Université Lille Nord de France

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

Titre Thèse	Artificial Intelligence based approach for optimized 5G massive antenna array allocation strategies	
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Summary of the project:

Context

Some 5G base-stations (or gNB) which will be located in dense urban areas will be supporting downlink throughput on the order of Gb/s. One of the considered technological solution is to equip them with massive antenna arrays (with at least 64 antennas), now called massive MIMO array; MIMO meaning Multiple Input Multiple Output. As an example, thanks to such massive arrays placed at the transmitter side (multiple input), the base station can simultaneously send information to different users in the cell within the same frequency-time resource bin (multiple output) using simple linear precoding.

Bottlenecks:

The technical and scientific issues that are being encountered with this technology are numerous and must be tackled before any operational deployment by the operators. From the energetic point of view, simultaneously feeding a large set of RF chains even with a reduced power with respect to conventional MIMO arrays is not appealing. On this topic, the results reported in F. Challita's PhD thesis have shown that it is possible to reach the near-optimal massive MIMO capacity (using all antennas) by carefully selecting only a few antennas. The selection criterion is based on the channel propagation characteristics. Nonetheless, knowledge of the perfect channel state information (CSI) is a critical aspect when FDD (Frequency Division Duplex) is used with massive MIMO. Indeed, the number of allocated resources to estimate the radio channel is so large that it severely decreases the overall capacity and increases the latency due to protocol overhead. The objectives of the proposed PhD thesis is to develop an original radio channel estimation framework using machine learning, and more generally, artificial intelligence approaches to reduce the allocated resources to estimate the radio channel.

The outcome of this project is essential driven by the large number of 5G use-case applications such as, for example, massive IoT connectivity for industry 4.0, vehicle to infrastructure (V2I) communications for autonomous vehicles in tunnels or even massive connectivity in dense urban areas. The outline of the PhD thesis is the following:

a) A bibliographic study on the state of the art on propagation models (or others) based on learning algorithms and dataset creation.
b) An experimental section in which the student will participate to a large massive MIMO measurement campaign in different scenarios (traffic influence, mobility, time of the year, etc.)
c) Construction of a realistic database to train the training algorithms.
d) From generic propagation models available in the literature and training algorithms tools, the objective.
e) Validation of the model by comparing the performance the massive MIMO communication chain estimated either from the model or the measured data.

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The PhD candidate will work in the TELICE research group at IEMN. A massive MIMO radio channel sounder will be available at the beginning of the thesis.