Improvements to multi-material modelling in a 3D ALE code

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Keywords: multi-material hydrodynamics; ALE methods; interface reconstruction.

ABSTRACT

AWE's three-dimensional Arbitrary Lagrangian Eulerian (ALE) code, Pegasus, has been enhanced to make use of Youngs' interface reconstruction method [1, 2] in the advection and pin crossings algorithms.

The new advection scheme, replacing the Cale algorithm [3, 4], first determines the order in which the materials in a multi-material cell should be advected, as described by Bell and Hertel [5], based on the abundance of each material in the donor and acceptor cells. The normal to the interface between each material is calculated in isoparametric coordinates so that distorted elements can be treated as unit cubes, allowing Youngs' interface reconstruction method to then be used to determine the overlap of each material with the advection volume. The new algorithm is of comparable speed and the results of test problems are presented which show that numerical errors such as beading are reduced.

Youngs' method has also been used in the new pin crossings algorithm. The original algorithm established when pins crossed a Lagrangian surface while the new algorithm is based on multi-material cell representation of the surface, which is useful when the material surface is no longer in line with the Lagrangian surface as a result of an ALE calculation. Knowledge of the location of each pin is maintained, so when a pin is seen to enter a pure (single-material) cell of the material of interest it is immediately recorded as having crossed the material. If the pin enters a mixed (multi-material) cell, first the isoparametric coordinates of the pin within the cell are calculated and compared with the location of the interface as calculated using Youngs' algorithm. Thus it can be determined if the pin has crossed the material interface within the multi-material cell. The results of test problems demonstrating the accuracy of the new algorithm are presented.

References

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