



**Offer #2021-04075**

## **Post-Doctoral Research Visit F/M Viability of Simultaneous Information and Energy Transmission in Wireless Communications**

**Level of qualifications required :** PhD or equivalent

**Fonction :** Post-Doctoral Research Visit

### **About the research centre or Inria department**

The Inria Sophia Antipolis - Méditerranée center counts 34 research teams as well as 8 support departments. The center's staff (about 500 people including 320 Inria employees) is made up of scientists of different nationalities (250 foreigners of 50 nationalities), engineers, technicians and administrative staff. 1/3 of the staff are civil servants, the others are contractual agents. The majority of the center's research teams are located in Sophia Antipolis and Nice in the Alpes-Maritimes. Four teams are based in Montpellier and two teams are hosted in Bologna in Italy and Athens. The Center is a founding member of Université Côte d'Azur and partner of the I-site MUSE supported by the University of Montpellier.

### **Context**

This postdoctoral position is hosted at INRIA, Sophia Antipolis, in the framework of the study of the viability of simultaneous information and energy transmission in future developments of 5G and 6G telecommunications systems. It develops within a close collaboration between Inria and the main actors of the telecommunications scene in France.

### **Assignment**

Radio frequency signals can be used to simultaneously transmit both information and energy, as proved by Nikola Tesla through numerous experiments. Nonetheless, a century later, the exploitation of these phenomena has not yet seen massive commercial use. With the deployment of 5G communications systems and the development of their next generation, simultaneous information and energy transmission (SIET) has gained attention as a feature that might be embraced by the telecommunications industry and thus, be implemented in a near future. This postdoc aims to contribute in this direction and provide scientific support to the decision faced by telecommunications operators and manufacturers on how to efficiently implement SIET.

The postdoc is expected to extend existing results on the fundamental limits of SIET in canonical channels under tractable mathematical constraints [1-4] to more realistic scenarios considering finite constellations, and impairments typical of cellular communications. The objective is to provide solid arguments to telecommunications operators and manufacturers on the viability of the implementation of SIET and generate recommendations for the next generation of cellular systems.

[1] Selma Belhadj Amor, Samir M. Perlaza, Ioannis Krikidis and H. Vincent Poor. "Feedback Enhances Simultaneous Information and Energy Transmission in Multiple Access Channels", IEEE Transactions on Information Theory, vol. 63, no. 8, pp. 5244–5265, Aug 2017.

[2] N. Khalfet and S.M. Perlaza, "Simultaneous information and energy transmission in the two-user Gaussian interference channel," IEEE Journal on Selected Areas in Communications, vol. 37, no. 1, pp. 156 – 170, Jan. 2019.

[3] Sadaf ul Zuhra, Samir M. Perlaza, and Eitan Altman, "Simultaneous Information and Energy Transmission with Finite Constellations", in Proc. of the IEEE Information Theory Workshop (ITW), Kanazawa, Japan, Oct., 2021.

[4] Nizar Khalfet, Ali Tajer, and H. Vincent Poor. "On Ultra-Reliable and Low Latency Simultaneous Information and Energy Transmission Systems", Research Report, INRIA, No. RR-9261, Lyon, France, May, 2019.

### **Main activities**

The analysis of simultaneous information and energy transmission (SIET) in the context of multiple information transmitters is a difficult problem. The difficulty is in part due to the fact that transmitters must coordinate their transmission scheme and cooperate to achieve the dual goal of SIET. Often, such

coordination is not possible due to the lack of signalling among all the interacting devices. This analysis calls for the use of mathematical tools from information theory, communication theory, and game theory.

The scenario of interest is that in which a large number of information transmitters, e.g., base stations and mobile devices, are concentrated within a given area, e.g., sport facilities. Within this context, the objective is to study the viability of SIET as an alternative energy source for low-energy consumption devices such as sensors, drones, or information displays for which batteries or alternative energy sources are not physically feasible. The expected results are sufficient conditions for jointly achieving targetted values of information transmission rate, energy transmission rates, decoding error probabilities and energy outage probabilities as a function of the number of transmitting devices, average transmit power and parameters of the channel models.

## Skills

Candidates are expected to have a PhD degree in mathematics, electrical engineering, telecommunications or areas related to communication theory, information theory or game theory. Previous knowledge on information theory, and game theory is desirable. The candidate must have a provable level of written and spoken english. Skills in french language are not required.

## Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

## Remuneration

Gross Salary: 2653 € per month

## General Information

- **Theme/Domain** : Networks and Telecommunications  
System & Networks (BAP E)
- **Town/city** : Sophia Antipolis
- **Inria Center** : [Centre Inria d'Université Côte d'Azur](#)
- **Starting date** : 2022-01-01
- **Duration of contract** : 12 months
- **Deadline to apply** : 2021-10-31

## Contacts

- **Inria Team** : [NEO](#)
- **Recruiter** :  
Medina Perlaza Samir / [samir.perlaza@inria.fr](mailto:samir.perlaza@inria.fr)

## About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

**Warning** : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

## Instruction to apply

### Defence Security :

This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating

to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

**Recruitment Policy :**

As part of its diversity policy, all Inria positions are accessible to people with disabilities.