Success Story

Altair

Achieving Superior Crash Performance for the Soueast DX7

SOUEAST

Key Highlights

Industry
Automotive

Challenge
Optimize the crash performance while reducing reliance on physical tests.

Altair Solution
Analysis and optimization to improve performance. Participate in the design of the test and ensure the proposed design is properly implemented.

Benefits

- Reduce the physical test times
- Improved design recommendation

China based automobile manufacturer, Soueast, has a mission of "providing an exciting mobile lifestyle and cultivating a cultured automotive community." After more than twenty years in business, Soueast has been able to successfully integrate advanced technologies from internationally renowned companies - Chrysler and Mitsubishi, and established two of its brands, Soueast and Mitsubishi in China. Looking to the future, while continuing to partner with international companies, Soueast is dedicated to strengthening its own R&D capabilities and its product brand.

The DX7 is Soueast's drive into the competitive SUV market based on its 3.0 new product strategy. The DX7 features an exterior and interior designed by top Italian design company, Pininfarina, who have over 100 years of leading European concept automobile design, along with world quality and safety standards systems using Mitsubishi technology.

Soueast partnered with Altair for product development support and utilized the Altair HyperWorks suite of simulation tools for full vehicle simulation. In particular, HyperWorks' structural solver, RADIOSS was chosen for crash and safety simulation to help Soueast achieve the highest rating in the C-NCAP collision test.

The Challenge

Crash safety is an essential part of the development process. The body structure is the foundation of crash safety, and designing a car body that has good collision energy absorption performance is one of the main goals of automotive design. The safety performance of the car will eventually need to be evaluated through a physical crash test but due to the high cost of prototype crash tests, it is not practical to validate a design's feasibility through trial and error alone. Thanks to the repeatability, relative low cost and convenience of computer aided engineering (CAE), virtual simulation has become an effective way to test a design's

Keywords: Crash, Optimization, RADIOSS, HyperStudy, HyperWorks, Product Design

Soueast Success Story

"Soueast made full use of HyperWorks for CAE simulation in every stage of full vehicle R&D, enhancing the effectiveness and technical level of our products, as well as reducing product development risks. We were able to develop a superior performance SUV with HyperWorks."

Mr. Zuo Zisheng
General Manager
Soueast Motor

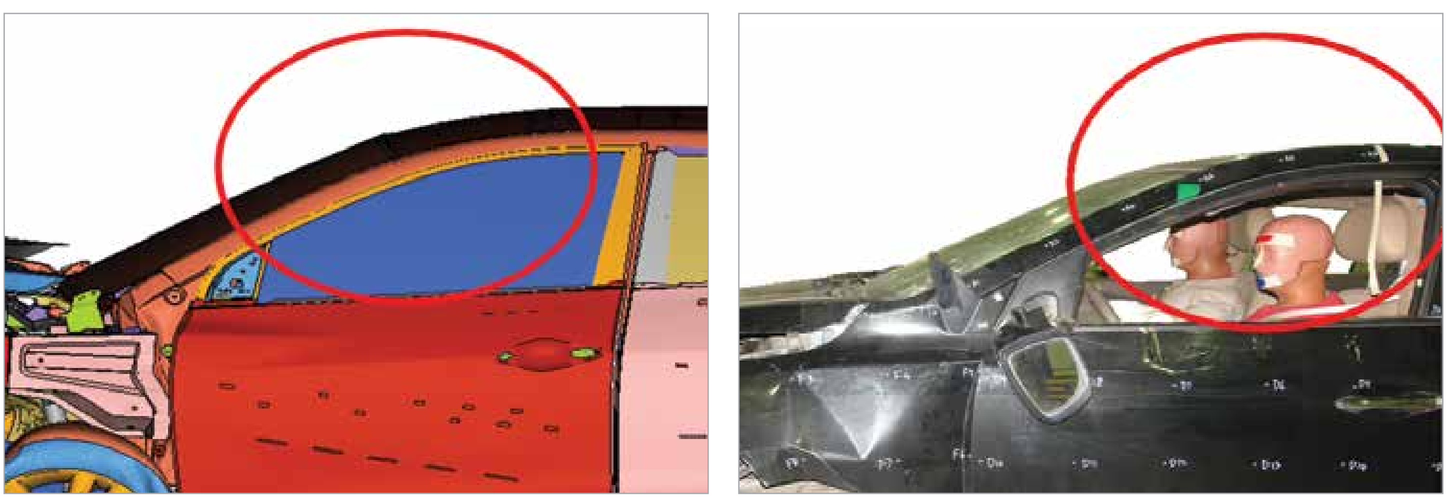
feasibility before physical prototyping. However, the key the success of virtual simulation is dependent on whether the simulation results are an accurate representation of the physical test results. The target for the DX7 project was to achieve the best possible crashworthiness while under tight time and budget constraints.

The two main challenges were:
Firstly, the CAE simulation results must be highly accurate to correctly reflect the physical crash test. Built upon many years of benchmarking experience by international automobile manufacturers, HyperWorks' structural analysis solver, RADIOSS, has developed several features specifically for accurate simulation of automotive collision including several failure modes.

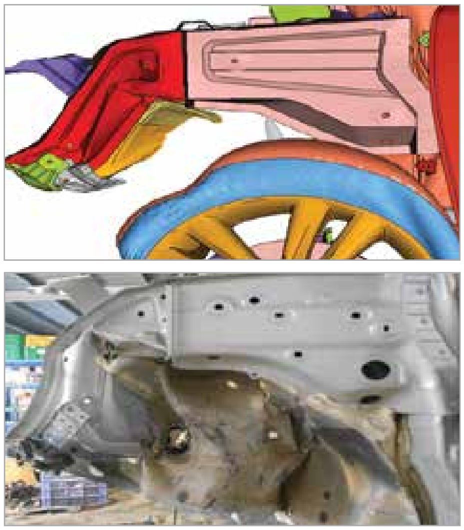
Secondly, in addition to analyzing structural crashworthiness, the restraint system must be analyzed and optimized. RADIOSS is widely used for simulating restraint systems such as seat belts and steering columns, and it includes a module specifically designed to model airbag deployment.

The Solution

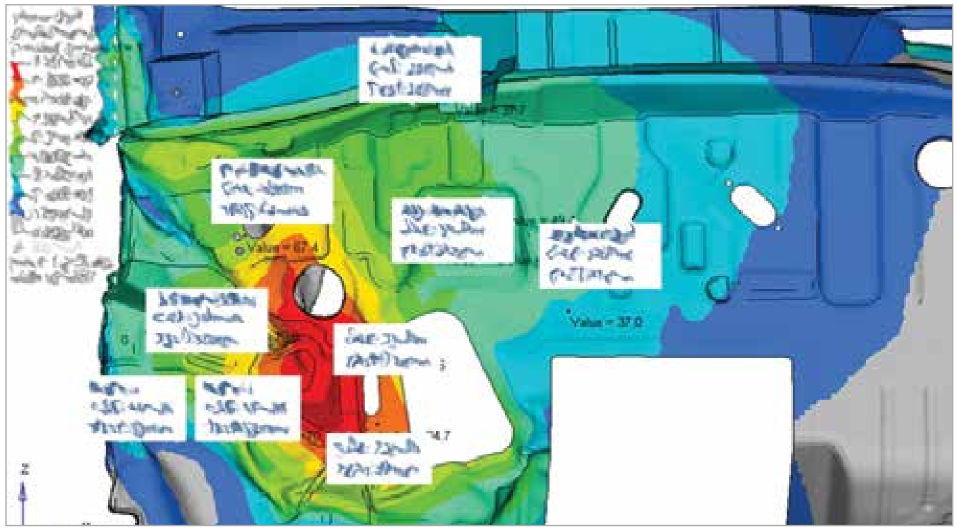
To assist with this project, Soueast worked with Altair's engineering services division, Altair ProductDesign. The team were tasked with utilizing the HyperWorks suite and its RADIOSS solver to help Soueast simulate and optimize the crash performance of the DX7 vehicle. This process involved analyzing the current structure and restraint system and



Comparison of deformation of A-pillar



Comparison of deformation of the shotgun



Comparison of static intrusion of the firewall

suggesting potential enhancements to the design that could improve performance.

A critical loadcase in the development of the body structure of the DX7 was the C-NCAP high speed 40% offset deformable barrier. The biggest difference between a 40% offset collision and frontal rigid wall collision is that the offset impact event has only one side's longitudinal beam to absorb the impact energy, therefore the offset collision tests the strength of the structure more rigorously. In order to achieve the required crush performance, the impact force must be efficiently managed through the A-pillar, sill beam, door beams, floor, subframe, etc. As such the design process should not only take into account the performance of the frontal crash structure, but must also consider the structural deformation of the A-pillar, doorframe, rocker and roof rail. This is currently the harshest C-NCAP high speed load case, an example of which can be seen in the image below.

The main contents of a 40% offset collision benchmark includes multiple firewall intrusion points, footrest intrusion, A-pillar intrusion at multiple positions, three pedals intrusion, column mount point intrusion, acceleration and speed of lower B-pillar, stringer crush deformation pattern, sensor acceleration of upper and lower engine, sensor acceleration of lower gearbox, contact timing of front engine, contact timing of back engine, contact timing of front gearbox, contact timing of the rear gearbox with steering column, and more.

The measurement metrics required to closely monitor the performance of the 40% offset collision includes multiple firewall intrusion points, footrest intrusion, A-pillar intrusion at multiple positions, three pedals intrusion, column mount point intrusion, acceleration and velocity of lower B-pillar, longitudinal rail deformed shape, acceleration from sensor on the engine, acceleration from sensors on the bottom of the gearbox, contact timing of the front of the engine, contact timing of the back of the engine, contact timing of the front of the gearbox, contact timing of the gearbox to the steering rack, and more.

During the early design phase, an energy management based approach with a reasonably good packaging practice is essential to provide sufficient crush space. Packaging consideration for major systems includes turbo intercooler, battery, ECU, etc. Extensive optimization using HyperStudy was then performed for bumper beam, longitudinal rail, shotgun, kick-down, and sill design. Finally, the targets of acceleration and intrusion results could be achieved, and furthermore, the weight of the front body was reduced. Regarding development of the restraint systems, optimization was performed on the steering column crush, footrest design, seat design, seat belt force limiters, airbag size and the venting opening. These activities contributed to a successful design which, using the 64 km ODB loadcase as an example, achieved a high level of crashworthiness. The methodology was further validated by the close correlation that was achieved between simulation and physical test results.

The Result

Using RADIOSS for collision simulation proved to be highly successful for the DX7 project. The vehicle's body achieved very good crashworthiness performance and the restraint system was optimized to enhance performance while minimizing weight, further proving the tremendous role simulation has in guiding design, and not just analyzing performance. Following the project with Altair, the DX7 successfully achieved the 5-star C-NCAP test rating which Soueast had been striving for.

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About Altair

Altair is focused on the development and broad application of simulation technology to synthesize and optimize designs, processes and decisions for improved business performance. Privately held with more than 2,600 employees, Altair is headquartered in Troy, Michigan, USA and operates more than 45 offices throughout 22 countries. Today, Altair serves more than 5,000 corporate clients across broad industry segments.

www.altair.com

About Altair ProductDesign

Altair ProductDesign is a global, multi-disciplinary product development consultancy of more than 800 designers, engineers, scientists, and creative thinkers. As a wholly owned subsidiary of Altair Engineering Inc., this organization is best known for its market leadership in combining its engineering expertise with computer aided engineering (CAE) technology to deliver innovation and automate processes. Altair ProductDesign utilizes proprietary simulation and optimization technologies (such as Altair HyperWorks) to help clients bring innovative, profitable products to market on a tighter, more efficient time-scale.

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About HyperWorks

HyperWorks is an enterprise simulation solution for rapid design exploration and decision-making. As one of the most comprehensive, open-architecture CAE solutions in the industry, HyperWorks includes best-in-class modeling, analysis, visualization and data management solutions for linear, nonlinear, structural optimization, fluid-structure interaction, and multi-body dynamics applications.

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