Three Dimensional Fluid-Structure Interaction Model Problems Solved Using Stabilised Finite Element Analysis

Richard Taylor
College of Engineering, Swansea University

In this presentation, a variety of external and internal flow three-dimensional FSI model problems are presented in the hopes of establishing benchmarks for future comparison. Challenges such as the selection of material properties and boundary conditions are discussed, and comparisons are made with existing publications and available analytical solutions.

The numerical techniques used to solve the model problems consist of the monolithic Newton, block Gauss-Seidel and novel staggered solvers previously developed and presented by Dr. W.G. Dettmer and Prof. D. Perić. A summary of the solution algorithms will be presented along with a small analysis of relative performance. The focus in this work is restricted to laminar incompressible Newtonian fluid flow, with the fluid domain discretised using stabilised finite elements adapted to capture the motion of the fluid mesh along the fluid-solid interface.

The model problems to be presented consist of :

External flow:
· a soft elastic beam fixed at both ends
· a thin cantilever plate

Internal flow:
· a slender flexible pipe fixed at both ends
· a slender pipe with a “weak patch”
· a slender pipe fixed at one end