6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

An interface-aware subscale dynamics closure model for voids and solids

A. Barlow[1], M. Shashkov[2] and M. Klima[3]

[1] Computational Physics Group, AWE Aldermaston, Reading, Berkshire, RG7 4PR, UK, andy.barlow@awe.co.uk

[2] X-Computational Physics, XCP-4, Los Alamos National Laboratory, Los Alamos, NM 87545, USA, shashkov@lanl.gov

[3] Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Trojanova 13, Praha 2, 120 00, Czech Republic, klimamat@fj.cvut.cz

Keywords: *shock hydrodynamics, multi-material hydrodynamics, Lagrangian methods, ALE methods.*

Multimaterial cells are often used in Arbitrary Lagrangian Eulerian (ALE) codes to represent material interfaces that undergo high deformation and cannot be modelled robustly with a Lagrangian treatment. A separate set of material properties is normally maintained for all the materials in each multimaterial cell along with the volume fractions that define the proportion of the cells volume occupied by each material. A closure model is then required to close the governing equations, which are otherwise underdetermined, that is, to define how the volume fractions and states of the individual material components evolve during the Lagrangian step.

The interface-aware sub-scale-dynamics (IA-SSD) closure model [1] consists of two stages. During the first, bulk stage, the well known equal compressibility model is used. During the second stage, sub-scale interactions of the materials inside the multimaterial cell are taken into account. Each material interacts in a pair-wise fashion with the materials with which it has a common boundary. The interactions are based on the solution of the acoustic Riemann problem between each pair of materials and is limited using physically justifiable constraints: positivity of volume, positivity of internal energy and controlled rate of pressure relaxation.

The method developed in [1] was only formulated for gas dynamics. The closure model has now been extended for void opening, void closure and solids. The extensions to the method will be presented and assessed on a series of test problems involving solids.

REFERENCES

[1] A. Barlow R. Hill and M. Shashkov, “Constrained optimization framework for Interface-aware sub-scale dynamics closure model for multimaterial cells in Lagrangian and arbitrary Lagrangian-Eulerian hydrodynamics”, *Journal of Computational Physics*, 276, pp. 92–135, 2014.