FRIEDRICH-ALEXANDER UNIVERSITÄT ERLANGEN-NÜRNBERG
TECHNISCHE FAKULTÄT

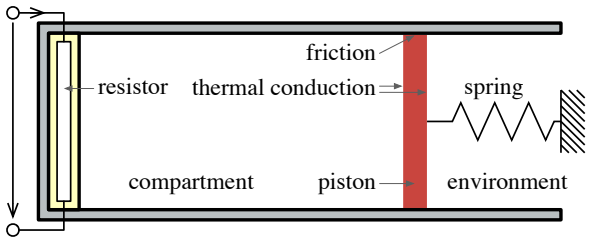
Lehrstuhl für Technische Dynamik
Prof. Dr.-Ing. habil. Sigrid Leyendecker

Thesis

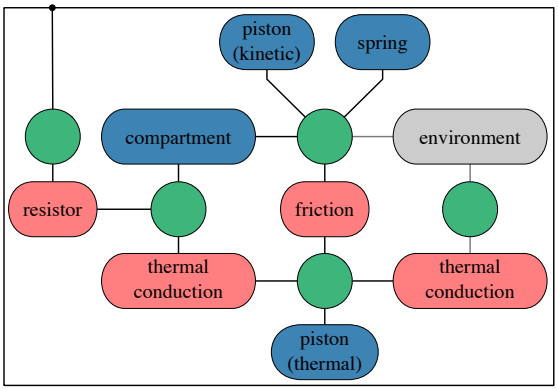
Sustainable Systems Engineering

mechanics + thermodynamics, compositionality, sustainability, optimization/control

The Institute of Applied Dynamics is looking for students who wish to prepare their bachelor, master or project thesis as part of a relatively new project. Its goal is the development of a compositional framework enabling modular and hierarchical modeling of multiphysical systems. The considered class of systems is defined based on two types of geometric structures: the first one (shown below in green) represents the interconnection structure and reversible energy exchange and the second one (shown in red) represents irreversible processes. The definition of these geometric structures already asserts the first and the second law of thermodynamics. A diagrammatic language is directly related to the compositional structure of the model. The example below features a cylinder-piston device:



sketch of a piston-cylinder device



diagrammatic expression of the corresponding model

A major task is to contribute to the development of a software library which shall first and foremost enable efficient modeling of multiphysical systems based on the diagrammatic syntax. Further, the development of algorithms for simulation, thermodynamic analysis, optimization, and control design is of central interest. Preserving and exploiting the compositional and geometric structure is a major theme of the project. Possible applications include multi-energy systems, heat engines, buildings, ...

prerequisites

- background in any of the following fields: applied mathematics, computer science, mechanics, thermodynamics
- strong *basics* of computer science (excluding object-oriented programing)
- strong *basics* of linear algebra
- interest in physics, sustainability, and computer-aided engineering

nice to know

- Julia programming language
- LaTeX, Git
- numerical methods
- multibody dynamics
- (geometric) numerical integration
- optimal control

If you are interested, please write an email to markus.lohmayer@fau.de.