**8th. World Congress on Computational Mechanics (WCCM8)**
**5th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)**
**June 30 –July 5, 2008**
**Venice, Italy**

# A FULLY INTEGRATED FLUID-STRUCTURE INTERACTION METHODOLOGY AND APPLICATIONS

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**Key Words:** *Fluid-Structure Interaction, Computational Methods, Vascular Blood Flow*

## ABSTRACT

In this talk, fluid-structure interaction procedures are developed from basic principles. The *space-time mapping* and the associated *space-time Piola transformation* emerge as the key ingredients of the mathematical theory enabling a straightforward derivation of the equations of motion on moving domains in their various forms. Suitability of the space-time and arbitrary Lagrangian-Eulerian (ALE) approaches for discretizing the different forms of the equations of motion, and the implications for geometric and momentum conservation are discussed. The ALE framework is adopted and the numerical procedures are derived focusing on the monolithic solution strategy and the consistent linearization of the coupled system. This fully integrated approach is used to solve problems of vascular fluid-solid interaction. Two application of the human cardiovascular system are presented. One is modeling and simulations of left ventricular assist devices (LVADs). The other is fluid-structure interaction in intracranial cerebral aneurysms.