Offer of a doctoral thesis scholarship

Subject: Uncertainty quantification in internal structural acoustics for micro/macro nonlinear fluid-structure coupled systems.

Annual net amount of the scholarship: around 16 800 Euros

Location: Laboratory "Modélisation et Simulation Multi-Echelle" (MSME, UMR 8208 CNRS), Université Paris-est, 5, Bd Descartes, 77455 Champs sur Marne, France

Advisors:
Prof. Christian Soize et Pr. Evangéline Capiez-Lernout (Laboratory MSME)
Prof. Roger Ohayon (Laboratory "Mécanique des Structures et des Systèmes Couplés" (MSSC, EA 3196), CNAM, 2, rue Conté, 75003 Paris

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Duration : 3 years, starting: September-October-November 2015

This **proposal is restricted** to students having an European or a Switzerland nationality.

Description of the thesis subject: In the context of fluid-structure interaction, complex nonlinear phenomena still have to be analyzed. Moreover, the uncertainty quantification on both the system-parameter uncertainties and the model uncertainties induced by the modeling errors in the computational models, is known to be necessary in order to improve the robustness of the predictions concerning the design optimization and the performances. Many research efforts have been made on this subject in the context of linear structural acoustics and more recently in structural dynamics taking into account the geometric nonlinearities. Nevertheless no advanced research has been published on the uncertainty quantification for micro / macro-nonlinear fluid-structure coupled systems, such as those of naval hydrodynamics and space systems, in particular for structures with large deformations in the presence of a free surface, with possible gravitational effects and capillarity.

Brief plan of the thesis work:

- Construction of a deterministic nominal model corresponding to a structure with large deformations containing a compressible fluid with free surface for which the capillary effects induced by the presence of surface tensions are taken into account.
- Construction of all the operators of a nonlinear reduced-order model in order to decrease the number of unknowns and to get reasonable computational costs.
- Developments of appropriate algorithms for solving the nonlinear coupled equations.
- Construction of a stochastic nonlinear computational model taking into account both the system-parameter uncertainties and the model uncertainties.
- Formulation of a stochastic nonlinear optimization problem in order to identify the hyperparameters (the parameters of the stochastic model of uncertainties) of the stochastic computational model.
- Validation of the full methodology on different coupled fluid-structure systems.

References :

[1] R. Ohayon, C. Soize, Vibration of structures containing compressible liquids with surface tension and sloshing effects. Reduced-order model, Computational mechanics, accepted for publication, doi 10.1007/s00466-014-1091-4, online, 2014.
[2] C. Soize, Stochastic Models of Uncertainties in Computational Mechanics, American Society of Civil Engineers (ASCE), Reston, 2012.
[3]E. Capiez-Lernout, C. Soize, M. Mignolet, Post-buckling nonlinear static and dynamical analyzes of uncertain cylindrical shells and experimental validation, Computer Methods in Applied Mechanics and Engineering, 271(1), 210-230, 2014.