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SIMULATION OF A PROPOSED FLUID-STRUCTURE INTERACTION VALIDATION CASE

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A new validation test case for large-deformation Fluid-Structure Interaction (FSI) codes is proposed, and simulations of the experimental setup are presented. This validation case extends previous benchmarks in the literature, by providing high Reynolds number, turbulent, three-dimensional experimental and computational data for FSI algorithms and solution methods comparison. The proposed case consists of a flexible flag attached to a vertically mounted square rod immersed in fully developed pipe flow. This flow is created in the test section of ARL/PSU's twelve-inch water tunnel loop facility. As the flow passes over the square rod, vortices are generated which subsequently excite the flag and cause it to oscillate. The deformation of the flag is the key metric used for experiment-simulation comparison, similar to the two-dimensional laminar computational benchmark of Turek and Hron [1].

A high-resolution simulation of the proposed experiment is performed using an FSI solver previously developed at ARL/PSU [2]. This solver implements a partitioned, overset grid enabled ALE-based method for the solution of tightly coupled FSI problems. In particular, overset meshes are attached to the immersed deformable structure, and permitted to move independently of the static background mesh. The overset grid capability is the enabling technology to allow large deformation of body fitted meshes, required to capture the turbulent boundary phenomena, without the need to re-mesh or distort the grid beyond usability. This approach also allows for simplified meshing of complex geometries, and a reduced domain size for mesh motion calculations, providing for significant reductions in computational cost. Comparison of computational results to experimental measurements are presented.

REFERENCES

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