A generic framework for the partitioned solution of strongly coupled multifield problems

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ABSTRACT

We will present a flexible and generic C++ framework for the numerical solution of strongly coupled multifield problems. The application of a partitioned approach enables the use of different numerical methods, discretizations and solvers for the individual fields. In this way, optimized, existing software can be reused, increasing the efficiency of the simulation. Due to the nature of the partitioned approach, the coupling of the different solvers for the individual fields calls for methods that support an accurate data transfer and help to stabilize and accelerate the overall solution process. For the acceleration of the partitioned solution approach we apply and further develop different variants of the quasi-Newton least squares method. The numerical methods for the data transfer and convergence acceleration are implemented in our software framework *comana* [1], which facilitates the application of different coupling strategies for a vast range of multifield problems. The interaction with different solvers is achieved through a uniform interface to the solvers' databases.

The software framework *comana* has been successfully applied to the solution of different multifield problems. We will present several applications demonstrating the flexibility of our approach. The problems we will consider include electro-thermo-mechanical coupling which is of interest, for example, in field-assisted sintering technology. Furthermore we will address the partitioned solution of fluid-structure interaction problems which arise in many different engineering disciplines. The applications we will present range from the analysis of blood flow in arteries [2] to maritime applications, where complex situations such as the landing manoeuvre of service ships to offshore wind turbines are simulated [3].

REFERENCES

[1] König, M. and Radtke, L. and Düster, A. A flexible C++ framework for the partitioned solution of strongly coupled multifield problems. *Comput. Math. Appl.* (2016) **72**:1764–1789.

[2] Radtke, L. and Larena-Avellaneda, A. and Debus, E. S. and Düster, A. Convergence acceleration for partitioned simulations of the fluid-structure interaction in arteries. *Comput. Mech.* (2016) **57**:901–920.

[3] König, M. and Ferreira González, D. and Abdel-Maksoud, M. and Düster, A. Numerical investigation of the landing maneuver of a crew transfer vessel to an offshore wind turbine. *Proceedings of the International Conference on Ships and Offshore Structures.* (2016) 1–24.