

## **PhD position (for three years)**

### **Coupling Effects in Re-Programmable Micro-Matter**

Programmable matter based on self-folding origami was introduced a decade ago as a concept to generate arbitrary 3D shapes from originally planar sheets, using shape memory alloys (SMAs) as hinge actuators. Among all active materials SMAs like NiTi exhibit highest power densities upon thermal actuation due to a first order phase transition. At the Institute of Materials Simulation at FAU Erlangen-Nürnberg we want to extend this concept to enable reversible shape changes and reduce the dimensions to the sub-mm scale: The NiTi actuators are supported by switchable ferromagnetic thin film patches as additional active material to fold and lock the microstructure.

In this challenging project we collaborate with the IFW Dresden (material development) and the Karlsruhe Institute of Technology (micro fabrication). This thesis work will cover the modeling and simulation part, and plays a central role for progressing. Close cooperation and communications with the partner institutes is expected. We are looking for a person with background in physics, materials science, numerics or computational engineering. The candidate should have good skills in several/all of the following: continuum mechanics, thermodynamics, programming, data analysis and simulation. Based on existing finite element SMA models reduced order representations will be found and applied to the complex thermo-magneto-mechanical coupling in this fascinating multi-actuator system.

The Institute of Materials Simulation (WW8) at the Friedrich-Alexander University of Erlangen-Nürnberg conducts modeling and simulation studies on a broad range of disordered systems, network structures and functional materials, from atomistic to continuum scales. Recent simulation tools, both open source and commercial, are available, and access to high performance computing is provided. The PhD thesis has a pronounced interdisciplinary character and opens views into different fields of materials science, micro technology and simulation. The work is situated within a priority program of the German Science Foundation (SPP 2206) that includes regular workshops with participants, publication of scientific results in international journals and presentation on international conferences. The time duration of the PhD thesis is scheduled for three years, which will be ensured through close supervision and collaboration within an interdisciplinary team.

The position is full-time, and payment follows the German TV-L 13 scale. Starting date is as soon as possible, please send applications in electronic form (pdf) only. The University of Erlangen-Nürnberg intends to increase the number of women in research and teaching positions and, therefore, strongly encourages female researchers to apply. Disabled applicants will be preferentially considered in case of equivalent qualification.

**Field of activity:**

Extending material model for SMAs with fatigue, magnetic film interaction  
Conducting FEM simulations of single/multiple actuator structures  
Writing manuscripts for publication in international peer-reviewed journals  
Traveling to KIT (Karlsruhe) and IFW (Dresden) to learn about materials and techniques  
Participation at national and international conferences

**Necessary proficiency:**

Master degree in physics, materials science, computational engineering (or similar)  
Background in continuum mechanics, thermodynamics, finite element method  
Preliminary experience in scientific programming / scripting

**Desirable proficiency:**

Numerical methods  
Good skills in spoken and written English  
Enthusiasm for learning, communicating and teaching

**Remarks:**

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**Detailed information / applications to:**

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