Internship proposal (MSc./Eng. Degree)

CNN-based segmentation and tracking of physical structures in satellite-derived sea surface image time series

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Research team: IMT Atlantique, Lab-STICC, TOMS, Brest
Expected duration: 6 months

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Scientific context and specific objective:
Deep learning [1] has experienced tremendous growth in a few years in the field of artificial intelligence and computer vision. Initially exploited for classification and recognition problems, it has also become a reference framework for the resolution of signal and image processing problems: image synthesis, super-resolution, denoising, inpainting, segmentation ....

The detection and tracking of physical structures (e.g., fronts, filaments, eddies...) in satellite-derived sea surface observations of the sea surface is a key issue for the characterization and understanding of the upper ocean dynamics [2,3,4]. Most approaches rely on rule-based algorithms [2,3] and only few studies have explored machine learning strategies [4]. The goal of this internship will be to develop and evaluate deep learning models, especially CNN-based (Convolutional Neural Net) segmentation models [5,6,7], for these detection and tracking tasks. Two specific objectives will be of particular interest:

- the exploitation of multi-source/multi-modal satellite data ;
- the space-time adaption of CNN-based models.

Case-studies for real satellite-derived observation datasets [e.g., 3] will be considered. All experiments will be implemented under Python using dedicated libraries such as Keras and/or Tensorflow frameworks.

Keywords: neural networks, CNN, objection detection and tracking, sea surface dynamics, physical structures, multi-source satellite observations

Workplan
The envisioned workplan involves three main aspects:
- A study of the state-of-the-art of object detection and tracking using CNN-based models
- The definition of CNN-based models for the detection and tracking of geophysical structures in satellite-derived sea surface image time series
- The experimental evaluation and benchmarking of the proposed models.

References
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