Prediction of Occupant Injury in an Out-of-Position Impact Using the Fluid Structure Interaction Capabilities in LS-DYNA

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Occupant restraint systems such as seatbelts and airbags are designed to cushion the motion of the occupant when a collision occurs. For an occupant sitting in a normal driving or passenger position, the airbag significantly reduces the risk of sustaining injury in the event of a crash. However, for occupants who are close to the airbag (out of position) when it deploys, injuries from the deploying bag are frequent (Dalmotas et al. 1996). The injuries were primarily to the head and neck of the occupant.

Mechanical tests of the performance of an airbag for out of position occupants is time consuming and costly. Combining mathematical simulations with mechanical testing can make this process more cost and time efficient. In the control volume airbag models for in position occupants the pressure inside the bag is assumed to be uniform at each time step. For predictive modeling of the inflation process of an airbag, this method of modeling was shown to be insufficient (Fredriksson 1996). Therefore, both the gas and the structure have to be discretized for the model to be predictive in the early phases of airbag inflation. Recently it has been shown that it can be accomplished for simple cases of airbag deployment (Marklund 2002). However, since the inflation of the airbag is inducing injuries to the head and neck of the occupant, the aim of this presentation is to evaluate the applicability of simulations including airbag, dummy and steering wheel. The configurations are the 5% Hybrid-III dummy with the chin on the steering wheel and with the chin on the airbag module. The model predictions are compared to results from corresponding mechanical tests. Head accelerations, neck forces and neck moments are of particular interest.

The mechanical tests are carried out by Autoliv Research and the simulations are carried out by Engineering Research Nordic. In the tests, the steering wheel is a circular steel plate and the gas generator is a gas generator simulator developed at Autoliv Research. The airbag is a folded generic 2D driver side airbag with a volume of approximately 60 l.

References

Dalmotas (1996), Air Bag Deployment Crashes in Canada, 15th International Technical Conference on the Enhanced Safety of Vehicles. Melbourne 1996
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