24 MONTHS POST-DOCTORAL POSITION

Multiscale non-linear deep learning strategies to enhance ocean surface dynamics description

This project is multidisciplinary and focuses on the development of new Deep Learning models for non-linear multiscale characterization with applications in fluid turbulence, remote sensing images and the combination of both to study ocean dynamics.

Keywords : Artificial Intelligence; Neural Networks ; Inverse Modelling, Ocean dynamics ; Signal and Image processing ; Multiscale analysis ; Remote Sensing ;

1. Context

The multiscale and non-linear nature of ocean surface dynamics plays a fundamental role in biogeochemical, ecological and climatic processes and consequently its characterization is a main topic in the current oceanographic research. Today the ocean dynamics can be studied through a large variety of remote sensing images of the ocean surface (Yahia et al. 2010, Renosh et al. 2015, Qiu et al. 2020) as well as from numerical simulations (Lellouche et al. 2021).

Thus, this project aims to reconstruct the unknown states of the ocean surface from physical knowledge of the system and available data that can be spatially distant, prior in time, at coarser resolution etc. We can then envisage physics-informed super-resolution, data generation and forecasting (Fablet et al. 2021) among other applications.

The main methodological objective is the formulation of multiscale DL models able to extract non-linear couplings. Moreover, we want this models to 1) be based on the physics of the system, and so to have a physics guided learning, and 2) to be interpretable from a physics point of view. With this purpose both the loss function and the model architectures will be adapted.

In order for our model to be a emulator of the state of the ocean, and then to take into account its turbulent nature, a stochastic component will be included and the incertitudes of the reconstructed states quantified.

Finally, numerical simulations of the ocean are available to validate our DL model before application on real remote sensing images.

2. Eligibility Criteria

Candidates are required to have a PhD in Deep Learning/Machine learning with strong experience in Neural Networks. Ideally, the candidate will have previous experience in fluid physics and/or oceanography and would have shown strong interest on these topics during her/his PhD or previous postdocs. Good skills in python, pytorch, pytorch lightning are also required, as well as a background in teamwork. Previous experience in a multidisciplinary research team will also be considered as positive. **The candidate must have passed at least 18 months in a non-French laboratory between May 1, 2019 and the start of the project.**

3. Supervision and research team

The Postdoc will work in collaboration with Carlos Granero-Belinchon and Ronan Fablet from IMT Atlantique, Simon van Gennip from Mercator Ocean International, and Bertrand Chapron from Ifremer. Thus, the research team is composed by physicist, oceanographers and artificial intelligence researchers from different laboratories, leading to a multidisciplinary project. Moreover, the postdoc will develop within the OSE research team at IMT (https://cia-oceanix.github.io/) which is a dynamic research group on image processing and artificial intelligence for Oceanography and Climate. The postdoc will also be part of the new Inria team Odissey (https://team.inria.fr/odyssey/).

4. Terms of emplyment

The post-doctoral position is a two-year full-time appointment starting during 2023. Gross salary will depend on the experience of the candidate, up to approx. 55,000 €/year (net salary: up to approx. 30,000 €/year). The candidate will also benefit from French social insurance, and will have up to 45 days of annual leave. The candidate will be able to benefit up to 90 days of remote working per year.

The candidate will be based at the IMT Atlantique Campus (Brest) in a dynamic and stimulating working environment at five minutes walking from the beach.

Within the framework of the ANR JCJC project SCALES the postdoc will have funding for participation in conferences, publication fees and visits to external laboratories. Moreover, within the framework of the ANR Chair OCEANIX the postdoc will have access to compute servers : Datarmor and servers from OSE at IMT Atlantique.

Teaching activities at IMT Atlantique will also be proposed to the postdoc, mainly in signal processing, computer vision and artificial intelligence. These actvities, which imply an additional salary, will not be mandatory.

Motivated candidates should send a CV and a motivation letter to: carlos.granero-belinchon@imt-atlantique.fr.

The Postdoc is expected to start in 2023.

References

Yahia, H., Sudre, J., Pottier, C., et al., Motion analysis in oceanographic satellite images using multiscale methods and the energy cascade, Pattern Recognition 43, 3591:3604 (2010)

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