Update on CPM for Airbag Modelling

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1 Abstract

The out of position (OOP) airbag studies was initially conducted by traditional LS-DYNA FEM based FSI. Unfortunately, the method required lots of computing resources and encountered many limitations. Corpuscular particle method (CPM) was then introduced to avoid those problems about 10 years ago.

CPM is a meshless method based on the Kinetic Molecular Theory. Each particle represents many gas molecules. In general, it is a coarse grained multi-scale method for gas dynamics obeying ideal gas law. This method can predict well between OOP safety simulations and tests. Recently, airbag design gets more sophisticated which contains extra internal parts or separated compartments, etc. In order to catch the effect of those added features, CPM method is continuously improved and added new options to meet those challenges. In this paper, we will introduce few enhancements.

The first is the new feature for initial air option, iair=1. Originally, this option is only fill initial volume of the bag with UP air. During the initial deployment, the bag pressure may go under ambient pressure due to the huge impulse created by the inflator jets. The bag pressure is less than the environment and it makes the bag very hard to open. If this airbag has unblocked vents, those vents should allow ambient air into the bag in the real situation. This added energy will make the bag easier to deploy than without the effect as shown in Figure 1.

This feature is added in the recent LS-DYNA and simply sets iair option to -1. Based on the photo taken by using schlieren method, our customer showed the gas through the internal vent forms a jet instead random distribution, Figure 2. A new option is implemented under *DEFINE_CPM_VENT to allow rearranging particle release direction after passing through the internal vent, Figure 3. The particle distribution matches well with experiment using this new feature. The deployment shape and peak force are also matched well using the new method [1].

2 Figures

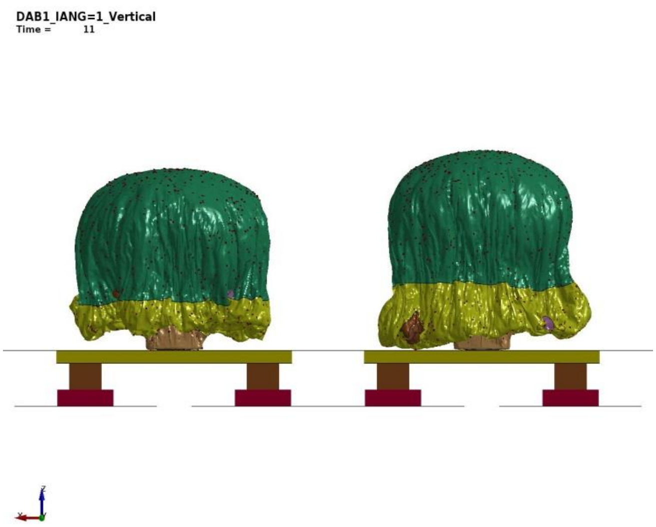

Fig.1: . Deployment with/without aspired ambient air

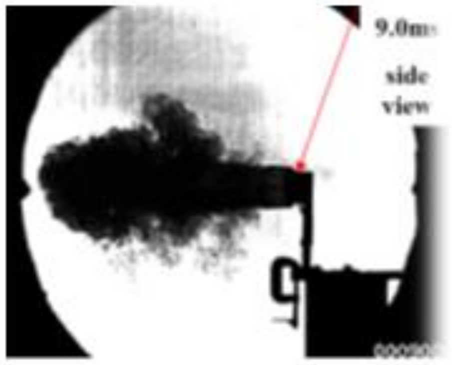

Fig.2: . Inflator as flow taken using schlieren method

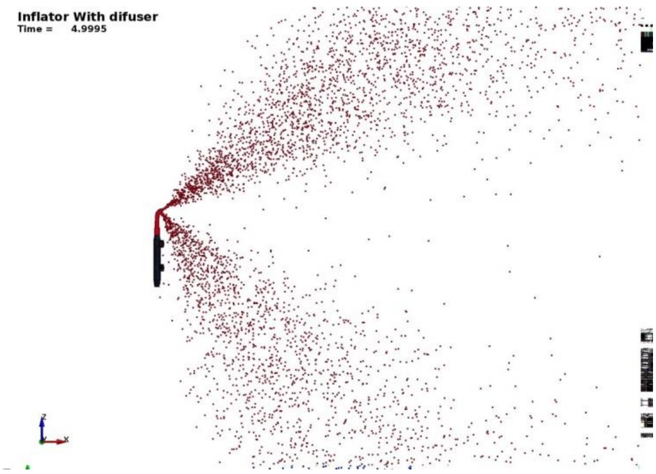

Fig.3: . Option with Jetting option

3 Literature

[1] H. Ida, M. Aoki, M. Asaoka, K. Ohtani,"A Study of gas flow behavior in airbag deployment simulation",24th International Technical Conference on the Enhanced Safety of Vehicles(ESV). No. 15-0081, 2015.