

**Open PhD Position - Oct. 2025, CEA-Leti (Grenoble, France)**

## **Multipath-aided Cooperative Simultaneous Localization & Mapping through Machine Learning**

**Goals :**

The main goal of this PhD is to explore the potential of machine learning (ML) tools for simultaneous localization and mapping (SLAM) applications, while leveraging multipath radio signals between cooperative wireless devices. The idea is to identify characteristic features of the propagation channels observed over multiple radio links, so as to jointly determine the relative positions of the mobile radio devices, as well as those of scattering objects present in their vicinity. Such radio features typically rely on the arrival times of multipath echos of the transmitted signals. The envisaged approach is expected to benefit from multipath correlation as the radio devices are moving, as well as from spatial diversity and information redundancy through multi-device cooperation.

**Expected work :**

The PhD work will be organized as follows. First, we will investigate the fundamental limits of the cooperative multipath-based radio SLAM problem, in terms of observability/feasibility (vs. monostatic radar-like approaches), through the study of both theoretical performance bounds and realistic multipath channel simulations. Then, we will analyze the candidate radio features that may be used as inputs to feed the ML tools (along with related data formatting/conditioning issues). Subsequently, the SLAM estimation problem itself will be tackled, following a gradually complexified approach (initial cooperative positioning of mobile nodes, extraction of instantaneous multipath channel features per link, positioning of passive objects/scatterers leveraging cooperative links over time, refinement of all estimated positions...). On this occasion, a variety of neural network families may be considered (among e.g., physics-informed, auto-encoders reducing the problem dimensionality, memory-based to leverage mobility, image processing oriented, incl. possibly generative approaches...) and compared with more conventional estimation approaches (e.g., cooperative tracking filters). Finally, other key « peripheral » algorithms and processing tasks inherent to the cooperative SLAM context will also have to be designed around the core neural network engine (regarding e.g., data association and data fusion). The developed solutions will be validated and evaluated based on real measurements, which will be collected with integrated Ultra Wideband devices in a reference indoor environment (incl. a controlled mobile convoyer), and simulated data, which will be generated by means of a Ray-Tracing tool.

**Working environment and supervision scheme :**

This PhD will be conducted under the co-supervision of Pr. Veronica Belmega (ESIEE – Univ. Gustave Eiffel, Paris, France & LIGM laboratory, Marne-la-Vallée, France), Christophe Villien (CEA-Leti, Grenoble, France), and Benoît Denis (CEA-Leti, Grenoble, France), at the Department of Wireless Technologies, which belongs to the Systems Division of CEA-Leti. The latter environment offers a stimulating, international, and multi-disciplinary working environment, at the crossroads between academic and industrial R&D communities, combining exploratory research and applied developments.

<https://www.leti-cea.fr/cea-tech/leti/Pages/recherche-appliquee/solutions-technologiques/communication-sans-fil-reseaux.aspx>

**Salary :**

2406 euros / month (gross)

**Profile of candidates :**

MSc (or equivalent program at Bac+5 from) in signal processing and/or applied maths for wireless communication networks, telecoms, radio systems/technologies... with good knowledge in machine learning.

**Impact of conducted research :**

This research is intended to cover group navigation applications in complex, dangerous, and/or unknown environments, where autonomous localization and sensing capabilities are needed (e.g., collision avoidance and path planning of robots in crowded factories and plants, ad hoc deployment of firefighters or first responders in confined emergency areas...).

**Required application material :**

CV, Official transcripts from the 2 last academic year(s), Recommendation letter(s) (or contact(s) for reference).

**Contacts for sending applications (uniquely by e-mail) :**

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