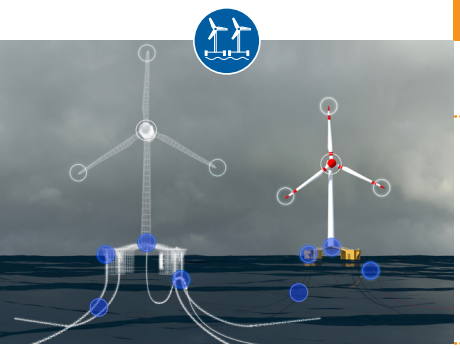
FRANCE ENERGIES MARINES

Research & Expertise Services

Definition of a structural health monitoring strategy for FOWT in real-time



Exploitation

Ensuring the **integrity of offshore wind farm assets** over the full project lifetime is crucial t**o maximise the economic value and manage project risk**. With increase in distance to the shore, harsher environment and novel elements introduced (hull, mooring and anchoring systems, dynamic cables), this is especially true for floating offshore wind farms. Monitoring solutions are increasingly considered to r**educe uncertainty of remaining fatigue life during floating system operation for their potential for cost reduction and to produce feedback from field to design.**

OUR OFFER

Methodology for in-service monitoring of critical components like mooring lines to inform on the structural health, estimate lifespan and extension of service life, failure probability and maintenance prediction through the following 4 steps.

- **Digital twin initiation:** Valuation and structuration of data generated by global simulation software during design process by using machine learning pipelines
- **Sensors strategy selection:** Sensors selection based on technical and economic criteria and optimization with virtual sensors
- **Data transmission and post-treatment:** Implementation of post-treatment chain compatible between simulation model outputs and sensors data in order to increase physical knowledge using deep learning
- **Real-time and continuous improvement of the global model through data feeding:** Data-truncated model to force mooring lines model and evaluation of fatigue remaining life based on data-driven or simulation models forced by sea states estimation

OUR REFERENCES

MHM-EMR R&D project

- Development of a methodology for monitoring the lifespan of mooring components / and a method and warning tools to prevent the risks of anchor skidding and its consequences

SUBSEE4D R&D project

- Development of an in-house software to connect: OpenFast simulation software with Zefyros global model, NEURON® and INS sensors, and our machine learning data pipelines
- Forcing wind turbine global model using forecasted sea states from anywhere in Europe (wind, wave, current)

DIONYSOS R&D project (ongoing)

- Development of data-driven models and truncated model for mooring tension estimation, tests on application case of anomaly detections in global model, mooring fatigue life update from sensors data, and global model parameters calibration

MONAMOOR R&D project

- Design and at sea deployment of a buoy dedicated to test nylon mooring lines, sensors and data acquisition system in order to validate the behaviour law of nylon mooring lines

OUR RESOURCES

A team with complementary and cross-disciplinary expertise: mooring systems, offshore monitoring, marine operations, mathematics applied to offshore renewable energies

Dedicated instrumentation

- MONABIOP demonstrator deployed on the Mistral Mediterranean test site equipped with a hybrid semi-tensioned chain-nylon mooring with the goal to validate the numerical modelling of nylon anchor line behaviour

Digital tools

- DeepLines™ licence, OpenFast
- Software module dedicated to monitoring of fatigue remaining life of mooring lines and floater hot spots
- Deep learning model architecture for unsupervised and supervised anomaly detection
- Automated computational chain for the estimation of physical variables from virtual sensors
- Automated post processing of INS/GNSS sensors data based on QINERTIA™ software
- Data-driven models and truncated model for mooring tension estimation

Database

- Vibrations from accelerometer data measured on *Zephyros* floating offshore wind turbine tower at 6 different heights
- Tension, elongation, buoy movements and mooring model of MONABIOP demonstrator

YOUR CONTACT

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