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AN UNSTRUCTURED FINITE VOLUME SOLVER FOR A NEW CONSERVATION LAW IN FAST TRANSIENT DYNAMICS

M. AGUIRRE, A.J. GIL, J. BONET, C.H. LEE

Civil & Computational Engineering Centre,
College of Engineering, Swansea University, Swansea SA2 8PP
e-mail:{m.aguirre, a.j.gil, j.bonet, c.h.lee}@swansea.ac.uk

Abstract. Since the advent of computational mechanics, the numerical modelling of fast structural dynamics has been a major field of interest in industry. Traditionally, a Lagrangian formulation is employed for the numerical simulation of these problems and low order spatial interpolation is preferred for computational workload convenience. The well known second order solid dynamics formulation, where the primary variable is the displacement, is typically discretised in space by using the Finite Element Method (FEM) and discretised in the time domain by means of a Newmark (trapezoidal) time integrator [1]. However, it has been reported that the resulting space-time discretised formulation presents a series of shortcomings. From the time discretisation point of view, the Newmark method has a tendency to introduce high frequency noise in the solution field, especially in the vicinity of sharp spatial gradients. From the space discretisation point of view, the use of isoparametric linear finite elements leads to second order convergence in displacements, but only first order convergence for stresses and strains. It is also known that these elements exhibit locking phenomena in incompressible or nearly incompressible scenarios.
Recently, a new mixed methodology [2] has been developed in the form of a system of first order conservation laws, where the linear momentum and the deformation gradient tensor are regarded as the two main conservation variables. The current paper will present and compare different techniques used for solving this methodology. Specifically, cell centred Finite Volume, Two Step Taylor Galerkin, Stream Upwind Petrov Galerkin (SUPG) and the Jameson-Schmidt-Turkel (JST) will be presented. The paper will focus on new developments towards the efficient implementation on unstructured meshes.

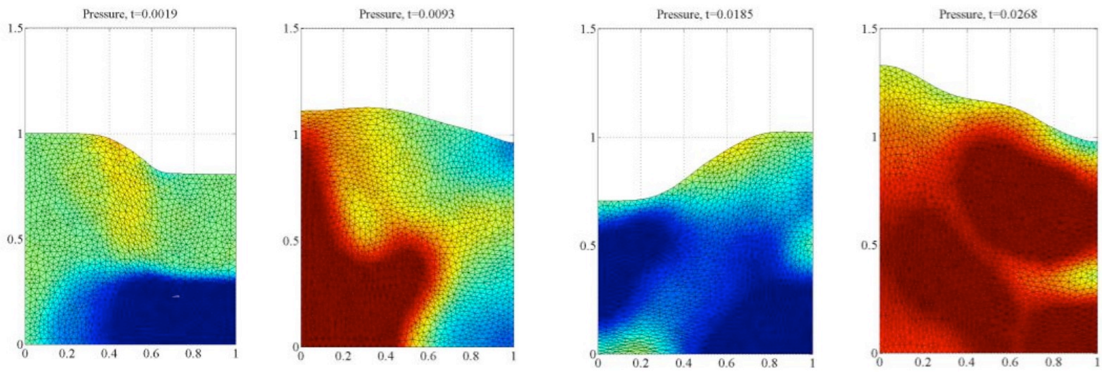

Figure 1 An example of fast dynamics solved using the JST method on unstructured meshes.

REFERENCES

[1] D. J. Benson, Computational methods in Lagrangian and Eulerian Hydrocodes. Computer Methods in Applied Mechanics and Engineering, 99:235-394, 1992.
[2] C. Lee, A. Gil, and J. Bonet, Development of a cell centred upwind finite volume algorithm for a new conservation law formulation in structural dynamics, Computers and Structures, accepted.