RADIAL BASIS FUNCTION INTERPOLATION FOR BLACK-BOX MULTI-PHYSICS SIMULATIONS

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ABSTRACT

Flexible and extensible partitioned multi-physics simulation environments require efficient and modular tools with a broad and customizable coupling functionality. PreCICE [1] is a library for flexible numerical coupling of single-physics solvers. It uses a partitioned black-box coupling approach, thus requiring only minimal modifications to existing solvers. This fact and a clean API foster quick and effortless integration into an existing codebase. Software packages currently coupled with preCICE comprise both commercial and academic solvers, with a particular focus on fluid-structure interaction. preCICE is written in C++ and features a clean and modern software design with extensive unit and integration testing while maintaining minimal external dependencies. Inter-solver parallelism, parallel communication and data mapping techniques will help to exploit future exa-scale computers.

The resulting fixed-point problem can be solved by various pluggable coupling schemes. Selectable schemes include parallel as well as serial ones using implicit or explicit coupling. Communication and data mapping between coupling participants is done in a decentralized fashion by a peer to peer approach thus minimising blocking barriers in the process. This distributed data approach is reflected in areas such as the simulation steering, e.g. setting of timestep lengths where one client acts as primus inter pares. Coupling schemes and mapping methods have also been adapted to work on distributed data. Data mapping between non-conformal meshes can be done by methods ranging from nearest-neighbor to radial-basis-function interpolation. In our talk we will put special emphasis on distributed implementation of the data mapping features and the P2P communication, while the paper focus solely on the radial basis function interpolation.

REFERENCES

[1] Bungartz, H.-J. and Lindner, F. and Mehl, M. and Uekermann, B. A plug-and-play coupling approach for parallel multi-field simulations, Computational Mechanics, Vol. 55, (2015)