

# AN EFFICIENT MESH UPDATING TECHNIQUE FOR FLUID STRUCTURE INTERACTION PROBLEMS

Zacharias S. Mouroutis, George A. Markou, Dimos C. Charmpis,  
Dimitris G. Koubogiannis and Manolis Papadrakakis,

National Technical University of Athens  
Athens, Greece  
e-mail: zachmour@central.ntua.gr

**Key words:** Coupled Problems, Solution Algorithms, Mesh Updating

**Abstract.** *The purpose of this paper is to present a robust mesh updating technique combined with an efficient solution algorithm applicable to large-scale fluid-structure interaction problems. We show that a combination of the dimensional torsional spring concept and a preconditioned conjugated gradient type method, for the solution of the “elasticity” problem, provides a powerful tool for this computationally intensive problem.*

## 1. INTRODUCTION

The numerical simulation of loosely coupled fluid-structure interaction problems arises in many engineering applications including parachute dynamics, airfoil oscillation, flutter prediction, hydrodynamic design and other aeroelastic instability problems. In such applications, when some of the fluid domain boundaries undergo a motion with a large amplitude it becomes necessary to solve the flow equation on a moving or regenerated mesh. If the grid is not regenerated, then the mesh has to be dynamically updated. In the first approach, the fluid mesh is deleted and is regenerated from the beginning using the surface of the structure as boundary condition. In the second approach, the grid points that lie on the structures boundary can move, but are staying always attached to this boundary. In the dynamic mesh update the mesh is considered as an elastic body with imposed displacements on its boundaries.

The first approach is rather easy to implement but happens to be computationally expensive for 3D applications. The second approach is more involved in its formulation since interpenetration of neighbouring elements must be avoided during the movement. Different methodologies have been proposed in the context of this second approach. Some of them are more computationally efficient, but less robust with respect to element (or node) interpenetration, while others are more robust but very time consuming. The most common methodologies, which have been used until now, are the lineal spring analogy, the torsional spring analogy and other similar methods. On the basis of the previously described difficulties the ideal method should combine robustness and efficiency, by preventing interpenetration of neighbouring tetrahedral and keeping the computation time to the minimum.