

# Multi-physics applications in HPC

## Multi-Code Coupling using the Alya system

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### ABSTRACT

Multi-physics problems are of great interest for applied fields, like engineering and bio-mechanics. In fact, it is really hard to imagine an industrial application where just one single physical theory is able to capture all its determining factors. In the HPC context, different extreme parallel codes have been developed through the last decades, and very powerful simulation tools are available nowadays for several independent research fields. Also, recent developments have relied in a multi-code coupling approach in order to be able to use the already existing scalable parallel applications to tackle multi-physics problems where a single code is unable to simulate the whole physical scenario or leads to inefficient performance. This multi-code coupling approach can result in very flexible and powerful parallel multi-physics applications, and some results of an specific implementation of this concept are presented in this contribution.

The developments were carried out using the Alya system [1], which is a parallel multi-physics code developed at the Barcelona Supercomputing Center - Centro nacional de Supercomputación (BSC-CNS). Test cases and actual research problems results for fluid-structure interaction (FSI) problems for wind energy generation, bio-mechanical applications for blood flow through the ascending aorta and solids contact problems are presented. The highly parallel aspects of the implemented approach are highlighted, the communications scheme described and the performance of the code measured.

### REFERENCES

- [1] J.C. Cajas, M. Zavala, G. Houzeaux, E. Casoni, M. Vazquez, C. Moulinec and Y. Fournier , *Fluid-Structure Interaction in HPC Multi-Code Coupling*, Civil-Comp Press, Proceedings of the Fourth International Conference on Parallel, Distributed, Grid and Cloud Computing for Engineering, 2015.