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Accelerated deep learning approaches for vibro-acoustic digital twins VAMOR DC2

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Company: KU Leuven

Location: Leuven

Category: business-and-financial-operations

If you recognize yourself in the story below, then you have the profile that fits the project and the research group:

·I have a master degree in engineering, physics or mathematics and performed above average in comparison to my peers. I am not in possession of a doctoral degree at the date of recruitment.

·I am proficient in written and spoken English.

·I haven’t had residence or main activities in Belgium for more than 12 months in the last 3 years.

·During my courses or prior professional activities, I have gathered some basic experience with the basic physical principles of acoustics and the related numerical modelling techniques, such as the Finite Element Method (FEM), Boundary Element Method (BEM). I have a good knowledge of deep learning approaches and/or with the basic principles of Model Order Reduction or I have a profound interest in these topics.

·As a PhD researcher of the KU Leuven LMSD division I perform research in a structured and scientifically sound manner. I read technical papers, understand the nuances between different theories and implement and improve methodologies myself.

·Based on interactions and discussions with my supervisors and the colleagues in my team, I set up and update a plan of approach for the upcoming 1 to 3 months to work towards my research goals. I work with a sufficient degree of independence to follow my plan and achieve the goals. I indicate timely when deviations of the plan are required, if goals cannot be met or if I want to discuss intermediate results or issues.

·In frequent reporting, varying between weekly to monthly, I show the results that I have obtained and I give a well-founded interpretation of those results. I iterate on my work and my approach based on the feedback of my supervisors which steer the direction of my research.
·I feel comfortable to work as a team member and I am eager to share my results to inspire and be inspired by my colleagues.
·I value being part of a large research group which is well connected to the machine and transportation industry and I am eager to learn how academic research can be linked to industrial innovation roadmaps.
·During my PhD I want to grow towards following up the project that I am involved in and representing the research group on project meetings or conferences. I see these events as an occasion to disseminate my work to an audience of international experts and research colleagues, and to learn about the larger context of my research and the research project.

This doctoral project is part of a larger, multidisciplinary and international project VAMOR: “Vibro-Acoustic Model Order Reduction” (GA 101119903) funded under the Marie-Sklodowska-Curie Actions Doctoral Networks within the Horizon Europe Programme of the European Commission.
VAMOR contributes to a more sustainable and quieter future for Europe. Noise pollution has arisen as one of the key factors towards the degradation of the quality of life in European societies. In that context, efficient physics-based sound modelling is a key enabler towards not only optimized and sustainable acoustic profiles through efficient design procedures, but also affordable so-called digital twins that monitor product performance in real time. To this end, the overarching goal of VAMOR is to provide high level scientific and transferable skills training on a new generation of efficient vibro-acoustic modelling techniques, so-called model order reduction (MOR) strategies, to a group of high achieving, competent doctoral candidates to promote a quieter and more sustainable environment. VAMOR brings together a remarkable consortium, which combines research leading academic institutions - KU Leuven, Technische Universitaet Munchen (TUM), Technical University of Denmark (DTU), Kungliga Tekniska Hoegskolan (KTH), Universite du Mans, Conservatoire National des Arts et Metiers (CNAM) - with a constantly innovating, wide variety of industrial partners working on software, material, testing, design and sound enhancement (Siemens Industry Software NV, Müller BBM, Trèves, Phononic Vibes, Saint-

Gobain Ecophon, Tyréns, Purifi ApS).

Doctoral Candidate 2 (DC2) within VAMOR will develop novel deep learning approaches to obtain a digital twin that is trained using both physics based metamodels/insights and measurements on the physical asset. To accelerate the training of the machine learning architecture, reduced order models of vibro-acoustic systems are expected to play a key role in data generation, due to their rapid evaluation as compared to their full order model counterpart. Besides the usage of physics based reduced order models, also the addition of physical constraints in the machine learning architecture through physics informed neural networks will be considered to speed up the training. Finally, the addition of measurement data in the reduced physical models will be explored with the aim to obtain a more representative parameter dependent digital twin. The approach will be validated by investigating the sound radiated from a car tyre before and during operation. The DC will explore the combination of conventional MOR strategies with deep learning, physics-informed neural networks and inclusion of data in surrogate models.

Main Supervision at KUL: Prof. Konstantinos Gryllias and Prof. Elke Deckers.

Co-Supervision at CNAM: Prof. Lucie Rouleau.

The research is hosted by the Mecha(tro)nic System Dynamics division (LMSD), which currently counts >100 researchers and is part of the department of mechanical engineering of KU Leuven. The research group has a long track record of combining excellent fundamental academic research with industrially relevant applications, leading to dissemination in both highly ranked academic journals as well as on industrial fora. More information on the research group can be found on the website: https://www.mech.kuleuven.be/en/research/mod/about and our linkedIn page: https://www.linkedin.com/showcase/lmsd-kuleuven/. The PhD will be co-supervised by the Conservatoire National des Arts et Metiers Laboratory of mechanics of structures and coupled systems (LMSSC). The laboratory, located in the central area of Paris, currently counts >40 researchers mostly working on the development and validation of robust predictive models of dynamic coupled systems using adaptive treatments. The results of this research are mainly applied to the academic world, research centers and R&D department of high technology industries..The team has various industrial collaborations, mainly with aeronautics and naval industry. More information can be found on the website: https://lmssc.cnam.fr/en/content/structural-mechanics-and-coupled-systems-laboratory

·The possibility to study in a dynamic and international research environment in collaboration with industries and prominent universities worldwide.

·You will receive a monthly gross salary of 3400€ multiplied with the country specific coefficient of Belgium (1.0). The net income will result after the deduction of income tax, social contributions, and other permitted deductions that need to be considered. In addition to the net salary you will receive a mobility allowance of 600€.

·An opportunity to pursue a joint PhD in Mechanical Engineering both from KU Leuven and the Conservatoire National des Arts et Metiers, typically a 4 year trajectory, in a stimulating and ambitious research environment.

·The place of employment is Leuven, Belgium. In the context of the joint degree, you will spend in total 8 months in CNAM. An additional 2 month secondment is included in Siemens Industry Software (SISW) which is located in Leuven.

·Ample occasions to develop yourself in a scientific and/or an industrial direction. Besides opportunities offered by the research group, further doctoral training for PhD candidates is provided in the framework of the KU Leuven Arenberg Doctoral School (https://set.kuleuven.be/phd), known for its strong focus on both future scientists and scientifically trained professionals who will valorise their doctoral expertise and competences in a non-academic context. More information on the training opportunities can be found on the following link: https://set.kuleuven.be/phd/dopl/whytraining.

·EU Researcher allowances will be used to cover both the employee's as the employer's mandatory charges.

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