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MuPIF: Multi-Physics Integration Platform

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A reliable multiscale and multiphysics numerical modeling requires including all relevant physical phenomena along the process chain and across multiple scales. The complexity of problems requires combination of knowledge from different fields. This brings in also the changeless for software engineering and design. There is a strong need for integration platforms, that enable integration of existing simulations tools and databases into complex simulation workflows, providing capability to exchange information and efficiently use available computing resources. Traditional approaches use syntactic interoperability based on specific communication protocols and conversion tools. The more attractive approaches are based on semantic interoperability, where data are exchanged together with their meaning, which allows for machine interpretation, translation, and verification [1].

The presented contribution introduces multi-physics integration platform MuPIF [2]. MuPIF is a distributed, object-oriented framework written in Python. The top level abstract classes are introduced for models (simulation tools) and generic data types. They define abstract interfaces allowing to manipulate and steer derived classes (representing individual models and specific data representations) using the same generic interface. One of the key features of the MuPIF platform is the definition of abstract interfaces for models as well as for high level data types (spatial fields, microstructures, etc.). This allows to achieve true plug&play architecture. As the same concept is applied for high level data, the platform natively supports different data formats, storage schemes and even data repositories.

MuPIF supports distributed workflows, where individual simulations and data can be executed/stored on remote computers, providing security, authentication, and resource allocation. This allows running MuPIF on various systems, network setups and integrate in-house or commercial codes. Recent simulation chains proved MuPIF capabilities on opto-thermal, CFD, and phase thermodynamic models using Matlab, Comsol, X-stream, Micress and other codes. At present, the MuPIF is used in COMPOSELECTOR project [3] to design innovative composite materials.

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