Post-doctoral/research engineer position (16 months) in machine/deep learning for floating wind turbine mooring lines health monitoring

Context

IMT-Atlantique, an engineering school under the supervision of the Ministry of Industry, is looking for a post-doc or research engineer for 16 months, to start at the earliest from June/July 2021. The position is based on the Brest campus of the school. The candidate will join the Mathematical and Electrical Engineering (MEE) department, within the OSE (Observations, Signal, Environment) team of the Lab-STICC, whose research activities include signal and image processing for environmental data, and learning dynamical models using artificial intelligence.

The open position is part of the SUBSEE4D project co-sponsored by Cervval, a company specializing in digital simulation and decision support in complex systems, France Energies Marines (FEM), the national research institute dedicated to Offshore Renewable Energy (ORE), and IMT Atlantique.

Despite a significant offshore experience coming from the oil and gas (O&G) industry, several specificities of offshore renewable energy systems induce uncertainties of their subsea dynamics. Today, as any emerging technology, the efforts are focused on the system efficiency and robustness as part of the design stage. Very few works are dedicated to the in-service follow-up and the maintenance strategy which represent a critical point both technically and financially for the very next commercial farms.

Within the SUBSEE4D project, FEM is in charge of the development of a mooring lines health monitoring software module. A multidisciplinary team including this position is being set-up to deliver software which will be offered to a floating wind farms operator for further customization and deployment on a scale 1:1 floating wind turbine pilot project. The software aims at improving the estimation of the fatigue life of the mooring components as well as the related alert systems using machine learning techniques, taking as input different kinds of data, including environmental (winds, waves etc).

IMT Atlantique brings to the project its expertise in machine learning, in particular for dynamical systems: data assimilation, quantification and uncertainty propagation in dynamical systems learned from data, interpolation/reconstruction of time series [1, 2], emulation of physical models, physics-aware machine learning [3], forcing by explanatory variables, predictor importance assessment...

In this context, the candidate will take part in the IT development of the data-processing platform. He / She will provide technical expertise and will prototype statistical and probabilistic modesl that will be used for variables estimation and related uncertainties, as well as supervised and unsupervised classification algorithms to evaluate the system state, before being integrated in the module developed by FEM. The available data sets for training will first come from realistic simulations of a floating wind turbine, and will be progressively enriched with in-situ sensor data. Machine Learning tools will be used to optimally combine simulations and observations, and to include physical or structural constraints to the learning algorithms.

Methodological developments will also be expected, to complement and further improve research on dynamical systems learning from data performed in the IMT team. Publications in international conferences and journals will be issued from this work.

Floating wind turbine global simulation involve coupled aero-hydro-servo-elastic physical models. The candidate will need to work in close collaboration with the project team to ensure the physical consistency the developed models from learning phase to validation phase. This position requires the ability to fit in a multidisciplinary team.

Candidate

The candidate must have (preferably) a PhD or possibly a Masters/Engineering degree in image or signal processing, machine learning or related fields, or equivalent experience. Qualifications required:

- Machine/Deep Learning, Signal and Image Processing, Applied Mathematics, Dynamical Systems

- Programming in Python (numpy, scipy, matplotlib...)

- Experience in machine/deep learning methods and associated libraries in Python (Pytorch, Keras, Tensorflow, scikit-learn...)

- An experience related to physical modeling of complex systems or renewable energies will positively appreciated

Contact

- Lucas Drumetz, Associate Professor, IMT-Atlantique, MEE Department, and UMR Lab-STICC, OSE team.

- Romain Ribault, Research Engineer - Mooring System and Offshore Monitoring, France Energies Marines.

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References

[1] D. Nguyen, S. Ouala, L. Drumetz, and R. Fablet, "Assimilation-based learning of chaotic dynamical systems from noisy and partial data," in *ICASSP 2020-2020 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, pp. 3862–3866, IEEE, 2020.

[2] J. Estopinan, G. Tochon, and L. Drumetz, "Learning sentinel-2 spectral dynamics for long-run predictions using residual neural networks," in *European Signal Processing Conference 2021*, 2021.

[3] S. Ouala, D. Nguyen, S. L. Brunton, L. Drumetz, and R. Fablet, "Learning constrained dynamical embeddings for geophysical dynamics," in *CI 2019: 9th International Workshop on Climate Informatics*, 2019.