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Postdoc position (24 months - Cnam and Telecom Paris) Deeplearning for SAR images time series analysis

1 Context

SAR imagery presents some specificities compared to conventional imagery : complex vector data, speckle phenomenon [1, 5], representation of polarimetric and interferometric information in the form of complex covariance matrices, geometric distortions due to the active sensors. All these characteristics make the processing of SAR image stacks more complex than in natural imaging. However, this imaging technique also offers the possibility of obtaining acquisitions regardless of the ambient brightness and its sensitivity to reliefs and changes makes it a tool of choice for the temporal analysis of three-dimensional scenes. This postdoc is part of the ANR ASTRAL project which aims to develop deep learning methods for multidimensional analysis of SAR data.

2 Objectives

The work carried out by the postdoc will be declined through two axes : i) a work on the architecture and the training of networks dedicated to the analysis of complex multi-dimensional data ii) the incorporation of physical knowledge in the learning.

Several strategies are possible to address this problem : (1) a network can be trained to correct the artifacts present in the reconstructions obtained by a state-of-the-art method [7, 3] ; (2) 3D inversion and network processing can be combined in a "loop unrolling" strategy alternating a step of spatial back-projection (gradient descent on the data attachment term) and a step of projection on the variety of reconstructed volumes (proximal operator implemented as a deep network) ; (3) with an architecture combining direct model and a Neumann network type [4].

These approaches present a decomposition of the reconstruction problem through a physical model and a data driven one. The physical model generally corresponds to the inversion of a linear operator corresponding to an approximate version of the data acquisition process but could also be learned from simulations. In any case, the reconstructions obtained by this physical model remain coarse and need to be regularized by a data-based model. Due to the small amount of annotated data, the learning of the two combined models will be done through an auto or semi-supervised approach [6, 2].

3 Profil

We are looking for a candidate with a PhD in machine learning, applied mathematics and/or signal processing. The ideal candidate has an appetite for scientific research and a solid founda-

tion in machine learning. Notions in optimization or inverse problems are a plus.

4 Organisation

This postdoc offer is for 24 months with a flexible start date in spring 2022. The postdoc will be shared between the Center for Research and Studies in Computer Science and Communications (CEDRIC) of the Conservatoire National des Arts et Métiers (Cnam) in Paris, 3rd arrondissement, and the Laboratory of Information Processing and Communication (LTCI) in Saclay.

The work of the postdoctoral fellow will be carried out in collaboration with Clément Rambour and Nicolas Thome of the team Complex data, learning and representations on the Cnam side and with Florence Tupin of the team IMAGES (Image, Modeling, Analysis, GEometry, Synthesis) on the Télécom Paris side.

5 How to candidate

Send your application (resume + brief explanation of your motivation) by email to `clement.rambour@cnam.fr`.

Références

[1] G. Chierchia, D. Cozzolino, G. Poggi, and L. Verdoliva. SAR image despeckling through convolutional neural networks. In *IGARSS, 2017*, pages 5438–5441. IEEE, 2017.

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[3] G. Fornaro, F. Serafino, and F. Soldovieri. Three-dimensional focusing with multipass sar data. *IEEE Transactions on Geoscience and Remote Sensing*, 41(3) :507–517, 2003.

[4] D. Gilton, G. Ongie, and R. Willett. Neumann networks for linear inverse problems in imaging. *IEEE Transactions on Computational Imaging*, 6 :328–343, 2019.

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[6] A. B. Molini, D. Valsesia, G. Fracastoro, and E. Magli. Towards deep unsupervised sar despeckling with blind-spot convolutional neural networks. *arXiv preprint arXiv :2001.05264*, 2020.

[7] A. Reigber and A. Moreira. First demonstration of airborne sar tomography using multibaseline l-band data. *IEEE Transactions on Geoscience and Remote Sensing*, 38(5) :2142–2152, 2000.