University of Stuttgart
Germany

Institute of Structural Mechanics and Dynamics

RESEARCH ASSISTANT

Applications (female/male/diverse) are invited for an exciting 3-year fully-funded **research position** at the Institute of Structural Mechanics and Dynamics at the University of Stuttgart, Germany.

The position is initially limited to a period of 3 years. An extension to complete the PhD is possible within the time limits of the Wissenschaftszeitvertragsgesetz (WissZeitVG).

This PhD position will be based in the DFG research project "Method Development for Robust Hybrid Knowledge- and Data-driven Model Order Reduction for Deformable Porous Fluid-Saturated Materials". High-fidelity simulations for fluid-saturated porous materials are usually extremely costly. This is opposed to the need of answering relevant engineering questions, such as inverse parameter identification (IPI), optimization, or uncertainty quantification (UQ), for which a high number of simulation runs is required. Therefore, developing model order reduction methods (MOR), which maintain a reasonable balance between accuracy and computational efficiency is extremely demading. Most MOR methods lie in either knowledge-driven or data-driven reduction categories.

In order to resolve this issue, this project aims to develop innovative MOR techniques that hybridize both categories. For knowledge-driven MOR, a key feature that will be utilized is that many porous materials can be (partially) assumed thin materials with a geometrical scale separation. Based on this, the method of asymptotic expansions will be used to derive knowledge-driven reduced models. The ability to perform analytical error estimation is a key advantage here. However, some essential physics will be ignored due to the simplifying assumption. This weakness will be taken into account in the planned hybrid MOR approach, where the knowledge-based MOR approach is combined with a data-driven one. For data-driven MOR, special deep learning techniques, such as standard artificial neural networks and variational autoencoders will be developed. Furthermore, hybrid combinations of the pure knowledge- and data-driven MOR approaches will be designed to describe nonlinear materials with mixed-type complex geometries. Finally, all models will be validated and tested for robustness and computational efficiency for IPI, optimization, and UQ.

What you can expect:

- Mathematical derivation of a knowledge-driven reduced biphasic model for nonlinear porous materials of thin structure
- Developement of innovative error estimates and selection criteria to improve the accuracy and efficiency of the knowledge-driven reduced model
- Collaboration in the development of data-driven reduction approaches based on solutions from both high-fidelity full model and knowledge-driven reduced model
- Testing and validation of the models by applying them to systems for different engineering applications
- Collaboration in the development of hybrid knowledge- and data-driven MOR methods
- Interdisciplinary work with scientists from different research areas (engineering, natural sciences, medicine)
- Participation in national and international conferences to promote professional exchange
- Participation in teaching (helping with lectures and seminars, independent conducting of exercises as well as participation in examination matters)
- Supervision of students, including bachelor's/master's theses
- Possibility of doctoral studies is given

What we expect:

- Completed university studies (diploma or master) in the field of engineering, preferably in aerospace, civil engineering, mechanical engineering, mathematics, physics, technomathematics, computational mechanics, computational engineering or comparable
- Excellent knowledge of applied mechanics and/or structural analysis
- Programming experience
- Experience in the following areas: FEM, continuum mechanics, material theory, homogenization
- Teamwork and interdisciplinary mindset
- Confident appearance, good presentation style
- Very good German and good English skills, both written and spoken

Pay scale of the position: A 100% TV-L 13 position

Please e-mail your complete application documents including CV, certificates, list of grades (master and bachelor) to:

Prof. Dr.-Ing. Tim Ricken
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Please send your application by e-mail in a pdf file containing cover letter, curriculum vitae, certificates and, if applicable, further documents. If this is not possible for you, you can also send us your application in paper form. Please note that we unfortunately cannot return application documents. Therefore, please do not submit any original documents, as we will destroy the application documents in accordance with data protection regulations once the procedure has been completed.

The University of Stuttgart would like to increase the proportion of women in the academic field and is therefore particularly interested in applications from women. Severely disabled persons will be given priority if equally qualified. As a certified family-friendly university, we support the compatibility of work and family, and of professional and private life in general. We have an employee health management system that offers our employees a wide range of continuing education programs. Our Welcome Center helps international scientists getting started in Stuttgart.

For preliminary information please contact

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