TITRE DE LA THESE:
Integration of Reconfigurable Intelligent Surfaces and Machine Learning towards Future 6G Networks

Direction de thèse : Samir SAOUDI

Co-encadrants :
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Laboratoire(s) : Lab-STICC

Equipe(s) de recherche : COSYDE

Département(s) IMT Atlantique : MEE

S'agit-il d'une thèse en cotutelle internationale ?
Oui

Si oui, organisme avec lequel la cotutelle est envisagée :
Carleton University, Canada

Le sujet proposé présente-il un caractère interdisciplinaire ?
Oui

Si oui, expliquer brièvement pourquoi (2 ou 3 lignes) :
Le sujet proposé est à l'intersection entre plusieurs domaines : la théorie des communications sans fil (wireless communications), le machine learning comme branche de l'informatique et composante principale de l'intelligence artificielle, et les systèmes hardware embarqués.

La source du co-financement est-elle identifiée ?
Oui

Si oui, préciser quel co-financement est envisagé :
Carleton University

Autres informations :
Informations utiles que vous souhaiteriez communiquer (si pertinent) :

Contexte ou état de l'art scientifique :
Décrire en 5 à 10 lignes le contexte de la thèse.

In the context of wireless communications evolution towards future 6G networks, the concept of smart radio environments, based on reconfigurable intelligent surfaces (RIS), has been gaining a lot of traction. The idea of being able to change the propagation environment is not only conceptually interesting but also highly beneficial in a variety of scenarios. However, the development of RIS for applications in wireless communications is at its first stages, and many practical aspects still need to be thoroughly investigated. The goal is to evaluate the potential implementation approaches, and practically investigate the modeling and optimization of RIS-assisted communications. As this multi-objective optimization will have to be performed given limited information about the channel; the adoption of tools from the machine learning field is an attractive option that is being advocated and demonstrated currently.

Objectifs de la thèse :
Décrire en 10 à 15 lignes les résultats attendus.

The thesis work will bring together elements from the wireless communications theory, propagation understanding, artificial intelligence and machine learning, with the use of collected and/or available real world data. From the communications stand point, and after a state-of-the-art review of the existing methodologies and implementation approaches of RIS (reflectarrays, dynamically tunable metasurfaces, …), a strategic decision on the adopted choice will be the first outcome. Then, the first direction will be a comprehensive modeling of the RIS-assisted communication scheme, and the derivation of its analytical performance limits and metrics. The results will be assessed via software simulations. The second direction is the development of a simulated model of a realistic hardware platform (in collaboration with the other project partners), comparing its performance with the obtained analytical results, pinpointing the problems that were neglected/underestimated in the modeling stage, and going back to the optimization of the models. This cycle will be repeated to increase the comprehensiveness of the proposed models, defining the optimal complexity-performance trade-offs, and providing a demonstrative operational platform with its supporting functional understanding.

Compétences attendues du ou de la candidat·e :
Lister les principales compétences nécessaires pour ce sujet de thèse.

Strong background in mathematics and stochastic modeling
Strong background in wireless Communications
Experience with machine learning is a plus
Advanced level in English (especially in writing)

Remark:
We are in contact with candidates for an exchange and interview with our Canadian partner from Carleton University. The full application with the selected candidate will be sent before May 17th.