Thermo-mechanical problems: Eulerian-Lagrangian approach within Kratos-GiD framework

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Abstract

Fluid-structure interaction and, more generally, coupled problems define the ``hot-spots'' in the computational mechanics. Resolution of those requires both the tools for modeling/visualization and the efficient solvers. Here we present a combination of GID-pre/post-processor with Kratos-Multi Physics tool.

In particular we develop a coupled Eulerian-Lagrangian algorithm for solution of complicated thermo-mechanical problems involving thermo-mechanical interaction between an object (or viscous fluid) and the ambience. In the proposed approach the Lagrangian domain is moving on top of the fixed Eulerian mesh, following the core concept of embedded methods. The mechanical interaction is thus taking place on the Eulerian mesh, separated into real, fictitious, and interface sub-domains by the image of the Lagrangian domain onto Eulerian mesh. This approach permits to enjoy all the advantages of the Lagrangian method with respect to interface definitions, while save the computational effort associated with the re-meshing on a major part of the computational domain, that is treated by the Eulerian formulation.

Using compressible model for the ambience leads to two important advantages. First, it permits consideration of thermal problems without restriction upon temperature gradients (that exists when Boussinesq hypothesis-based solvers are used). On the other hand, compressibility of the ambience eliminates convergence problem of the FSI and permits the application of standard Dirichlet-Neumann coupling. However the results presented here are obtained by using one-way Dirichlet coupling, justified by the physical properties of the constituents in the problem of interest.

From the point of view of pre/post-processing,.our approach has a number of algorithmic peculiarities such as necessity of outputting simultaneously both the Eulerian and Lagrangian meshes as well as possibility of ``disabling'' parts of the domain. Some of these aspects are successfully tackled with the present version of GiD, while simplification of the implementation of the others still needs to be considered.