Comparison of Interpolation Algorithms on Non-Matching Meshes for Partitioned Thermo-Mechanical Fluid-Structure Interactions

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ABSTRACT

Fluid-Structure Interaction (FSI) aims to describe multiphysics problems where both fluid dynamics and structural mechanics are involved. The present work focuses on the partitioned coupling between a structural solver based on the Finite Element Method (FEM) and a fluid solver based on the Particle Finite Element Method (PFEM) [1] in order to simulate thermo-mechanical FSI involving free surface flows and large deformations of the domain. The coupling is performed by transferring nodal information (such as the heat flux, the mechanical load, the nodal temperature and the nodal displacement) between the two solvers, under the form of Neumann-Dirichlet boundary conditions imposed at the fluid-structure interface [2].

In many applications, this partitioned scheme also implies non-conforming meshes. For instance, when the fluid and the solid meshes contain elements of different characteristic sizes at their common interface. Consequently, a mesh-interpolation technique is required for the transmission of nodal information. In this work, the so-called Radial Basis Functions (RBF) [3] and K-Nearest Neighbours (KNN) interpolation techniques are compared on 2D and 3D test cases. Both are fast and flexible techniques requiring no topological information other than relative distances between nodes, allowing for a straightforward interpolation between non-conforming meshes. Moreover, Element Transfer Methods (ETM) are also considered.

The presentation starts with a brief introduction to the basic principles of the PFEM and the Neumann-Dirichlet partitioned coupling, followed by a discussion regarding the mesh-interpolation techniques. Finally, this work includes, but is not limited to, some examples and comparisons of results with respect to the literature.

REFERENCES

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