PhD: Sparse model-based learning for multi-antenna systems

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1 Context

The PhD student will be part of the MoBAIWL project (Model-Based frugal AI for efficient WireLess communication systems), which aims to design efficient data processing methods for wireless communication systems, using physical models to structure, initialize and train frugal learning methods.

In particular, multi-antenna systems will be considered. They may greatly enhance the spectral and energy efficiency of wireless network by focusing waves. However, in order to unleash their full potential, such systems require complex data processing that can be tackled using either signal processing or machine learning methods. In order to achieve a satisfying trade-off between these two approaches, *model-based learning* has been introduced recently and led to promising results in various fields of wireless systems.

2 Objectives

The main objective of this study is to combine sparse signal processing, physical propagation models and machine learning in the context of multi-antenna systems. To do so, the following leads are envisioned:

(O1) Identify the most appropriate sparse recovery algorithms for channel estimation in terms accuracy/complexity tradeoff. Make them adaptive to physical model imperfections by converting them to unfolded networks. Compare the obtained networks to generic architectures.

(O2) Take into account system constraints such as hybrid beamforming or hardware impairments within sparse models, evaluate their impact on the corresponding unfolded networks and compensate for them in an efficient manner.

(O3) Take advantage of the spatial resolution of multi-antenna systems to explore applications of the developed methods.

3 Logistics

The PhD will be supervesed by a multi-disciplinary team of experts comprising:

- Luc Le Magoarou(main supervisor)
- Philippe Mary (Director)
- Clément Elvira
- Cédric Herzet

The PhD student will be hosted in the SIGNAL team of the IETR (on the campus of INSA Rennes), for a duration of three years starting between September and November of 2024. Students in their final year (M2/PFE) with a background/interest in signal processing, machine learning and applied mathematics are encouraged to apply by sending an email to luc.le-magoarou@insa-rennes.fr.