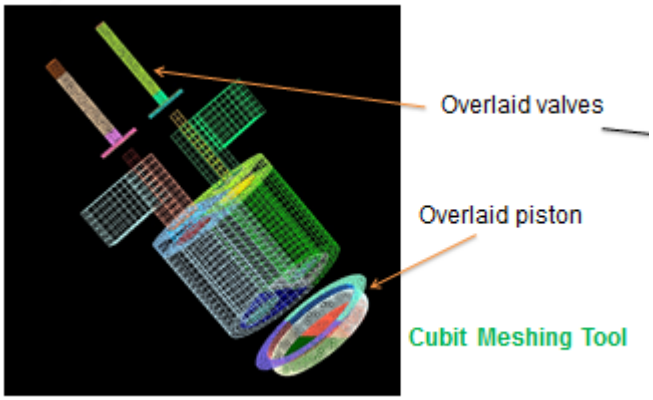
A Local ALE Method for Flows with Moving Boundaries

Abstract

A numerical method for fluid flow calculations in domains containing moving rigid objects or boundaries is developed. The method falls into the general category of Arbitrary Lagrangian - Eulerian (ALE) methods, but differ from previous formulations in that it is based on a fixed mesh. The mesh is modified locally in space and time to describe the moving interfaces. The interfaces are allowed to move independently over the mesh. The method is shown to be fully robust; during the simulations it never requires re-meshing and needs only a minimal amount of interpolation. The method is being developed to be incorporated into the Los Alamos National Laboratory KIVA simulator for internal combustion engines.

The accuracy of the algorithm is assessed using an analytical solution for flow between separating parallel plates and is found to be of second order. The technical issues that arise from this approach are discussed and examples of application in incompressible flows are shown that illustrate the robustness of the technique and its full capability to perform simulations involving irregular meshes and moving boundaries of complex shape.



Test Engine with 3D ALE begins