Model-based deep learning for joint channel estimation and precoding in hybrid MIMO systems

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1 Context

The internship 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 future wireless communication systems (6G and beyond), using physical models to structure, initialize and train frugal artificial intelligence methods.

In particular, multi-antenna systems (hybrid massive MIMO) will be considered. They may greatly enhance the spectral and energy efficiency of wireless network by focusing precisely radiated 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 [1] and led to promising results in various fields of wireless systems [2–6].

Figure 1: Typical massive MIMO setting

2 Objectives

The main objectives of the internship are the following:

(O1) Designing a model-based learning strategy in order to jointly estimate the channel and choose an appropriate precoder in an hybrid MIMO system.

(O2) Comparing the developed method to existing purely data-driven approaches [7].

(O3) *(Optional)* Adapting the method to exhibit robustness to the most common hardware impairments [8, 9].

One interesting lead for **(O1)** is to combine the channel estimation method of [2] with the precoding approach of [10] to obtain an end-to-end learning method. Regarding **(O3)**, it is possible to include impairments in a sparse model of the channel with a specific parameterization of the used dictionary, similarly to what is proposed in [2, 11]. If everything go as planned, the results of the internship should lead to the submission of an article to an international conference.

3 Logistics

The internship will be hosted in the SIGNAL team of the IETR (on the campus of INSA Rennes), for a duration of six months starting between January and March 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. The internship is thought of as a preparation for a PhD on a related topic (whose funding will also come from the MoBAIWL project).

References

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