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Parallel Scalable Domain Decomposition Methods in Pharmaco-Mechanical Fluid-Structure Interaction

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Abstract

Today, cardiovascular diseases are among the leading causes of death worldwide.
With a special focus on the treatment of hypertension and the clinical consequences, thereof, the computational modeling of fluid-structure interaction with pharmaco-mechanical effects becomes vastly relevant.
Therefore, the state of the art of fluid-structure interaction is extended to reflect the influence of drugs on the structural properties of arterial walls leading to a fully coupled fluid-structure-chemical interaction, denoted as FSCI.
Highly-scalable parallel GDSW (Generalized Dryja–Smith–Wildund) preconditioners have been implemented in the solver framework FROSch (Fast and Robust Overlapping Schwarz), which is part of the software library Trilinos and can easily be applied to the geometry and structure blocks in an FSI simulation framework.
Furthermore, these methods have also been extended to monolithic GDSW-type preconditioners for fluid flow problems; the parallel implementation is also available in FROSch.
Ultimately, we plan to solve the resulting FSCI linearized system with a Krylov method preconditioned by the FaCSI preconditioner which was introduced by Deparis, Forti, Grandperrin, and Quarteroni in 2016. The inverses appearing in FaCSI will be approximated by GDSW-type overlapping Schwarz preconditioners.

In this short talk, some first results and a brief summary of the methodology will be presented based on our software FEDDLib (Finite Element and Domain Decomposition Library) and Schwarz preconditioners from the Trilinos package FROSch.

JLESC topic

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