SONDRA

CentraleSupélec

Postdoc proposal: Statistical and Deep Learning Schemes for Maritime RADAR Detection and Surveillance

1 Context

Coastal RADAR aims to control and monitor the maritime surface. By matching transmitted and received electromagnetic waves, radar is able to detect and range vessels whose back-scattered a sufficiently strong signal relative to the sea clutter. The detection performance generally depends on the target's Radar Cross Section (RCS) and the clutter noise power, which can be summarized by the Signal to Noise Ratio (SNR). In a rough sea state (e.g., 5 on the Douglas sea scale), the detection performance of small vessels hidden by strong sea clutter (Bragg clutter) can deteriorate drastically. The postdoc aims to innovate and improve detection methods previously developed in SONDRA and L2S laboratory in this context.

2 Research

The postdoc will first investigate robust detection methods such as Adaptive Normalized Matched Filters (ANMF) [1], which require estimating the covariance matrix of secondary data in a robust manner [2]. The covariance matrix estimation step could include prior information on the structure using either Riemannian geometry [3] or optimization under persymmetric [4], Toeplitz [5], Kronecker constraints [6], etc. This step could be crucial for improving detection and mitigating the probability of false alarms.

The second direction investigates deep learning approaches to handle a detection, segmentation or/and generation scheme, either end-to-end or in an unrolling way [7, 8]. The latter approach can be less data-hungry and easier to interpret. Since radar data are complex-valued, an architecture based on Complex-Valued Neural Networks (CVNN) [9] can be exploited to learn radar phase information. Meta-learning methods can be investigated to improve detection performance.

The developed algorithms will be tested on CSIR database and maritime data collected by our partner BOWEN.

3 Requirements

This position is funded by ANR ASTRID Maturation. We seek a highly motivated postdoctoral fellow to investigate statistical and deep learning methods for detection in Radar. The ideal candidate should possess the following qualifications:

- A robust background in machine learning, signal processing, or applied mathematics (statistics, optimization, etc.).
- Strong programming abilities in either Matlab or Python.

4 Supervision team contacts:

Jean-Philippe Ovarlez, SONDRA, CentraleSupelec, jeanphilippe.ovarlez@centralesupelec.fr
Frédéric Pascal, L2S, CentraleSupelec, frederic.pascal@centralesupelec.fr
Mohammed Nabil El Korso, L2S, CentraleSupelec, mohammed.el-korso@universite-paris-saclay.fr
Chengfang Ren, SONDRA, CentraleSupelec, chengfang.ren@centralesupelec.fr

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