

Applications of the coupling-library preCICE in SimTech

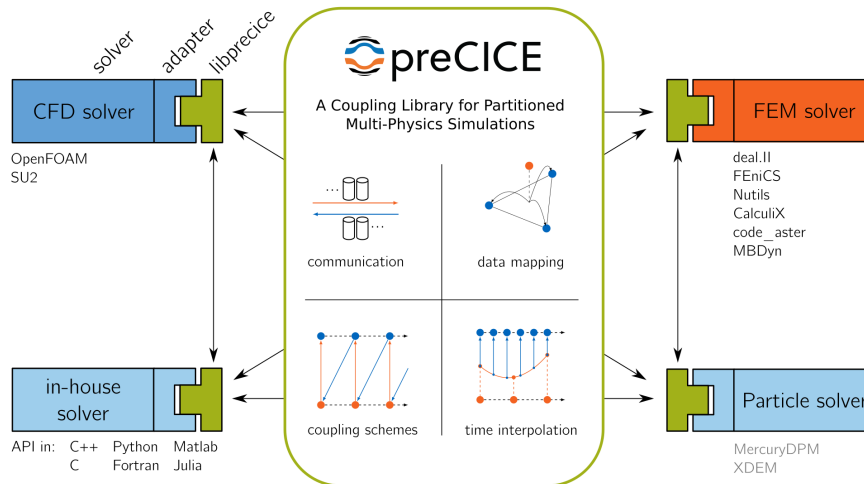
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The open-source coupling library preCICE [1] enables the simulation of partitioned multi-physics simulations by gluing together separate software packages. It offers methods for data communication, equation coupling, and data mapping. This poster shows concepts and recent development advances of the library, which enable highly-efficient coupled simulations on massively parallel compute clusters.

Although preCICE itself is written in C++, it offers high-level application programming interface (API) functions for a variety of programming languages such as Julia, Python, Matlab or C. The API functions enable the exchange of coupling data via preCICE and steer the simulation time loop in the solver in a minimally-invasive way. For data communication, preCICE relies on a point-to-point communication concept between parallel processes in order to avoid global communication as much as possible. In order to cope with strongly coupled scenarios, sophisticated quasi-Newton acceleration methods are configurable in preCICE. For data transfer between non-matching meshes, preCICE provides a multitude of fully-parallelized data mapping methods.

Nowadays, preCICE consists not only of the core library itself, but also a variety of tutorial cases, coupled solvers, and extensions. The recent development of a so-called Micro Manager [2] enables the use of preCICE in multiscale coupling in a flexible and adaptive way.



References

- [1] Chourdakis, G and Davis, K and Rodenberg, B and Schulte, M and Simonis, F and Uekermann, B. et al. 2022. preCICE v2: A sustainable and user-friendly coupling library [version 2; peer review: 2 approved]. *Open Research Europe*. 51:2.
- [2] Desai, I and Bringedal, C and Uekermann, B. 2022. A flexible software approach to simulate two-scale coupled problems. DOI: [10.23967/eccomas.2022.037](https://doi.org/10.23967/eccomas.2022.037)