APCOM & ISCM
11-14th December, 2013, Singapore

Airbag Deployment Analysis Using Monolithic Coupling Method Based on Level Sets

***G. Hashimoto[1] and H. Okuda[1]**

[1] Department of Human and Engineered Environmental Studies Graduate School of Frontier Sciences, The University of Tokyo, Japan

*Corresponding author: ghashimoto@k.u-tokyo.ac.jp

Various FSI simulation methods have been recently developed and applied. However, it is still difficult to solve large-deformation FSI problems such as airbag deployment. These problems might include self-contact of thin structure in some cases. So far we have developed a Lagrangian-Eulerian partitioned coupling method based on level sets in order to deal with some fluid/thin-elastic-structure systems. In this method, computational meshes are divided into an overlapping, moving Lagrangian mesh for the structural domain and a fixed Eulerian mesh for the fluid domain. And furthermore, we express the large-deformable interface as a zero level set on the fluid Eulerian mesh. As the difference from other Lagrangian-Eulerian coupling methods, our algorithm has two characteristics: generation of the accurate level set function by using virtual nodes arranged in the normal direction to the structure, and extrapolation/interpolation of velocity component by using the level sets so as to impose the kinematic coupling condition at the interface.

In this study, a Lagrangian-Eulerian monolithic coupling method with above-mentioned two characteristics is developed as another approach to analysis large-deformation FSI problems robustly. The kinematic coupling conditions are imposed at the interface by applying the Lagrange multipliers and the level sets. We deal with airbag deployment as the verification. As the results, we confirm that the airbag inflates by the air flow with high density and pressure, and show the algorithmic performance.

Keywords: Fluid-Structure Interaction, Monolithic Coupling Method, Level Set, Lagrangian-Eulerinan Coupling, Parallel Computing