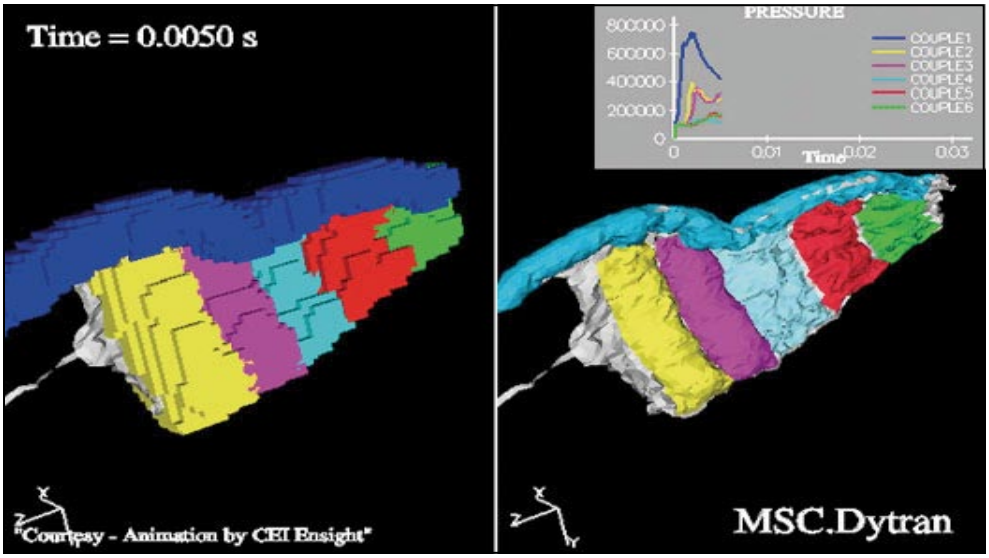
Autoliv Uses MSC.Dytran® for Simulation of Innovative Side-Curtain Airbag



"MSC.Dytran gives us a tool to study design variations and their resultant impact."

Customer:
Autoliv, Inc., Sweden
www.autoliv.com

Software:
MSC.Dytran®

Summary:
Autoliv, the world's largest manufacturer of automotive safety equipment, has developed side-curtain airbag systems by using MSC. Dytran to simulate the dynamic events that occur during inflation, such as gas flow and enclosure impact stiffness. MSC.Dytran provides Autoliv with an effective tool to study OOP (outof-position) scenarios, enabling engineers to identify and quantify the impact of numerous design variables. The software provides real value in terms of reducing the time and overall development effort required, compared to conventional prototype build and test methods.

Side-curtain airbags have demonstrated the ability to help reduce the possibility of ejection and serious injury during automotive collisions. Engineers developing these new types of airbags are aided by Virtual Product Development tools (VPD), which allow the engineer to more fully analyze the airbag mechanism and dynamic inflation. Autoliv, the world's largest manufacturer of automotive safety equipment, has developed side-curtain airbag systems by using MSC.Dytran to simulate the dynamic events that occur during inflation, such as gas flow and enclosure impact stiffness.

"I often use MSC.Dytran to model fluid flow - the dynamic inflation of the airbag - and interaction with the deployment of the airbag," says Jesse Crookston, product analyst, Autoliv. "The software aids in understanding more about the physical mechanisms and in optimizing the components. For example, if the model shows high stresses in certain areas, which correlates to an experiment, we can then test numerous variations in the model to optimize the design."

According to the U.S. Insurance Institute for Highway Safety (IIHS), nearly 60% of all side-impact crash fatalities are a result of serious head injuries. The Inflatable Curtain (IC), developed and patented by Autoliv, deploys downward from above the vehicle's doors to protect the heads of front- and rear-seat passengers in side-impact collisions.

One of many airbag design issues that must be considered is rapid deployment. Typically, frontal collisions with automobiles or stationary objects can be over in as little 100 milliseconds; in side collisions, the crash event may be over in as little as 50 milliseconds. To provide effective restraint, inflation of the airbag must occur in significantly less time if it is to be effective.The traditional method for inflating an airbag is often a pyrotechnic device very much like igniting solid propellant in a solid rocket booster. The chemical reaction creates a gas that rapidly inflates the cushion, causing it to deploy from its enclosure and fill in, in as little as 20 milliseconds, protecting the driver and passengers. The Inflatable Curtain developed by Autoliv deploys to cushion the heads of the driver and passengers seated next to the sides of the vehicle. The system consists of four major components, including the sensor, inflator, metal or plastic housing, and cushion. The cushion is stored behind the headliner in the rail above the doors.

MSC Software

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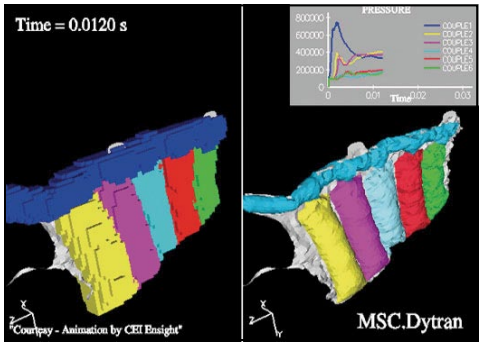

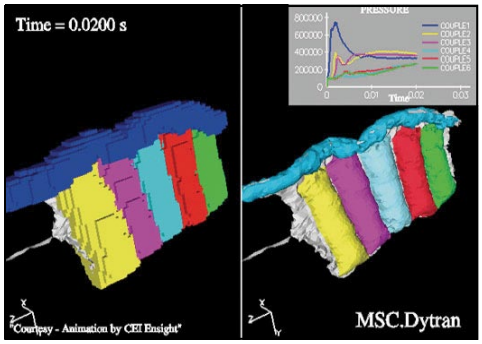

The airbag's cells are woven on the loom directly from Nylon 66 yarn, using one-piece-weaving technology that eliminates stitching. The woven bag is then processed through a silicon coating machine that reduces the material's porosity, allowing the bag to remain inflated for several seconds, which is crucial in roll-over accidents.

"Our efforts are focused on building a robust product for such a dynamic event," says Crookston. "Typically, we use MSC.Dytran for predicting the gas flow in the airbag and component dynamic impact structural stiffness, such as the enclosure and bracket. MSC.Dytran also allows simulation of the side-curtain airbag deployment using a computational fluid dynamics FD code for all its compartments."

Simulating airbag deployment is a complex and labor-intensive process, including meshing of the material and folds, analysis of fluid flow, and dynamic stresses on the enclosure. A third-party algorithm is used to create the fold, while the mesh is generated.

"Often it requires several iterations to fully optimize the fold. If you have the right tools you can reduce these iterations," explains Crookston.

After the sensor has triggered the pyrotechnic device, the inflator pumps gas into the airbag. Understanding the fluid flow from the inflator to the cushion and inside the cushion is critical for understanding the behavior of the airbag. Therefore, all the characteristics have to be properly described and represented. This is a particular strength of VPD tools, because fluid flow in an airbag cannot be determined during an experiment. "MSC.Dytran gives us a tool to study design variations and their resultant impact," states Crookston. "For instance, fabric stresses along a seam or along a fold line, deformation of the steel or plastic housing, or the dummy injury values associated with changes in fold or gas flow are a few of the potential issues."

When developing an airbag for occupant performance, both in-position and out-of-position (OOP) testing must be evaluated. MSC.Dytran is a preferred solution for OOP. As Crookston explains,

"Using MSC.Dytran provides an effective tool to study OOP scenarios. You have to be able to identify and quantify the impact of numerous design variables.

Using MSC.Dytran, we are able to pinpoint the key contributing variables and isolate them for optimization. Otherwise you're shooting in the dark. The software provides real value in terms of reducing the time and overall development effort compared to conventional prototype builds and testing."

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