Research PhD positions in the DyVirt ETN funded by the EC

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Leibniz Universität Hannover (Germany) and the University of Liverpool (UK) are recruiting one research PhD candidate each within the DyVirt ETN, which are supposed to work closely together and within the DyVirt consortium.

Within the context of DyVirt, both research PhD candidates will focus on the development of complex load models to capture spatial and temporal variations of loads on large, complex structures in dynamic environments. The understanding of the variations in operational and ambient conditions expected for the structure of interest and load prediction will serve as a key ingredient for virtualisation. On one hand, load models must capture the key characteristics of the loads in order to obtain realistic analyses and predictions of structural performance; on the other hand, test campaigns are usually constrained and the resulting data is usually limited so that significant uncertainties are involved in the modelling. The issue is particularly critical when the loads concerned are time dependent and the structural behaviour is nonlinear so that the performance is potentially very sensitive to model uncertainties. Load models for complex structures have the additional issue that they may need to represent many individual loads distributed in space and time on the structure such that their location and duration may be uncertain, even if the loads themselves are well understood. This challenge requires strong cross-disciplinary interactions between engineering, physics and mathematics.

The research PhD candidates are supposed to address this challenge with the following complementary approaches.

ESR11 Prediction of Loads using a Bayesian approach
(host: University of Liverpool, Institute for Risk and Uncertainty)

This research PhD candidate will

- Develop a method to find the best possible point estimate for the Evolutionary Power Spectra (EPS) representing complex loading scenarios
- Develop methods of combining fragmentary data and expert knowledge into a Bayesian update to generate load representations as statistical averages whereby none of the individual pieces of information dominates the result
- Develop an update procedure using the sparse functional basis of the compressive sensing approach in order to achieve a low dimensionality of the problem associated with high numerical efficiency and high transparency of the approach

Expected results are:
(i) A methodology for numerically efficient point estimation of an EPS in complex environments based on fragmentary information.
(ii) A methodology for transparent combination of expert knowledge and data for the estimation.

ESR12 Prediction of loads, imprecise probabilities approach
(host: Leibniz Universität Hannover, Institute for Risk and Reliability)

This research PhD candidate will

- Develop a method for bounding the range of point estimates for the Evolutionary Power Spectra (EPS) representing complex loading scenarios based on an imprecise probabilities approach
- Identify a set of estimates for the load characterisation, implementing expert knowledge through a nested set of specifications
- Adapt the approach for: (i) assessing the load model robustness and (ii) identifying extreme cases for loads and responses, which are particularly important for a risk assessment
- Adapt the method so that discrepancies reveal issues in the modelling or load model capabilities, and so that the approach facilitates a direct sensitivity analysis of the structures

Expected results are:
(i) A methodology for numerically efficient interval estimation of an EPS in complex environments based on fragmentary information.
(ii) A methodology for assessing the quality of the load model.

The developments on both approaches will include an expansion to multivariate cases in order to capture dependencies between the individual load models in a combined model for the overall complex structures. Uncertainties and fragmentary information on the dependencies are treated accordingly with both pathways.

Requirements

Both projects require a particularly strong mathematical background and a keen interest to work in the interface of signal processing and probabilistic engineering mechanics/dynamics. Applicants should have a background in Engineering (preferably Civil, Mechanical, Aerospace or Naval/Marine Engineering) or in relevant fields from Mathematical Sciences. A combined education in these fields would be an advantage.

The student will join a multi-disciplinary research group in the host institutions as well as in the DyVirt consortium.

Funding details

Both positions are funded by the European Commission (EC) with salaries according to EC and local standards.

Starting Date

September 3, 2018

Student nationality

Please refer to the fee structure of the University of Liverpool for ESR 11.

Application

Candidates are requested to submit a single pdf file containing:

- A letter motivating the application
- A detailed CV
- Academic transcripts

to: Professor Michael Beer (beer@irz.uni-hannover.de).

Application deadline: April 26, 2018, 10 p.m. Europe/London