Experimental validation and optimization of 5G mmWave localization algorithms

Unité (Direction/Département/Service)	**DRT/DSYS/STSF**
Description de l'Unité	CEA-Leti, the Laboratory for Electronics & Information Technology is operated by Direction de la Recherche Technologique at CEA. It mainly aims at helping companies to increase their competitiveness through technological innovation and transfer of its technical know-how to industry. Major player in the MINATEC Micro-Nano technologies innovation center, CEA-Leti benefits from 8000 m2 state-of-the-art clean rooms, with equipments worth some 160 million euros. It is currently employing about 1600 people among whom CEA employees co-workers of various status including 100 people from industrial partners. CEA has a very important patents portfolio, and filed about 200 patents and 700 publications per year. The six divisions of CEA-Leti cover activities from the fields of silicon technology platform, microelectronics, microsystems, optronics, wireless technologies, and technologies for bio and health. The Lab for Smart Connected Objects (LCOI), which belongs to the System Integration Division (DSYS), has been carrying out research activities in more specific domains related to the Internet of Things, Wireless Sensor Networks, Cooperative - Intelligent Transport Systems and wireless localization (both radio-based and fusion-based). Related know-how and expertise include cross-layer protocols design (ex. radio physical layer, medium access control and networking), algorithmic studies and simulation-based validations, as well as proof-of-concept HW/SW platforms realization...
Domaine	Signal Processing, Wireless Technologies
Type de contrat	**Internship**
Sujet de stage (150 caractères)	**Experimental validation and optimization of 5G mmWave localization algorithms**
Durée du contrat	**6 months**
Description de l'offre (3000 caractères)	Wireless localization has been identified as a key intrinsic feature of future 5G communications in the millimeter wave domain above 25GHz (mmWave). While operating in these frequency bands, highly directional antenna systems are used so as to achieve better transmission ranges. The location information is thus helpful to ease radio access with respect to local base stations (e.g., by enabling faster or adaptive location-based beam selection and beam alignment) or even to dynamically track multiple mobile users. Besides contributing to optimize wireless communications, the localization functionality is also of the highest importance for specific applications explicitly claimed by 5G, such as autonomous driving. In this context, advanced estimation algorithms have been developed for the last past months, aiming at retrieving relevant location-dependent radio parameters, such as signal's Angle of Arrival / Angle of Departure / Delay, etc..., over both uplinks and downlinks. Ultimately, these variables can be used to infer the positions and the orientations of mobile users with respect to their local serving base stations. Other recent research contributions also aim at optimizing Beam Forming and resources allocation on the transmitter side for the sake of improving localization performances, while minimizing the footprint onto data communications (in terms of data rate, latency, coverage, etc.). However, most of these contributions still make quite optimistic assumptions regarding propagation channel and/or hardware limitations/impairments. In the frame of the proposed internship, we aim at an experimental proof-of-concept of these mmWave localization functionalities, relying on real antenna systems developed at CEA-Leti at 26GHz, as well as on a dedicated channel sounder. The corresponding work plan can be split into the following tasks: - Bibliographical studies (e.g., mmWave technology, wireless localization, estimation theory…); - Adaptation and simulation-based validations of existing single-link channel estimation algorithms, while accounting for realistic propagation/hardware impairments (Matlab); - Participation to the specification and realization of a localization-oriented measurement campaign in controlled scenarios, based on a real integrated mmWave antenna system and a suitable channel sounder ; - Final offline validations of the adapted localization algorithms based on the previous experimental data (Matlab). This work will be conducted in parallel of PhD investigations currently carried out in the hosting lab on a related research topic.
Moyens / Méthodes / Logiciels	Matlab Simulations, Integrated antenna systems, Channel sounder
Profil du candidat (3000 caractères)	*Solid knowledge of generic signal processing techniques and tools (e.g., estimation theory, filtering, compressed sensing, MIMO processing...); *Knowledge of wireless communications (e.g., technologies/standards, modulation/demodulation techniques, channel modeling...); *Experience in experimental channel sounding highly appreciated; *Experience in radio mmWave technology highly appreciated;
Site	**Grenoble**
Lieu	**17, avenue des Martyrs, 38054 Grenoble Cedex 9**
Possibilité de poursuite en thèse	**Yes**
Diplôme préparé	**MSc, Master 2 Research, Engineer**
Langue 1	**Anglais** — **Niveau** **Courant**
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Encadrant du stage	**Benoît Denis**