeks of annual leave per year + possibility of exceptional leave (moving home, etc.),
- generous statutory benefits: the French national health coverage, unemployment allowances, retirement/pension funds, etc.,
- possibility of subsidized meals and partial reimbursement of public transport costs,
- location in one of the most attractive cities in France for professional and nonprofessional activities (entertainment and culture, sport, gastronomy, etc.). Train connections: 1:25 to Paris and 0:47 to a seaside.

Funding: Full postdoctoral fellowship provided by the [SATT Ouest Valorisation](#).

Duration: 18 months. Starting date: as soon as possible.

Location: IETR laboratory of **CNRS** (Rennes, Region of Brittany, France).
Regular visits to the BodyCAP company (Caen, Normandy, France) are planned.

How to Apply

Please send your applications to Dr. Denys Nikolayev (denys.nikolayev@univ-rennes1.fr).

Each application should consist of (PDF format):

- a CV (incl. publications),
- contact details of at least three professional references (mail, address, position),
- a motivation letter.

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,
- short description of graduate and PhD projects,
- details of any relevant work experience (if applicable).