11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

NEW IMMERSED CAD METHOD FOR THE SIMULATION OF TURBULENT FLOWS PROBLEMS

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Key words: *Immersed methods, NURBS, CAD, Anisotropic mesh adaptation, Level-set.*

Today immersed methods for Fluid Structure Interaction (FSI) such as the embedded boundary method, the immersed Boundary method, the fictitious domain, the Immersed Volume method [4] and the Cartesian method are gaining popularity in many scientific and engineering applications. All these techniques have been developped in order to simplify a number of issues in FSI applications such as problems involving large structural motion and deformation, topological changes, meshing the fluid domain or using a fully Eulerian algorithm.

However they operate on non-body fitted mesh which implies a special consideration of the interface. Recent researches are focusing on issues related to the detection and the intersection algorithms for the interface, the transmission of boundary conditions between the solid and the fluid domains and the immersion of a surface mesh [8] as well. Nevertheless it appears that these methods are limited by the quality and the accuracy of the surface mesh describing the immersed solid.

We contribute a new approach for the immersion method simplifying and bypassing the generation of a surface mesh. It is based on the use of Computer Aided Design (CAD) of the objects which which is defined by Non Uniform Rational B-Splines (NURBS) curves or surfaces. These functions can represent simple or complex geometries. We compute the distance function from any point in the fluid mesh to these NURBS, thus representing the immersed solid by the zero iso-value of this function. The computation of the distance function mainly relies in three steps. The first one is a preprocessing step consisting in patching the NURBS functions [9] . Then the use of a Newton method allows the calculation of the desired distance. However many methods for distance computation relatively to NURBS functions can be found in the literature, they have never been used to compute level-set functions and solve FSI problems.

Therefore instead of relying on the resolution of the surface mesh, the proposed method uses directly the Computer Aided Design (CAD) definition and keeps the quality of its analytical description. In practice, it eliminates the surface mesh generation step of the object and reduces the complexity to set up a FSI application. Combined with anisotropic mesh adaption it provides an attractive immersed framework.

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