Internship offer (MSc./Eng. Degree)

Adversarial learning of variational models for inverse problems

Supervisor: Ronan Fablet (ronan.fablet@imt-atlantique.fr)
Research team: IMT Atlantique, Lab-STICC, TOMS, Brest
Expected duration: 6 months

Scientific context and specific objective:

This internship offer is open in the framework of AI chair OceaniX (https://cia-oceanix.github.io/), which develops Physics-Informed AI for Ocean Monitoring and Surveillance. PhD opportunities are likely to be offered for the successful candidate.

Data-driven and learning-based strategies for the analysis, modeling and reconstruction of dynamical systems are currently emerging as promising research directions as an alternative to classic model-driven approaches for a wide variety of application fields, including atmosphere and ocean science, remote sensing, computer vision.... [2,3,4]. Especially, deep learning schemes [1] are currently investigated to address inverse problems, i.e. reconstruction of signals or images from observations. Especially, recent works [e.g., 3,4] have shown that one can learn variational models and solvers for the reconstruction. This internship will further investigate such variational formulations to design samplers of realistic reconstruction given the available observations. The envisioned framework will combine adversarial learning strategies, e.g. [5,6] with the joint learning of variational models and solvers [3].

For evaluation purposes, different case-studies will be implemented (e.g., image inpainting, reconstruction of hidden dynamics,…), for instance similarly to [3]. Application to the reconstruction of sea surface dynamics from satellite-derived observations might also be considered. Pytorch will be the preferred framework for these experiments.

Keywords: deep learning, inverse problems, variational models, optimizer learning, GAN.

Candidate profile

MSc. and/or engineer degree in Applied Math., Data Science and/or Computer Science with a strong theoretical background, proven programming skills (Python).

Advanced knowledge of deep learning models and a first experience with Pytorch would be a plus.

References

[1] LeCun et al. Deep learning. Nature, 521(7553) :436– 444, May 2015.
[2] Lguensat et al. The Analog Data Assimilation. Monthly Weather Review, 2017.
[3] R. Fablet, L. Drumetz, F. Rousseau. End-to-end learning of energy-based representations from irregularly-sampled data. arXiv, 2020.
[4] Kobler et al. Total Deep Variation for Linear Inverse Problems. arXiv, 2020.
[5] Goodfellow et al. Generative Adversarial Networks. arXiv, 2014.
[6] Nowozin et al. f-GAN: Training Generative Neural Samplers using Variational Divergence Minimization. arXiv, 2016.