**Proposition de recherche doctorale**

**Fully integrated Application Driven Millimeter Wave Systems**

**Mots clés :**
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- Unité de recherche : Laboratoire d’électronique et d’électromagnétisme
- Ecole doctorale : École Doctorale Informatique, Télécommunications, Électronique de Paris
- Domaine scientifique principal: Divers

**Résumé du projet de recherche (Langue 1)**

Efforts in increasing MMIC levels of integration are still being provided in many application sectors involving imaging, smart sensors for IoT, high resolution automotive radar, connected radar and more recently indoor positioning. Moreover (Technology Computer Aided Design) TCAD-based roadmap indicates clearly the capability of CMOS and BiCMOS technology in continuing push to higher frequencies toward millimeter wave spectrum and THz gap. These two trends encourage the investigation of the emerging topic of fully integrated application driven systems using some already existing microwave and mm-wave building blocks. Current microwave systems are often developed using on the shelves devices, which limit portability and very-large-scale integration (and consequently increasing cost). Innovative microwave instruments should hence be developed in a fully integrated approach aiming Monolithic Microwave Integrated Circuit (MMIC). The main challenges in this fully integrated approach, is to achieve simultaneously low-cost and low-power solutions without performance degradation. We propose in this research project to target two main applications that have in common many RF and mm-Wave building blocks forming a Tx/Rx module, and to design the core architecture meeting the specific requirements in terms of power consumption, configurability, bandwidth, noise figure…. The first application is sensitive to reflected waves while the second explores transmitting properties of the sounded media or channel. a) First application: Microwave Near-Field Scanning Imaging techniques remain a central topic for numerous medical, scientific, civil and military applications. They benefit from advanced big data, 3D solutions and fusion algorithms to provide very accurate real time information needed for example for medical diagnosis or serious game approaches. To explore in depth some given scenes, microwave imaging is appealed to play a key role and particularly near-field scanning microwave instrumentation has been investigated following different philosophies and using a variety of probes. Among these techniques, from microwave to millimeter-wave (mmW), instrumentation has been explored to measure distinct properties reflective devices. b) Second application: Microwave Positioning in the context of 5G In wireless local and personal area networks, the spectrum congestion, the low energy efficiency communications and the insufficient exploitation of the spatial resources are among the factors that may slow down its development. To overcome these forthcoming restrictions, wireless localization technology, as the mechanism for discovering relationship between connected objects, appears as one of the key solutions. This is because dedicated localization techniques in wireless communication can help in developing more extensively the exploitation of spatial resources and allow driving optimized routing for low energy multi hops communication and spectrum decongestion for Green ICT (Information and Communication Technology). To really be ubiquitous, positioning systems need to be embedded in various connected objects, even the smallest ones. This requires a specific attention regarding the size of proposed solutions and hence to benefit from the trend of increasing MMIC levels of integration. To address these needs and to be 5G compliant, this project will develop a strategy that takes benefit from miniaturization technology in order to propose an original fully integrated application based architectures in the millimeter wave spectrum. This positioning device is (Time Difference of Arrival) TDOA based solution [5] and this information is contained in the transmitting properties of the communication channel. These two applications have a common core circuit that is needed to be designed. By wisely combining passive components including antennas, splitters, combiner; and actives components including transistors, diodes, switches, active loads, one can design a kernel circuit including for the transmitting part, power amplifier, a digital to radio frequency converter (DRFC), a digital-controlled oscillator (DCO), and for the receiving part a wideband low-noise amplifier (WLNA), a track-and-hold amplifier (THA), and radio frequency to digital converter (RFDC). This core circuit should be able to allow access to both reflected and transmitted waves.

**Résumé du projet de recherche (Langue 2)**

Conception pilotée par l'application de nouvelles architectures BiCMOS opérant en bande millimétrique. Allier performances et faible coût.

**Informations complémentaires (Langue 2)**

Ce travail de thèse sera co-encadré par Pietro Maris Ferreira du laboratoire GeePs