technische universität
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Fakultät für Elektrotechnik
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Institut für Energiesysteme,
Energieeffizienz und
Energiewirtschaft

Master thesis 17.03.2026

Modeling of Power System Components in Modern Open Source Environment for Dynamic Stability Studies (in cooperation with Fraunhofer IEE)

In modern electric power systems, there is a paradigm shift from large central power plants to decentralised and renewable power generators and battery storage. The numerous smaller units increase the complexity of power systems. In particular, the dynamic stability (in the time-frame of milliseconds to seconds) of such systems is a growing concern, as such converter-dominated systems have lower rotational inertia due to the absence of synchronous machines. Simulations for dynamic stability assessment create a high computational burden, due to many potential scenarios which need to be simulated. This demands sophisticated dynamic simulation environments and models.

We aim at creating a modern open source simulation tool which is competitive in performance, open and extendable compared to commercial software such as DIgSILENT PowerFactory. You would be part of our effort to create a dynamic model of the German Power transmission system with thousands of buses, distributed generators, storage and loads. We are developing an open source simulation software package called PowerDynamics.jl (juliaenergy.github.io/PowerDynamics.jl/dev/), which is a state of the art tool built upon the scientific machine learning environment (“SciML”) in the modern “Julia” programing language for high-performance symbolic-numeric computation in scientific computing and scientific machine learning.

The main tasks include:

- Creating models of power system components for PowerDynamics.jl using the state of the art modeling language ModelingToolkit.jl (github.com/SciML/ModelingToolkit.jl) for high-performance symbolic-numeric computation in scientific computing
- Components include power electronic controllers, PV, Wind, battery storage, electrolyzers, loads,.. (to be discussed also based on your preferences)
- Modeling of dynamic behavior according to grid codes (transmission system operator specifications)
- Performing dynamic stability studies of modern low inertia power transmission systems (transient stability, fault-ride-through, etc.) and evaluation of the simulation results

Requirements:

- Knowledge of electric power systems
- Good programming skills e.g. in Julia (preferred), Python, C++, etc. and willingness to improve
- Preferably knowledge of modelling languages, such as ModelingToolkit.jl, Modelica or Simulink
- Preferably knowledge of numeric (time-domain) simulations and power system dynamic models

The work can be done in Kassel/Dortmund or remote. The thesis can be written in German or English language. The application deadline is 16.04.2026.

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