

Predictive Crashworthiness Simulation in a Virtual Design Process without Hardware Testing

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In 2006 BMW made a decision to use Abaqus/Explicit for all issues concerning passive safety in the virtual design process. Code quality and reliability of simulation results were identified as the primary reasons to change, and from that decision point forward, all product development teams began migration activities to switch to Abaqus/Explicit.

Meanwhile, the entire vehicle design and development process within BMW began to undergo fundamental changes, from one which previously incorporated key milestones involving physical prototypes, to one which seeks to largely eliminate physical prototypes and associated physical tests. Nowadays, BMW design engineers will get the first feedback from physical tests only after the series production tools have been manufactured. Therefore, design changes at that point will be extremely expensive. Furthermore, no physical test results will be available to calibrate and improve finite element models of virtual crash cars in the earlier phases of the development process. So predictiveness is now the most important criterion for BMW's passive safety simulation.

Because of these fundamental changes to BMW's development process, BMW established a new benchmark for crash solvers in 2009 in order to evaluate in detail the quality of simulation results. This paper intends to demonstrate some of the capabilities of Abaqus/Explicit for crashworthiness and occupant safety, with a strong focus on predictiveness and reliability. These factors are prerequisites for an efficient, cost-effective vehicle development process that relies less and less on physical prototypes and testing. And it explains why BMW has now reconfirmed the earlier decision to use Abaqus/Explicit for its crashworthiness and occupant safety simulation.

1. Introduction

Since 1998, BMW began seeking alternative simulation tools for passive safety design issues. The criteria for selecting a new simulation tool were:

- Algorithms of high quality and overall software robustness
- Competent development team
- Strong commitment to the methods development needs of BMW

After several years of searching and evaluation, BMW made a decision to move to Abaqus/Explicit as its new tool for crashworthiness and occupant safety simulation. Beginning in late 2004, BMW carried out the first car development project using Abaqus/Explicit for passive safety simulation. Successive car projects were also migrated, until all migration was completed by the end of 2006.