ADAPTIVE SPACE-TIME AEROELASTIC BRIDGE SIMULATIONS

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Problems involving Fluid-Structure Interaction (FSI) are important in many engineering branches. Not long ago, the only approach possible to tackle these problems was by means of costly tests in wind or water facilities. More recently, with the development of new hardware combined with the growth of computational mechanics, engineers have gained access to numerical tools for understanding, modeling and designing solutions for FSI problems.

The simulation of complex 3D FSI problems with all relevant physical aspects may exceed the computing capacity of the fastest computers available. Nonetheless, considerable progress is being made in the simulation of turbulence with Large Eddy Simulation (LES), in the development of high performance parallel codes and in the use of adaptive techniques to optimize accuracy of numerical solutions. Our approach involves LES with implicit turbulence modeling of sub-grid scales. This is combined with time-space adaptive techniques based on remeshing and on the use of suitable local time steps [3]. The FSI problems are described using Arbitrary Lagrangian-Eulerian co-ordinates to facilitate the implementation of dynamic and kinematic fluid-structure compatibility conditions.

Our main objective is the FSI analysis associated to the flow around a dominant central span of Rio-Niteroi bridge, in Rio de Janeiro, Brazil. This bridge is a crucial link in a 10 million people area, and has been subjected to severe wind induced oscillations, sometimes causing traffic shutdowns. This aeroelastic bridge problem was studied first by extensive experimental campaigns [1] and semi-analytical methods [2]. We have then moved towards more refined innovative numerical simulations using the above mentioned techniques. In this presentation these techniques are reviewed, and several demonstration problems are shown. Then we finally show the simulation of cross wind effects in Rio-Niteroi bridge, comparing our results with the available experimental data.

References

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