

PhD position on infinite-dimensional Bayesian inversion of physics-based models

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Company: KU Leuven

Location: Leuven

Category: computer-and-mathematical

We are looking for a candidate with a MSc degree in Civil or Mechanical engineering, obtained not earlier than 2020, and having an excellent background in structural mechanics.

Interested candidates should be motivated to complete a PhD within four years, starting as from 1 September 2024.

More information on becoming a PhD student at KU Leuven and living in Leuven can be found at <https://www.kuleuven.be/phd>, <https://set.kuleuven.be/phd> (Leuven Arenberg Doctoral School) and <https://www.kuleuven.be>. Depending on their background (MSc diploma, research experience), students may first need to pass a pre-doctoral test, e.g. selected courses (12 ECTS) and research work with presentation (3 ECTS), prior to being allowed to the PhD program.

This PhD project aims at the development of computational methods for infinite-dimensional Bayesian inversion of physics-based models in structural engineering. The work is motivated by recent developments in high-resolution sensing and monitoring of structures, which provide near full-field data (strains, accelerations, displacements). Such data can be used to identify parameters of models of structures (typically a finite element model), but also the dynamic loads acting upon the structure, as well its state (displacement and velocity at every degree of freedom). Since parameters such as the stiffness or loads depend on position and time, these represent field variables, explaining the need to address the identification or inversion in an infinite-dimensional setting. Currently available methods are not adapted to this problem setting and typically only working well for a small, finite number of variables to be identified.

The choice for Bayesian inversion is motivated by the fact that the Bayesian framework allows accounting for measurement and model uncertainty, by identifying a posterior distribution of the sought after variables as opposed to a single value.

The target of the overarching project is the development of Bayesian computational methods for these inverse problems and aims both at increasing their validity, and at reducing their computational cost. As a prototypical system with a lot of future and wider application potential, the monitoring (structural health of) structures (such as buildings or wind turbines) excited by wind loads are considered. The focus of this PhD project is the development of methods tailored to a context of structural engineering.

This PhD position is supervised by Prof. Geert Lombaert (Department of Civil Engineering), and co-supervised by Prof. Giovanni Samaey (Department of Computer Science). The position is based in the Structural Mechanics Section of the Department of Civil Engineering at the University of Leuven (KU Leuven). The Department of Civil Engineering is nicely located in and around the Arenberg Castle on Campus Arenberg in Heverlee, one kilometre from Leuven's city center. The research is part of the larger project "Computational methods for infinite-dimensional Bayesian inversion of physics-based models in engineering applications" led by Prof. Giovanni Samaey, Prof. Geert Lombaert, Prof. Dirk Nuyens and Prof. Johan Meyers. The research will be done in close collaboration with 5 other PhD students funded on the project, as well as researchers working on complementary related projects. Environment Research in the Structural Mechanics Section (<https://www.kuleuven.be/bwm>) of the Department of Civil Engineering focuses on the static and dynamic analysis of structures and is structured along six research lines: vibrations in the built environment, structural identification and evaluation, building acoustics, shape and topology optimization, computational structural engineering and human-induced vibration of civil engineering structures. The PhD position fits in the second line where the section has a long standing tradition in research on Structural Health Monitoring.

A remuneration package competitive with industry standard in Belgium, a country with a high quality of life and excellent health care system. The remuneration consists of a net monthly salary of about 2400 Euro (in case of dependent children or spouse, the amount can be somewhat higher). Following Belgian law, the salary is automatically adjusted for inflation based on the smoothed health index.

An opportunity to pursue a PhD in Civil Engineering in a 4-year trajectory, in a stimulating

and ambitious research environment with a strong track record in the research topic.

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 valorize their doctoral expertise and competences in a non-academic context. More information on the training opportunities can be found via the following link: <https://set.kuleuven.be/phd/dopl/whytraining> .

A stay in a vibrant environment in the hearth of Europe. The university has approximately 50,000 students and is located in Leuven, a town of approximately 100,000 inhabitants, located close to Brussels (25km), and 20 minutes by train from Brussels International Airport. This strategic positioning and the strong presence of the university, international research centers, and industry, lead to a welcoming environment with ample opportunities for social, cultural and sports activities. The mixture of cultures and research fields are some of the ingredients making the university of Leuven the most innovative university in Europe (<https://nieuws.kuleuven.be/en/content/2019/four-years-in-a-row-ku-leuven-once-again-tops-reuters-ranking-of-europes-most-innovative-universities>). Further information can be found on the website of the university: <https://www.kuleuven.be/english/life-at-ku-leuven> .

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