*Numéro de dossier : 2022-Xxx-yy*



PhD position at IFP Energies nouvelles (IFPEN)

*in Mathematics / Physical Sciences*

AI-assisted ocean wave field measurement using an X-band radar coupled with airborne drone observations

X-band navigational radars are promising instruments for ocean wave measurements, since the images they provide can be processed to obtain a wave-by-wave reconstruction of the sea surface, within a range of up to several kms. Such reconstructions would be of tremendous value in oceanographic research and observation and for monitoring purposes in the field of marine renewable energies, as well as for achieving real-time predictions of waves or ship motion, over horizons of several minutes, to enhance the feasibility and safety of many types of operations at sea.

Despite those prospects, radar images merely provide very indirect measurement of the ocean wavy surface, through the patterns formed by the *sea clutter* phenomenon. Turning radars into true distant sensors for ocean observation still requires the invention and development of methods for wave-by-wave, real-time inversion of radar sea clutter images. To achieve this, a more thorough understanding of the physics behind sea clutter formation and modulation is needed for the different zones of the radar image, together with an inversion method accounting for those mechanisms. It is on the latter two aspects that this PhD thesis is expected to make contributions, through the elaboration and exploitation of a database pairing radar images and (UAV-based) direct wave measurements, on consistent observation areas.

The thesis will be carried out through a partnership with the Borelli Centre at ENS Paris Saclay. It will include substantial experimental work, through *in-situ* measurement campaigns (probably in Ireland at the [HIGHWAVE project](https://www.highwave-project.eu/index.php/about-waves-formation) observation station). The data collected will be exploited by combining physical modelling with the implementation of deep learning algorithms, those two parts lending themselves to fruitful mutual interaction. The PhD candidate will have the opportunity to work in a stimulating and rapidly-evolving field with a rich scientific and technological content, as well as significant space to express their creativity.

**Keywords**: Applied mathematics, signal processing, image processing, data science, machine learning, probability and statistics, wave physics, oceanography

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| **Academic supervisor** | Prof. DIAS Frédéric, Centre Borelli, ORCID 0000-0002-5123-4929, and Dr. MOREAUD Maxime, IFPEN, ORCID 0000-0002-4908-401X |
| **Doctoral School** | [Ecole doctorale de mathématiques Hadamard](https://www.universite-paris-saclay.fr/ecoles-doctorales/ecole-doctorale-de-mathematiques-hadamard-edmh) |
| **IFPEN supervisor** | Dr. MERIGAUD Alexis, Département Contrôle, Signal et Système, alexis.merigaud@ifpen.fr, ORCID 0000-0002-7658-8942 |
| **PhD location** | IFP Energies nouvelles, Rueil-Malmaison (Greater Paris area), France |
| **Duration and start date** | 3 years, starting in fourth quarter 2023 |
| **Employer** | IFP Energies nouvelles, Rueil-Malmaison, France |
| **Academic** **requirements** | University Master degree covering at least two of the disciplines mentioned in the keywords |
| **Language requirements** | Fluency in English |
| **Other requirements** | Programming skills (especially Matlab or Python) |

To apply, please send your cover letter and CV to the IFPEN supervisor indicated here above.

About IFP Energies nouvelles

IFP Energies nouvelles is a French public-sector research, innovation and training center. Its mission is to develop efficient, economical, clean and sustainable technologies in the fields of energy, transport and the environment. For more information, see [our WEB site](https://www.ifpenergiesnouvelles.com/ifpen/presentation).

IFPEN offers a stimulating research environment, with access to first in class laboratory infrastructures and computing facilities. IFPEN offers competitive salary and benefits packages. All PhD students have access to dedicated seminars and training sessions. For more information, please see our [dedicated WEB pages](https://www.ifp-school.com/en/programs/phd-theses).