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

# A multi-directional HLLC-type Riemann solver for unstructured meshes for compressible hydrodynamics

**Jianzhen Qian**

Institute of Applied Physics and Computational Mathematics, Beijing, 100094, China, qian_jianzhen@iapcm.ac.cn

**Keywords**: *Compressible hydrodynamics, Riemann solver, Unstructured meshes*

We present a new type of multi-directional Riemann solver (denoted by MD-HLLC) and the associated numerical method for compressible hydrodynamics on arbitrary unstructured meshes in two dimensional space. This work is an extension of the cell-centered Lagrangian method of D. Burton et al [1] to Eulerian framework. In [1], a nodal-centered multi-directional Riemann solver was proposed for cell-centered lagrangian hydrodynamics which was shown to have increased robustness for resolving complex multi-dimensional flows with strong shocks. We follow the same methodology as in [1] to introduce the contact velocity defined on the grid node, and the edge-wise viscous stress tensor. The edge flux is constructed consistently with the node velocity via exploring jump relation across each nonlinear wave. The contact velocity of the grid is determined via enforcing conservation of momentum and total energy. The new solver differs from traditional solver in that the waves sampling directions associated to each edge does not have to be aligned with the edges and can have independent directions. Moreover, It is essentially multi-dimensional upwinding and preserves good properties as the traditional HLLC solver, such as positivity and contact preserving. The first and second order numerical schemes based on the MD-HLLC solver are constructed and numerical tests are present to show the robustness and accuracy of these schemes.

## REFERENCES

[1] D. Burton, T. Carney, N.Morgan, S.Sambasivan, M. Shashkov, A cell centered Lagrangian Godunov-like method of solid dynamics. *Comput. Fluids*, Vol. **83** pp. 33–47, 2013.