PhD offer: Extreme response in numerical and experimental wave tanks

Co-supervision Dept. of Ocean Engineering - IIT Madras / LHEEA Lab., Centrale Nantes

A full-time PhD position is open, in the framework of a Joint PhD Program (JDP) between Centrale Nantes (France) and IIT Madras (India).

THE PROJECT:

Context:
The use of CFD codes in design has been increasing over time, however CFD is still difficult to use when a wide range of environmental conditions needs to be assessed. This is essentially due to the computational cost of CFD.
The computational cost in design process depends on the cost of one single run but also on the number of runs needed to evaluate the occurrence of the quantity of interest. On this point the rules from classification societies often rely on several 3-hours time-domain simulations. This is not really an obstacle for time domain codes based on potential flow as it is usual practice in engineering, but it is very difficult to apply with the CFD approach.
On the other hand, CFD-based methods have fewer limitations about complex geometries, breaking waves, non-linear phenomena and represent a valuable alternative for a number of problems. In response to high computational cost, the design waves approach can be a suitable methodology, because runs are shorter and also their number might be reduced.
To be applied successfully the design wave needs first to be computed and then to be realised with CFD, this requires first to be able to reproduce accurately a time history and then to verify that nonlinear effects are correctly accounted for.

Recent studies have shown that an efficient numerical wave tank can be built thanks to one-way coupling or forcing from a potential flow solver solution. With this methodology the design wave approach can be computed in two steps. It can be first computed by iterations using the linear or nonlinear potential flow code and then generated in the CFD domain.

Objectives:
Within the context expressed above, the PhD subject aims at testing the capability of CFD to reproduce sea states and the corresponding response of the structure both from a stochastic and a point of view and from a deterministic point of view by simulating some equivalent design waves.

The candidate will first review existing procedures for the generation of design waves and classify the suitability to each of them to assess classical design problems.
Existing methods will also be reviewed in view of the extension to short-crested wave conditions.

Deterministic and stochastic validation of the wave generation procedure will be performed, also assessing the suitability of the proposed methodology and further developing it if needed.
This procedure relies on the modeling of wave-structure interactions through the coupling of openFOAM with wave solvers (HOS models in particular). The developed numerical model should be robust and accurate while targeting a reasonable computational effort for long-time simulations.

PROFILE OF THE CANDIDATE:

Candidates should hold a Master degree in Mechanical Engineering, Ocean Engineering, Fluid Mechanics, Numerical Analysis or related topics. A first experience in scientific computing and/or experimental hydrodynamics will be a plus.

English fluency is mandatory.

SCHEDULE AND CONDITIONS

Schedule:

Candidates are invited to contact both main supervisors, Prof. Sriram Venkatachalam (vsriram@iitm.ac.in) and Prof. Pierre Ferrant (pierre.ferrant@ec-nantes.fr) via email, with a CV and a motivation letter. Any additional information or document will be welcome (Master thesis, recommendations, etc).

Candidatures received after March 31st , 2022 will not be considered.

Talks with pre-selected candidates will be organized via video-conferencing and the final decision should be available on April 30th.

The successful candidate is expected to be enrolled September 1st, 2022 at the latest.

Conditions of employment:

The candidate will be funded for three years, starting with 6 months in Centrale Nantes, followed by 18 months in IIT Madras, and finally 12 months back in Centrale Nantes. During each of these periods, the candidate will be funded according to local conditions:

In IIT Madras: The stipend is Rs. 35,000 per month and the cost of living is Rs. 10,000 per month (incl. accommodation+food). If the student stays outside the campus, he will get a house rent allowance of Rs. 8000 per month.

In Centrale Nantes: The net salary is 1715 Euros per months, and the cost of living is approximately 800 Euros per months (incl. accommodation+food). An additional help for accommodation costs from public authorities may be obtained (100 to 300 Euros, depending on personal situation).

IIT Madras https://www.iitm.ac.in

IIT Madras –Dept. Ocean Engineering https://doe.iitm.ac.in/

Centrale Nantes https://www.ec-nantes.fr/english-version

LHEEA Lab. https://lheea.ec-nantes.fr/english-version