Université Lille Nord de France

Ecole doctorale régionale Sciences Pour l'Ingénieur Lille Nord-de-France - 072

Titre Thèse	Massive MIMO radio channel investigations for V2X Communications	
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Résumé du sujet :

To meet the increased throughput, robustness, and reduced latency demanded by the fifth generation of wireless mobile communications (5G), drastic improvements need to be made in the cellular network architecture. Among all use-cases defined in 5G, the envisioned intelligent transportation system (ITS) brought by vehicular communications will improve the safety and efficiency of the transportation by enabling a wide range of applications. Through the integration of information and communication technologies, all road users can gather sensor data and share information about traffic and road state dynamics with each other and with the road infrastructure. Such systems require reliable low-latency vehicular-to-vehicular (V2V) and vehicular-to-infrastructure (V2I) communication links that provide robust connectivity at a fair data rate. One of the main challenges that strongly differ from cellular scenarios is the rapidly time-varying radio propagation channel which must be carefully investigated and understood.

To take up these specific challenges, new technologies are being developed for 5G including the non orthogonal multiple access scheme (NOMA) and the use of massive multiple-input multiple output (MIMO) at the transmitter side with beamsteering. However, in order to take advantage of these two promising technologies, the propagation channel between antenna elements at the transmitter side and the receiver needs to be characterized. This response is generally referred to as channel state information (CSI). In practice, the system does not have access to the true CSI, but to an estimated version, and the quality of this estimated CSI is of paramount importance to fully exploit the benefits of the emerging NOMA and massive MIMO. Hence, an essential requirement for the use of these technologies is the accurate modeling of the propagation channel in different environments and mobility scenarios from which the performance of the vehicular communication can be realistically tested.

To this end, the IEMN Telice research group has developed a unique and flexible MIMO radio channel sounder in collaboration with the UGent Waves research group (Belgium). The FPGA-based architecture provides real-time measurements of the wireless radio channel and allows for testing some of the proposed original 5G access schemes. Furthermore, it will be upgraded into a massive MIMO system for testing V2X communications at 6 GHz.

This PhD thesis aims at experimentally and theoretically investigating the statistical time-variant properties of the V2X massive MIMO radio channel at 6 GHz. The considered massive MIMO architecture will have a number of radio-frequency chains lower than the actual number of antennas and falls under the umbrella of hybrid analog/digital systems. Therefore, developing original antenna selection strategies to minimize the number of active antennas while estimating the CSI over the whole array with enough accuracy is a requisite to improve the spectral efficiency while reducing the emitted power.