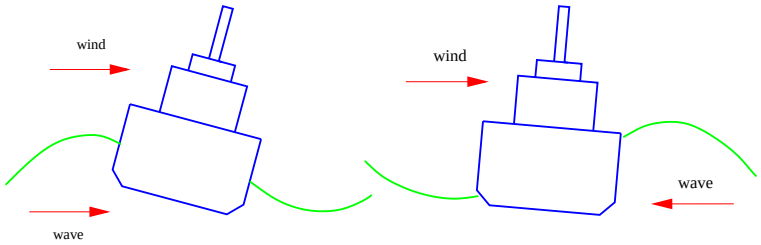
Two years position at ENSTA Bretagne
Project Stadynav



Project Description

ENSTA Bretagne (https://www.ensta-bretagne.fr/en) is a French engineering school that graduates engineers in Naval and Offshore Architecture (among other specializations). Research activities are carried out in collaboration with the Institut de Recherche Dupuis de Lôme (CNRS UMR 6027, https://irdl.fr/). ENSTA Bretagne and the French Naval Academy are the two academic partners of the project Stadynav.

The International Maritime Organization has initiated the development of second generation stability criteria. These new criteria are based on the use of increasingly sophisticated analysis techniques to judge the vulnerability of vessels in their dynamic behavior. The main instabilities are five in number: parametric rolling, pure loss of stability, excessive acceleration, dead ship condition, and surf-riding leading to broaching. In all cases, it is a question of being able to simulate the circumstances of the appearance of large roll motions that can lead to the limit of the vessel's stability. We are therefore interested in a dynamic that is no longer based on the small perturbation hypothesis and consequently the equations of the rolling motion are strongly non-linear.

The objective of the project is to further develop techniques for the global analysis of non-linear differential systems simulating the instabilities of the vessel leading to capsizing. The first step is to formulate a differential roll motion equation including all the physics of the relevant phenomena. Then a methodology for a fast, precise and global resolution will be chosen. More precisely two techniques are implemented: 1) the analysis of the integrity or the erosion of the basin of attraction; this takes into account the influence of the initial conditions provided that a temporal differential system simulating the rolling motion of the vessel is available, 2) Melnikov's method which allows a fine analysis of the behavior of the vessel near its limit of stability in roll. These methods will be implemented to analyze the dynamic behavior of the vessel subjected to an irregular sea state. Emphasis is placed on the optimization of algorithms in order to perform large parametric analyses in terms of hydro-mechanical characteristics of vessels and sea states. As an application real ships whose hydrodynamic databases are available will be thus compared on criteria of capsizing probability.

Position Description

The position is open to Doctors. The scope of the research work is:

1. further develop existing global analysis methods applied to the non-linear rolling of vessels,
2. implement these methods to meet the demands of the IMO within the framework of the Second Generation Criteria,
3. carry out application cases in order to test and/or compare vessels with respect to these criteria.

ENSTA Bretagne is looking for a highly motivated candidate eager to develop theoretical and numerical tools in the field of nonlinear dynamical system applied to ship stability. The **essential required qualifications, skills and experience** are

- a strong background in mechanical and naval hydrodynamics,
- a strong background in applied mathematics, numerical analysis and programming,
- an ability to write high level scientific reports and publications.

Supervision
The post-doctoral fellow will be employed by ENSTA Bretagne. He/She will be supervised by:

- Pierre-Michel Guilcher : researcher specialist of Naval Architecture and CFD for Naval Hydrodynamic applications, (pierre-michel.guilcher@ensta-bretagne.fr)
- Romain Hascoët : researcher specialist of stochastic dynamics, (romain.hascoet@ensta-bretagne.fr)
- Yves-Marie Scolan : researcher specialist of nonlinear dynamics, (yves-marie.scolan@ensta-bretagne.fr).

Practical Information

- Expected starting date: January 2021
- Duration: two years contract
- Final date for applications: December 15, 2020.

Please send your CV and cover letter to the following email address:
pierre-michel.guilcher@ensta-bretagne.fr
yves-marie.scolan@ensta-bretagne.fr

References
[1] Rainey, R.C.T. and Thompson, J.M.T., Transient Capsize Diagram New Method of Quantifying Stability in Waves, J. Ship Res., Vol. 35, pp. 58-62 (1991).
[2] Falzarano, J., Shaw, S., and Troesch, A., Application of Global Methods for Analyzing Dynamical Systems to Ship Rolling Motion and Capsizing, International Journal of Bifurcation and Chaos in Applied Sciences and Engineering, March, 1992, pp. 101-116
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[6] Wandji C, Corrignan P, 2012. Test application of second generation IMO intact stability criteria on a large sample of ships. 11Th International Conference on the Stability of Ships and Ocean Vehicles, Athens, 129-139
[7] Brodu A., Mauger E., Billard J.-Y., Scolan Y.-M., Vonier P. & Leguen J.-F. Comparison of global analysis technique and direct evaluation of capsizing probability on French frigates, Int. Ship Stability Workshop, Brest, 2013.