Journal

International Journal of Crashworthiness ›

Volume 13, 2008 - Issue 2

Original Articles

Multiphysics out of position airbag simulation

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Pages 159-166 | Received 05 Mar 2007, Accepted 25 Oct 2007, Published online: 20 Mar 2008

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Abstract

The deployment of an airbag is most fatal and dangerous to a passenger when it is in an out of position (OOP) situation, with the airbag making contact before it is fully inflated. This can lead to severe, if not life threatening, injuries to the passenger. This situation is more commonly associated with small females and children who are positioned near to the airbag module, i.e. in an OOP load case. The aim of this research is to assess the response of a Hybrid III 5th percentile female anthropomorphic dummy positioned in an FMVSS 208 low risk static airbag deployment OOP load cases using a transient dynamic finite element program called LS-DYNA. The simulation considers the standard procedures utilised in the LS-DYNA, where assumptions such as uniform airbag pressure and temperature are made, along with a more recently developed procedure that takes into account the fluid-structure interaction between the inflating gas source and the airbag fabric, referred to as arbitrary Lagrangian Eulerian (ALE) theory. Both simulations were compared to test data received by Jaguar, indicating satisfactory results in terms of correlation, with the more recently developed procedure, ALE theory, showing the greatest accuracy, both in terms of graphical and schematic comparison, especially in the very early stages of the inflation process. As a result, the new simulation procedure model was utilised to research into the effects of changing the designs of the airbag module.

Keywords: out of position, fluid structure interaction, control volume, airbag simulation, LS-DYNA, dummy interaction, ALE