PROPOSITION DE STAGE

Subject: **SHORT-TERM PREDICTION OF WAVE ELEVATION AND VESSEL MOTION FROM REMOTE SENSORS**

Company: **IFP Energies nouvelles**
Supervisors: **Alexis Mérigaud (alexis.merigaud@ifpen.fr) and Paolino Tona (paolino.tona@ifpen.fr), Digital Science and Technology Division**
Location: **IFPEN Rueil-Malmaison (92) or IFPEN Lyon, Solaize (69)**[1]
Duration: **5 months en 2024**
Compensation: **about 1050 € gross / month**

Description

As we move towards a low-carbon energy mix, the oceans offer tremendous potential to produce renewable energies: offshore wind, tidal and wave power, temperature and salinity gradients, etc. But the sea is also a demanding environment that puts the equipment and structures it supports to the test. Waves are both a potential source of energy and a considerable hazard that determines the feasibility or otherwise of many operations at sea. All operations at sea involve one or more critical stages (for example, crew transfer for a maintenance operation on a wind turbine) which require the movement of the vessel to be sufficiently low and which determine the sea states in which these operations can be carried out. Being able to predict swell and wave dynamics, and the resulting movements, even just a few tens of seconds in advance, would improve decision-making for many operations, reducing downtime and extending operational periods.

IFPEN is currently developing a real-time wave forecasting system (RTWF), which can predict the occurrence of short lull periods in stronger sea states, sufficient to overcome these critical stages. This RTWF system can also give an alert if a dangerous wave train is imminent. Therefore the RTWF makes it possible to carry out the same operations in previously inaccessible sea states, while guaranteeing the required levels of safety. Ultimately, by providing a decision-making aid, the RTWF system improves the compromise between the two contradictory imperatives of safety and speed of operations. The system will be based on various remote wave sensors, including X-band navigation radars. These radars, which are ubiquitous on ships and maritime and coastal installations, are currently considered to be the most promising instruments for measuring swell and making predictions over horizons of several minutes.

The first part of the internship will consist in producing a digital twin (ideally of the CTV, crew transfer vessel, type) of a vessel equipped with a radar. To do this, the student will use components already developed at IFPEN (sea state generator, radar simulator) and will develop simplified hydrodynamic components (to begin with, we envisage the use of RAO, response amplitude operator, to generate the ship movements). In the second part, the student will apply the SBP (Spectrum Based Prediction) prediction method to the synthetic data generated by the digital twin (true or reconstructed wave fields, ship motion) in order to predict the ship motion or the wave elevation at the center of the ship. He/she will try to assess its performance compared with predictions where the data are not combined.

The intern will have the opportunity to work in a promising field with a wealth of scientific and technical knowledge.

Desired profile

- 3rd year engineering student or equivalent, ideally Master 2 in research.

[1] The site is accessible by public transport (Lyon-Feyzin shuttle then GE2 bus line).

- Very good grounding in automatic control and/or statistical physics and/or applied mathematics and/or data science.
- Good knowledge of mechanics/hydrodynamics would be a plus.
- The candidate shall be proactive.
- Ability to read scientific publications in English, to understand the state of the art on the subject.

How to apply

To apply, please send your CV and cover letter to the internship supervisors Alexis Mérigaud (alexis.merigaud@ifpen.fr) and Paolino Tona (paolino.tona@ifpen.fr).