

Porto – A Framework for information interchange and multi-scale fluid dynamics simulations

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ABSTRACT

An essential part of the Porto framework design is the ability to share the same meta-data between applications, while accessing the data through different backend systems for reading and writing data. In addition, Porto has defined its own API for numerical codes that can be run as plug-ins. The different models implemented directly or indirectly through this API can be instantiated from a meta-model as part of the workflow, such that the model instance can be interchanged in the system. Meta-models and meta-data goes hand in hand in a hierarchical workflow description that allows independent simulations to share data.

To demonstrate the features of the newly developed framework, the flow of information during a typical application, i.e., the simulation of heat transfer within a dense particle bed, is illustrated. Therefore, historic data generated via detailed flow simulations is retrieved from a database, analysed, and handed over to a multi-physics flow model describing transport processes on a larger length scale. We compare this novel framework with a traditional, cumbersome way of establishing the flow of information and discuss the merits of our approach with respect to result quality, reproducibility and reusability.

Furthermore, The Porto framework is demonstrated by plugging in an existing packed bed reactor simulator written in Fortran. This simulator solves species and energy balances both along the length of the reactor and within the particles, which make up the packed bed. It can therefore incorporate kinetic data from materials modelling or thermogravimetric (TG) experiments to predict the performance of an industrial scale reactor. Advantages of incorporating this existing code into the Porto framework is the purification of the model representation – allowing this to be represented by meta-models, and leaving the instantiation of the model and all I/O to the framework.

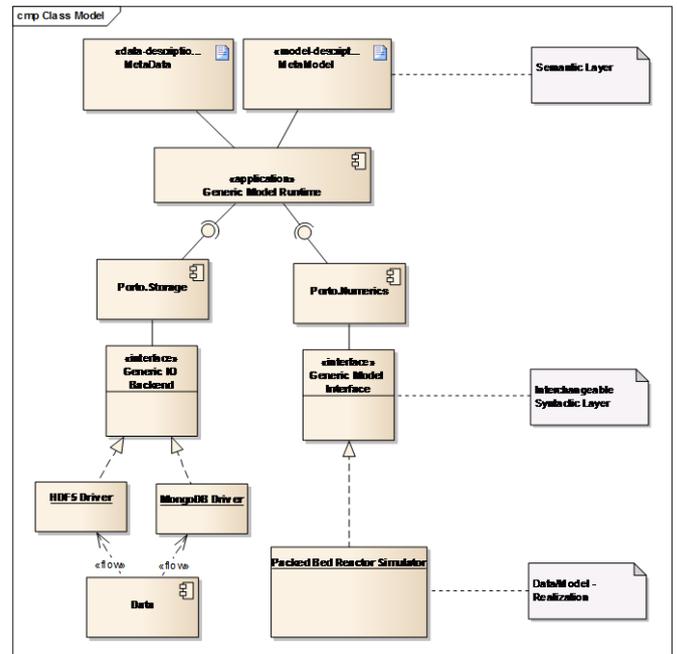


Figure 1 Overview of an application architecture for a packed bed reactor simulation use-case, from semantic, syntactic and realization level