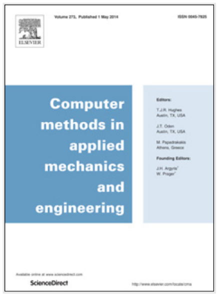
Accepted Manuscript



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PII: S0045-7825(16)31047-7
DOI: http://dx.doi.org/10.1016/j.cma.2016.12.003
Reference: CMA 11249

To appear in: *Comput. Methods Appl. Mech. Engrg.*

Received date: 1 September 2016
Revised date: 3 November 2016
Accepted date: 5 December 2016

Fast fluid-structure interaction simulations using a displacement-based finite element model equipped with an explicit streamline integration prediction

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Abstract

We propose here a displacement-based updated Lagrangian fluid model developed to facilitate a monolithic coupling with **a wide range of structural elements described in terms of displacements**. The novelty of the model consists in the use of the explicit streamline integration for predicting the end-of-step configuration of the fluid domain. It is shown that this prediction considerably alleviates the time step size restrictions faced by the former Lagrangian models due to the possibility of an element inversion within one time step. The method is validated and compared with conventional approaches using three numerical examples. Time step size and corresponding Courant numbers leading to optimal behavior in terms of computational efficiency are identified.

Keywords: incompressible flows, Navier-Stokes, fluid-structure interaction, Particle Finite Element Method, Lagrangian, coupled problems

1. Introduction

Fluid models based on Lagrangian descriptions of motion have proven to be advantageous for treating free-surface flows and problems that involve large motion of interfaces, such as fluid-structure interaction (FSI) problems. Since in Lagrangian approaches the computational mesh follows the fluid

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