Université Lille Nord de France
Pôle de Recherche et d'Enseignement Supérieur

Ecole doctorale régionale Sciences Pour l'Ingénieur
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Titre Thèse	Intelligent communication for vehicular communications	
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Résumé du sujet :

Nowadays, Intelligent transport systems (ITS) receive great awareness and attention in order to move forward towards the development of smart cities and to improve traffic. The ITS vision is that each vehicle on the roadway will be able to communicate with other vehicles (V2V for vehicle-to-vehicle communications) together with infrastructure (V2I for Vehicle-to-Infrastructure). In this regard, the advent of 5G or fifth-generation mobile communications is a great opportunity to push forward ITS. The future ITS system could benefit from key enabling technologies of 5G such as the non-orthogonal multiple access scheme (NOMA) and the use of massive multiple-input multiple output (massive MIMO) at the transmitter side with beamsteering and/or beamforming. NOMA is an access technique which consists in multiplexing multiple users in the power domain. NOMA was recently introduced as a new wireless medium access solution because the current methods (FDMA, TDMA, CDMA, OFDMA …) are unable to satisfy all the future system specifications and requirements. Massive MIMO is also a cutting-edge technology capable of meeting the 5G requirements. It consists in the use of a large excess of service antennas over active terminals. Extra antennas help focusing energy into ever smaller regions of space to bring huge improvements in throughput and radiated energy efficiency.

However, these promising technologies could be fully exploited only if the propagation channel between the transmitter and receiver side is accurately estimated from one side and the resource allocation (e.g. in terms of antenna selection) is dynamically performed through adaptive learning approaches. The channel estimation is generally referred to as channel state information (CSI). Consequently, 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, called MIMOSA, in collaboration with the UGent Waves research group (Belgium), capable of characterizing the channel under high mobility scenarios and a massive number of antennas. In order to make the system as much reactive as possible, the parameters characterizing the channel model and the realistic scenarios will be integrated in learning approaches that will adapt the system configuration to better response to the external environment conditions.

This PhD thesis in cotutelle between ULille (IEMN lab - INRIA) and UGent (INTEC lab) aims at experimentally and theoretically investigating the statistical time-variant properties of the V2X massive MIMO radio channel at 6 GHz (frequency of the future ITS system) based on channel measurements with MIMOSA sounder and integrate these properties for a dynamic changing of the system configuration in order to optimize the performance of the vehicular system. The PhD student with a profile in wireless communications and signal processing will spend 6 months in UGent to perform additional measurements and work on optimized resource allocation strategies. The project is organized as follows:

- WP1 5G literature review
- WP2 learning algorithms and antenna selection for 5G-channel sounding
- WP3 measurement campaigns and analysis


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