Advances in Automobile Engineering

Extended Abstract

Fluid Dynamics & Aerodynamics 2018 : High-accurate meshless formulations for non-smooth compressible flows

Xesus Nogueira and Luis Ramirez

Abstract

Numerical simulation is nowadays a fundamental tool in science and engineering. It is involved in almost every discipline, and it is used in almost every field of research. In particular, computational fluid dynamics (CFD) has become an essential tool in both design and research. The development of numerical methods for the simulation of problems involving highly complex geometries, which are frequent in many engineering problems, remains a very active research field in computational fluid dynamics. However, current CFD methods suffer from a series of drawbacks: The use of CFD in the aerospace design process is severely limited by the inability to accurately and reliably predict turbulent flows with significant regions of separation and; nowadays, the standard numerical techniques in CFD are mainly grid-based methods. Mesh generation and adaptivity continue to be significant bottlenecks in the CFD workflow. In this context, the use of meshless methods may be interesting for problems involving deformable or moving boundaries in the propagation media or multiphase flows. Moreover, these methods do not require a mesh for the discretization, and then they can overcome one of the most important bottlenecks in the design process. In this work, we propose a new high-accurate, stable and low dissipative meshless method based on a Galerkin discretization of a set of conservation equations on an arbitrary Lagrangian Eulerian (ALE) approach, using moving least squares as weight functions for the Galerkin discretization. Differently to most common smooth particle hydrodynamics (SPH) approaches, the proposed method uses Riemann solvers instead of the artificial viscosity approach to prevent oscillations near shocks. The stability of the scheme is achieved by the recent a posteriori multi-dimensional optimal order detection paradigm. Using moving least squares (MLS) functions the partition of unity property is verified even near shocks, which allows the method to obtain very accurate results. Recent Publications 1. E Gaburov and K Nitadori (2011) Astrophysical weighted particle magnetohydrodynamics. Monthly Notices of the Royal Astronomical Society 414:129???154. 2. P F Hopkins (2015) A new class of accurate, mesh-free hydrodynamic simulation methods. Monthly Notices of the Royal Astronomical Society 450(1):53-110. 3. S Clain, S Diot and R Loubre (2011) A high-order finite volume method for systems of conservation laws - multidimensional optimal order detection (MOOD). Journal of Computational Physics 230:4028???4050. 4. X Nogueira, L Ramrez, S Clain, R Loubre, L Cueto Felgueroso and I Colominas (2016) High-accurate SPH method with multidimensional optimal order detection limiting. Computer Methods in Applied Mechanics and Engineering 310:134???155

3rd International Conference on Fluid Dynamics & Aerodynamics. October 25-26, 2018 | Berlin, Germany

Xesus Nogueira and Luis Ramirez
University of A Coruna, Spain
Email : xnogueira@udc.es