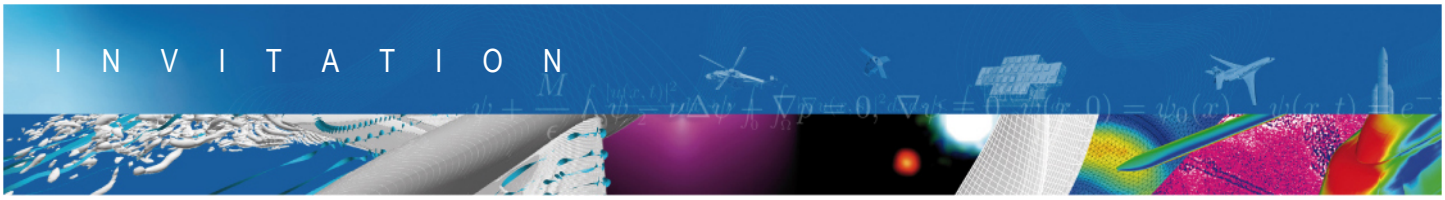

Complex-Valued Neural Networks for Radar Applications

Soutenance de thèse – José Agustin Barrachina
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Abstract:
Radar signal and SAR image processing generally require complex-valued representations and operations, e.g., Fourier, wavelet transforms, Wiener, matched filters, etc. However, the vast majority of architectures for deep learning are currently based on real-valued operations, which restrict their ability to learn from complex-valued features. Despite the emergence of Complex-Valued Neural Networks (CVNNs), their application on radar and SAR still lacks study on their relevance and efficiency. And the comparison against an equivalent Real-Valued Neural Network (RVNN) is usually biased.
In this thesis, we propose to investigate the merits of CVNNs for classifying complex-valued data. We show that CVNNs achieve better performance than their real-valued counterpart for classifying non-circular Gaussian data. We also define a criterion of equivalence between feed-forward fully connected and convolutional CVNNs and RVNNs in terms of trainable parameters while keeping a similar architecture. We statistically compare the performance of equivalent Multi-Layer Perceptrons (MLPs), Convolutional Neural Networks (CNNs), and Fully Convolutional Networks (FCNs) for polarimetric SAR image segmentation. SAR image splitting and balancing classes are also studied to avoid learning biases. In parallel, we also proposed an open-source toolbox to facilitate the implementation of CVNNs and the comparison with real-equivalent networks.

Keywords: Complex-Valued Neural Networks, Polarimetric Synthetic Aperture Radar, Classification, Semantic Segmentation.