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Research Software Engineering in the Energy Domain as Part of NFDI4Energy

Energy researchers often use (self-written) software as a starting point to perform research. Also, this software can be the result of research in this domain, like simulation tools. Research software presents an important research artifact in energy research. Therefore, the National Research Data Infrastructure for the Interdisciplinary Energy System Research (NFDI4Energy) addresses the handling of research software across the entire research and transfer cycle within energy system research projects. For this, the FAIR data principles are applied not only to data but also to software.
To improve the FAIRness of research software in the energy domain, we focus on three main aspects:

1. Improve the findability of research software through a registry based on a software ontology
2. Improve interoperability and especially reusability of research software through a simulation middleware
3. Provide an ontology-based approach for integrated development of energy system simulation scenarios through reuse of existing software models

We develop an energy simulation software ontology and a model registry, to improve the findability of research software. The ontology provides a structured overview of different modeling approaches and serves as a guide for researchers. Although, we aim to make the ontology as broad as possible, it only sometimes provides detailed depth in all modeling branches. Therefore, we allow experts to add details for their specific areas of expertise. The software registry complements the ontology and includes links to implementations of simulation techniques as well as test cases and other resources.

The simulation of energy systems often requires the interconnection of models from different disciplines. For this, co-simulation allows the combination of existing models and enables a comprehensive simulation. Co-simulations pose two main problems -the interconnection of different components and data exchange in the model, which leads to technical and conceptual challenges. In addition, potential users of such a coupled simulation model might need more knowledge or resources to implement a co-simulation independently. NFDI4Energy aims to provide easy access to simulation middleware that enables different types of co-simulation.

The complexity and diversity of domains and models in energy system simulation scenarios further require an ontological integration of semantics and domain knowledge in the planning, execution, and evaluation process of interdisciplinary energy system simulations. In this context, we develop ontological structures that integrate specialized hardware-in-the-loop (HIL) and laboratory testing in power system simulation scenarios. We base our approach on an information model that formalizes relationships and properties of simulation models and components and includes references to external model and component registries and the domain-specific ontology.

Overall, NFDI4Energy focuses on multiple supporting activities surrounding reproducible research and best practices in energy system modeling and simulation. This includes a high focus on the (re)use of research software. We would like to present these different aspects regarding research software within NFDI4Energy as a poster. We think that this overview fits perfectly to the scope of the deRSE conference 2024.

Slot length

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