Model-Based Deep Learning for Multi-Tone Interference Rejection in DSSS 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 the context of military communications, anti-jamming techniques are of paramount importance to protect against potential interferences. Within this framework, the anti-jamming Wiener filter is particularly well-suited for rejecting stationary narrow-band jammers that disrupt wideband systems such as Direct-Sequence Spread Spectrum (DSSS) [1]. This method requires estimating the frequency and power of the jamming components, which can be addressed 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 [2] and led to promising results in various fields of wireless systems [3–7].

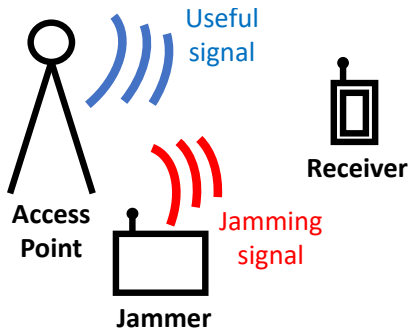

Figure 1: Typical scenario of military communications

2 Objectives

The main objectives of the internship are the following:

(O1) Designing a model-based learning strategy in order to jointly estimate the frequency and power of the jamming components.

(O2) Comparing the developed method to existing purely data-driven and signal processing approaches.

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

One interesting lead for **(O1)** is to use the structure of the Wiener filter to build a neural network. Regarding **(O3)**, it is possible to accomodate for impairments by relaxing some constraints of the model, thus introducing supplementary learnable parameters. 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 2025. 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.

References

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