

# Object detection with low supervision: Application to animal monitoring from above/under-water imagery

Research Engineer/Postdoc position

Expected starting: September 2021 (12-18 months)

## Keywords

Deep learning, Unsupervised learning, Weakly supervised learning, Anomaly detection, Object detection, Marine megafauna detection, Fish detection and counting

## Context and objectives

This research proposal is part of the two R&D projects between the research laboratory IRISA (Institute for Research in Computer Science and Randomized Systems) with other academic and industrial partners such as the institute for energy transition dedicated to marine renewable energies (France Energie Marines - FEM), the French Office for Biodiversity (OFB), and the French Research Institute for Exploitation of the Sea (Ifremer). The first one is the SEM-MACAPE project (Monitoring and study of marine megafauna by automatic characterization in wind farms), which aims to develop an automatic system for monitoring marine megafauna, in order to analyze the impact caused by the installation of wind farms on these animals to automate the environmental monitoring of wind farms using supervised and unsupervised deep learning methods. The second one is the GAME OF TRAWLS (Giving Artificial Monitoring intelligence to Fishing TRAWLS), which aims to explore the new opportunities offered by deep-learning methods for processing of data stored on fishing vessels, and in particular processing of in-situ images and videos for automated species recognition and counting.

Similar tasks were defined for these projects, shared between different partners, including the acquisition of aerial images of marine animals or underwater videos of fishes, the annotation of these images by specialists in the field, the evaluation of existing detection methods and the development of new methods based on modern deep learning frameworks. In parallel to the supervised learning tasks (learning with labels), the projects also aim to develop unsupervised or weakly supervised approaches for the discovery and detection of those animals without labels. The proposed position will focus on this second approach.

## Work program (expected)

In order to address the aforementioned objectives, a tentative work program is given below.

- Bibliographical study of unsupervised, weakly supervised, self-supervised methods for anomaly detection and object detection.

- Evaluation and benchmarking of state-of-the-art methods.
- Improvement of existing solutions (including the current in-house methods developed by the team) and/or development of new models for the unsupervised/weakly-supervised frameworks within the two contexts: 1/ detection of marine megafauna from aerial images and 2/ the detection and counting of fishes from underwater videos.
- Dissemination: report, publication, source codes.

## Required background and skills

- PhD (or will soon obtain) in Computer Science or related domain with experience in image processing, deep learning and applied machine learning
- Excellent programming skills in Python (familiar with one of deep learning packages, such as PyTorch or Tensorflow, is a must.)
- Experience with transformers, GANs, autoencoders, and/or unsupervised/self-supervised DL (autoencoders, etc.) would be a plus.

## Supervision

The successful candidate will join the OBELIX research group ([www.irisa.fr/obelix](http://www.irisa.fr/obelix)) from IRISA (UMR 6074), which is located in the UBS (Université Bretagne Sud) campus in Vannes 56000, France. He/She will be jointly supervised by **Dr. Luc Courtrai** (Maître de Conférences at UBS), **Dr. Minh-Tan Pham**<sup>1</sup> (Maître de Conférences at UBS) and **Prof. Sébastien Lefèvre**<sup>2</sup> (Professor at UBS).

## Application

Position to be filled as soon as possible (**call closed on August 15, 2021**). Send your detailed CV + Motivation letter to `{minh-tan.pham,luc.courtrai,sebastien.lefevre}@irisa.fr`. Potential candidates will be contacted for interview.

## References

- [1] Wei, Xiu-Shen, et al. Unsupervised object discovery and co-localization by deep descriptor transformation. *Pattern Recognition* 88 (2019): 113-126.
- [2] Cho, Minsu, et al. Unsupervised object discovery and localization in the wild: Part-based matching with bottom-up region proposals. *CVPR* 2015.
- [3] Defard, Thomas, et al. PaDiM: a patch distribution modeling framework for anomaly detection and localization. *arXiv preprint arXiv:2011.08785* (2020).
- [4] Kim, Jin-Hwa, et al. Semi-orthogonal Embedding for Efficient Unsupervised Anomaly Segmentation. *arXiv preprint arXiv:2105.14737* (2021).
- [5] Bergmann, Paul, et al. Improving unsupervised defect segmentation by applying structural similarity to autoencoders. *arXiv preprint arXiv:1807.02011* (2018).
- [6] Park, Jiwoong, et al. Symmetric graph convolutional autoencoder for unsupervised graph representation learning. *CVPR* 2019.

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