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A collaborative environment for high performance multi-physics simulations

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ABSTRACT

The context of industrial simulation is changing rapidly over the last decade: a transition is seen from single discipline simulation to simulation of coupled multiphysics ultimately combined with multidisciplinary optimization (MDO). At the same time the development teams are becoming more international with researchers of sometimes completely different background often physically spread over different locations. A side effect is that small expert teams (from universities or companies) have difficulties to contribute their valuable expertise because they have no means to support their own 3D simulation environment, while commercial developments are closed or not flexible enough.

Hence, two kinds of interaction problems are appearing in a collaborative environment. A technical problem arises about how different physical models and numerical methods can interact (among themselves and with exterior packages), and a human problem about how developers must interact when teams belong to different research centers, universities or industrial companies.

The paper addresses the software issues related to these two challenges. From a technical point of view, the coupling of different physics and numerical techniques shifts the emphasis to configurable coupling algorithms and to the creation of proper interfaces between each methodology, while requiring common standards e.g. for multidomain data storage and (parallel) handling. The human interaction problem shifts the emphasis to a transparent framework allowing modularity, reusability and flexible Intellectual Property Rights (IPR) management.

A solution is proposed and implemented based on a common framework that sustains a set of physical and numerical components which can be viewed as plug-ins:

- The common framework ensures a standard of development and a common architecture, while providing means for the diverse components to interact trough well defined interfaces. The framework is the basis of the human and software collaboration.
- Each partner contributes components that plug into the framework and work seamlessly together. The components implement the actual physical models and numerical methods. They can be joined together to form bigger components. IPR protection is provided at component level. To fix the ideas one can consider the

simple example of the same heat conduction component in the solid, which can be combined with two different flow solver components (e.g. provided by two different partners), in order to obtain a conjugate heat transfer application.

The main principles of the collaborative environment will be presented together with some case studies showing its use in multi-partner projects in aerospace (e.g. ADIGMA) involving both human and multidisciplinary interaction.

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