Tata Motors

Door closing event simulation using Adams Marc co-simulation

The MSC team worked hand in hand with the Tata Motors team to proactively sort out issues and find quick solutions.

Established in 1945, Mumbai headquartered Tata Motors Limited is a multinational automotive manufacturing company that delivers over 9,000,000 vehicles per annum Its range of products includes passenger cars, trucks, vans, coaches, buses, sports cars and military vehicles.

Tata Motors owns the English premium car maker, Jaguar Land Rover (JLR), and the South Korean commercial vehicle manufacturer, Tata Daewoo. The company has several auto manufacturing and assembly plants in six locations across India, as well as in Argentina, South Africa, Great Britain and Thailand. It also has R&D centers in India, South Korea, the UK and Italy.

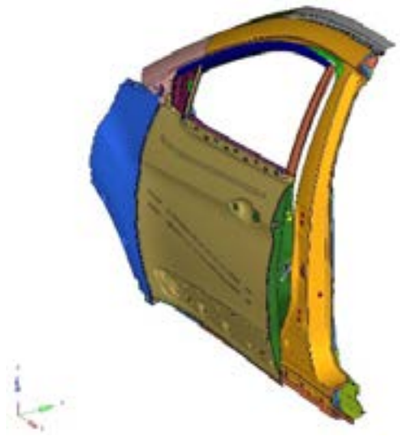


Figure 1: Door assembly in automobiles

Challenge

Vehicle part closures (such as those of doors, bonnet, trunk lid, and tailgate) are overhang sub-assemblies within the vehicle. The main function of these closures is to secure primary access to the vehicle. In addition, they are often required to accomplish diverse requirements over their complete lifetime.

The door closing is a result of complex interactions between different components of the door design, such as the latch, weather seal, etc. Parameters such as energy loss due to an air-binding effect, the inclination of the hinge axis, check-strap, etc. affect the door closure.

The seal has a major effect on the door closing function. For instance, the initial seal must deform as it engages the body panel to avoid defects such as wrinkles and deformation. Given the complexities, it becomes difficult to model the complete system accurately and simulate the door-closing event. With the existing approach, the time required to perform simulation was higher. Also, accuracy is compromised due to approximations.

The design rationality and manufacturing process play an important role in determining the functionality and performance of the door closing system. At early design stages, it is often difficult to precisely confirm the individual quantitative effect of these variables on the functionality. Therefore, computer-based simulation of the door system is more practical since it can isolate critical factors, in addition to being cost effective and time efficient.

Solution

The team used co-simulation to solve this design challenge. The co-simulation technique is a Multiphysics capability that provides runtime coupling of different simulation environments. In this case, co-simulation involves continuous interaction between Model-Based Design (MBD) and Finite Element Analysis (FEA) environments. The models are built separately in two different environments (Adams and Marc).

While building the model, care needs to be taken for the definition of interaction points (using GFORCE). These interaction points serve as a mediator between the two environments. As the number of interaction points increase, the runtime will, in turn, go up due to increased communication for response calculations.

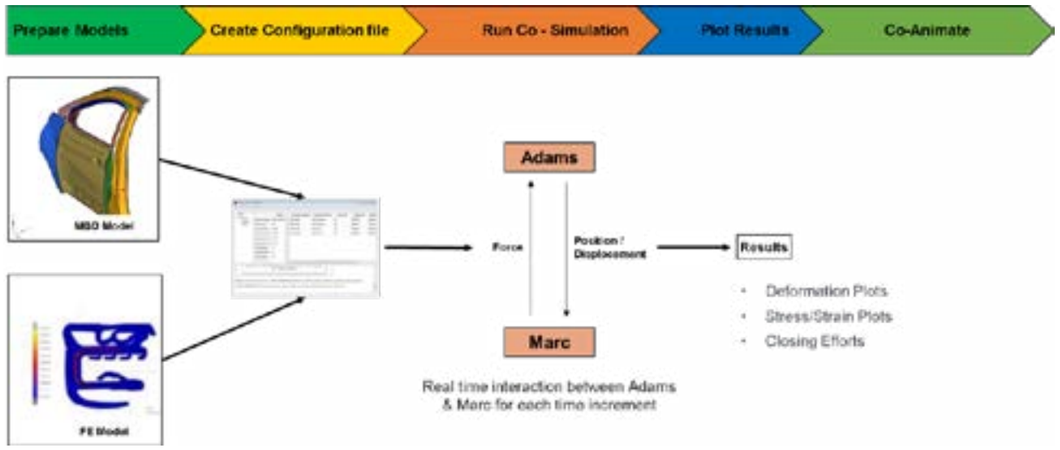
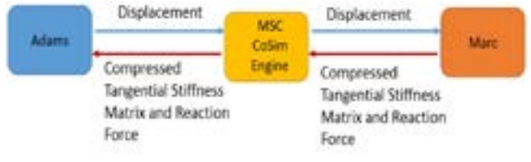


Figure 2: Adams Marc co-simulation workflow for door

Key highlights:
Product: Marc and Adams
Industry: Automobile
Benefits:
Co-simulation by coupling simulation environments in Marc and Adams

Adams shares details on the displacements and position with the Marc Software. In turn, Marc shares the revised forces, pressure, and moments to Adams based on actual contact between the seal and the door. Likewise, there is a continuous interaction between Adams and Marc. Seal deformations and stress data recovery are done in Marc. These stresses are then utilized for fatigue life evaluation.



Eigenmode shapes extracted with MSC Nastran - fairing second breathing mode

Benefits

When the results of the physical test were measured against those from the co-simulation method, the two were found to be in agreement. Based on the results, it was clear that with the co-simulation of kinematic and deformable bodies, a single model was sufficient to evaluate various sub-systems level responses, such as for seal performance or door closing effort estimation.

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The team has found the co-simulation process to have inherent potential to be used across other vehicle aggregates. It can also be used effectively for long duration problems. With this approach, FEA Analysts can focus their efforts better on result interpretation and design recommendations instead of spending time on pre-processing activities.

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