Master / Project Thesis

in Computational Engineering, Applied Mathematics, or similar

Compositional multibody/multiphysics simulation framework

The thesis project is concerned with time-discretization and/or computer implementation of multibody dynamics and/or other multiphysics simulation models, which are expressed within a novel modeling language. The language can be used for mechanical and electromagnetic systems (in the sense of classical physics) combined with irreversible processes (assuming local thermodynamic equilibrium). The language has a simple graphical syntax for expressing how increasingly complex systems are formed by interconnecting simpler subsystems. The subsystems may again comprise of further subsystems, etc. At the lowest level, primitive systems represent basic physical behaviors, namely storage as well as reversible and irreversible exchange of energy. Interconnection means that systems share energy domains and an expression in the graphical syntax essentially is a diagram that shows how the respective subsystems may interact by exchanging energy. An example is shown in Figure 1. Structural properties of the language ensure that any model is consistent with the first and the second law of thermodynamics.

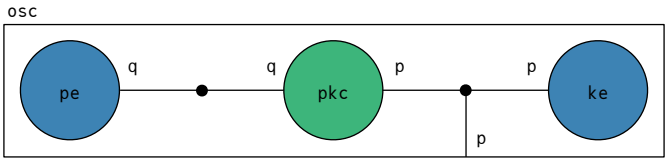

Figure 1: Interconnection pattern for a mechanical oscillator model. Boxes `pe` and `ke` represent storage of potential and kinetic energy, respectively. Box `pkc` represents the reversible coupling between the potential energy domain, represented by the junction on its left, and the kinetic energy domain represented by the junction on its right. The outer port `p` exposes the kinetic energy domain, allowing for an external forcing of the oscillator.

While the topic is of an interdisciplinary nature, the focus of the thesis can be placed on either mechanics/applied mathematics (modeling and discretization) or computer science (implementation). If this sparks your interest, please contact markus.lohmayer@fau.de.