World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:9, No:04, 2015

3D Codes for Unsteady Interaction Problems of Continuous Mechanics in Euler Variables

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Abstract : The designed complex is intended for the numerical simulation of fast dynamic processes of interaction of heterogeneous environments susceptible to the significant formability. The main challenges in solving such problems are associated with the construction of the numerical meshes. Currently, there are two basic approaches to solve this problem. One is using of Lagrangian or Lagrangian Eulerian grid associated with the boundaries of media and the second is associated with the fixed Eulerian mesh, boundary cells of which cut boundaries of the environment medium and requires the calculation of these cut volumes. Both approaches require the complex grid generators and significant time for preparing the code's data for simulation. In this codes these problems are solved using two grids, regular fixed and mobile local Euler Lagrange - Eulerian (ALE approach) accompanying the contact and free boundaries, the surfaces of shock waves and phase transitions, and other possible features of solutions, with mutual interpolation of integrated parameters. For modeling of both liquids and gases, and deformable solids the Godunov scheme of increased accuracy is used in Lagrangian - Eulerian variables, the same for the Euler equations and for the Euler- Cauchy, describing the deformation of the solid. The increased accuracy of the scheme is achieved by using 3D spatial time dependent solution of the discontinuity problem (3D space time dependent Riemann's Problem solver). The same solution is used to calculate the interaction at the liquid-solid surface (Fluid Structure Interaction problem). The codes does not require complex 3D mesh generators, only the surfaces of the calculating objects as the STL files created by means of engineering graphics are given by the user, which greatly simplifies the preparing the task and makes it convenient to use directly by the designer at the design stage. The results of the test solutions and applications related to the generation and extension of the detonation and shock waves, loading the constructions are presented.

Keywords : fluid structure interaction, Riemann's solver, Euler variables, 3D codes
Conference Title : ICCFDM 2015 : International Conference on Computational Fluid Dynamics and Mechanics
Conference Location : Venice, Italy
Conference Dates : April 13-14, 2015