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How Crash Simulation Helps Save Lives?

Car crashes happen in a split second but the preparation to make vehicles safer takes years of planning, testing, and engineering. One of the most powerful tools in this process is crash simulation.

Long before a physical car hits the road, its digital twin has already been "crashed" hundreds or even thousands of times on a computer. These simulations provide crucial insights that help engineers build safer vehicles for everyone. Crash simulation is used to understand how a vehicle behaves during different types of collisions.

Engineers use specialized software to model a wide range of crash events virtually from head-on collisions and side impacts to rollovers and rear-end crashes.

These simulations illustrate how energy travels through the car, how materials deform, and how passengers are affected.

How It Saves Lives:

Crash simulations enable engineers to:

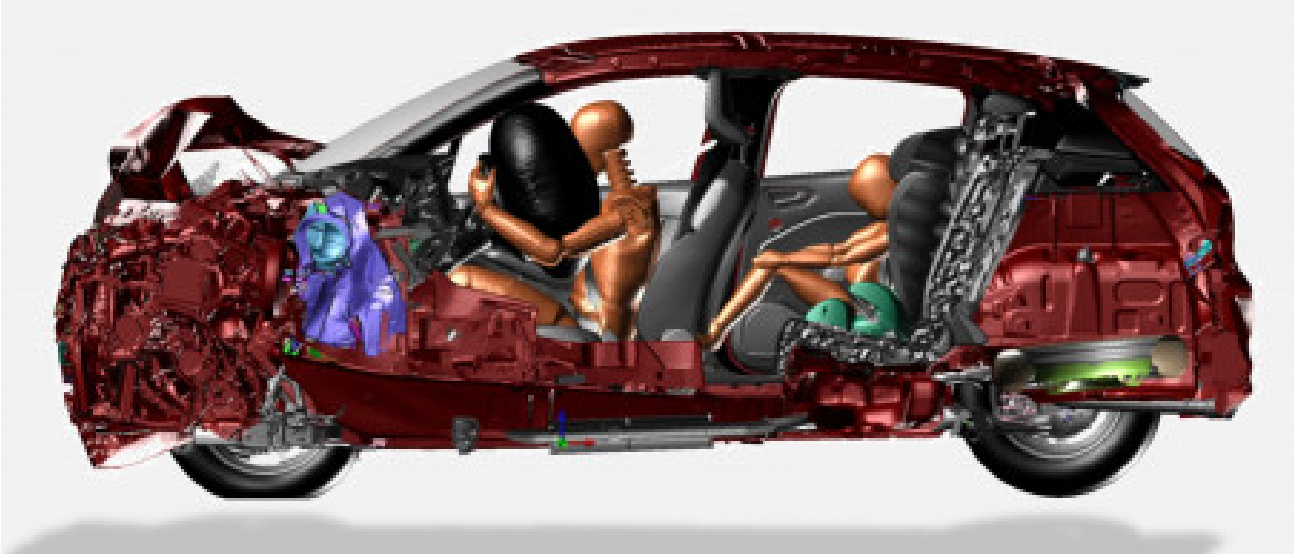
- Predict how different parts of the car will deform.
- Locate structural weak points that need reinforcement.
- Design crumple zones that absorb impact energy efficiently.
- Improve the timing and performance of airbags and seatbelts.
- Test the effects of collisions on people of different sizes and seating position.

By allowing safety improvements at the design stage, simulation helps reduce fatalities and serious injuries in real-world crashes.

According to the Insurance Institute for Highway Safety (IIHS), modern vehicle designs have led to a 46% drop in driver death rates since 1990 and simulation has played a critical role in that improvement.

In this edition:

> ***A crash simulation is not just about destruction, it's about understanding how to save lives.***



Real-World Impact:

Many car makers now conduct thousands of virtual crashes before a single physical prototype is tested. This speeds up design cycles, cuts costs, and most importantly, helps save lives. One example is the use of simulation in developing child safety seats. Engineers can now digitally test how different seat designs perform in front, rear, and side impacts leading to more effective products in the market.

In another case, the development of side-curtain airbags benefitted greatly from crash simulation. By modeling how the airbag would deploy during a rollover or side impact, engineers were able to improve its size, inflation rate, and positioning for maximum protection.

How Leading Automotive Companies Utilize Crash Simulations:

The traditional approach of crash testing required building multiple prototypes and physically crashing them in labs. While still important, this method is expensive and time-consuming. Crash simulation allows manufacturers to test hundreds or thousands of design variations digitally before choosing which physical prototypes to build.

This dramatically reduces costs and shortens development time. Virtual crash testing also enables a wider range of scenarios. For instance, engineers can simulate collisions involving pedestrians, cyclists, uneven terrain, or different passenger seating positions, situations that are difficult or dangerous to recreate in real life.

Crash simulation offers benefits across the board:

- Faster time-to-market for new models
- Lower R&D and prototype costs
- Higher safety ratings and better brand reputation
- Easier global compliance with safety regulations

What the Industry Leaders Are Doing?

BMW conducts more than 15,000 crash simulations during the development of a new vehicle. They use high-fidelity models to analyze how the car structure responds under stress. This allows their engineers to refine safety features such as side-impact beams, crash boxes, and structural joints long before a car reaches production.

Toyota applies crash simulation to ensure safety for a wide range of passengers, including children and elderly people. They use data from actual accidents to improve the realism of their simulations. Toyota's Total Human Model for Safety (THUMS) is one of the most advanced virtual human models in the world, allowing for more precise injury prediction and safety system optimization.

Safety is at the core of **Volvo's** identity. Volvo integrates real-world accident data with simulation to model rare and complex scenarios. For example, they simulate animal collisions, icy road crashes, and interactions with vulnerable road users like pedestrians and motorcyclists. This approach helps Volvo maintain its reputation for industry-leading safety.

Tesla uses crash simulations extensively to develop the safety of their electric vehicles. Since EVs have large battery packs, Tesla uses simulation to study battery deformation, fire risks, and high-voltage system protection in crashes. Their cars consistently receive top scores in global safety ratings, thanks in large part to their simulation-driven design process.

The Role of VPS Software in Crash Simulations:

Crash simulation software must handle a lot of complexity. It needs to simulate real-world physics, human body responses, material behaviors, and mechanical systems all at once. One of the leading tools for this is VPS (Virtual Performance Solution) by Keysight (formerly ESI Group). VPS is designed to give automotive engineers everything they need to run realistic, accurate crash simulations.

What is VPS?

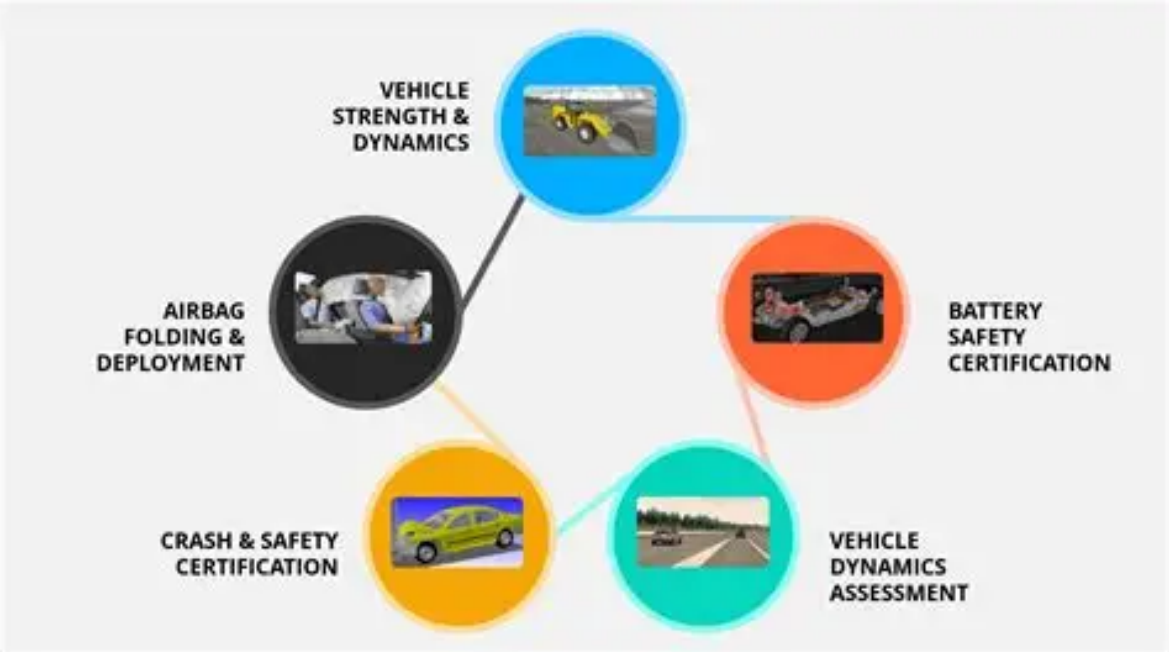
Keysight Technologies, a global leader in design and testing solutions, now offers VPS (Virtual Performance Solution) through its acquisition of ESI Group, further enhancing its capabilities in the simulation domain. VPS is an advanced crash simulation suite that brings together multiple physical domains into a single platform. It can simulate how a car behaves in various crash conditions, how passengers are affected, and how safety systems like airbags and seatbelts perform. Engineers can use VPS to model entire crash events from the moment of impact to milliseconds afterward.

Key Capabilities:

- Simulates full-vehicle crashes: front, side, rear, and rollover
- Predicts deformation, cracking, and energy absorption
- Includes dummy models for different body sizes and postures
- Evaluates the deployment of airbags and tightening of seatbelts
- Models occupant movement, injury risk, and restraint effectiveness
- Simulates battery behavior in EV crash conditions

VPS also supports advanced material models, like composites, high-strength steel, and aluminum, which are commonly used in lightweight vehicles. It includes detailed representations of vehicle structures, interior parts, and even pedestrian safety features.

It also supports virtual testing for global regulatory compliance, allowing manufacturers to adapt designs to different markets without repeated physical trials. VPS's ability to simulate these details ensures that every part of the vehicle, from bumper beams to headrests, behaves as expected during impact.



(Source: Keysight Technologies)

Why VPS Matters?

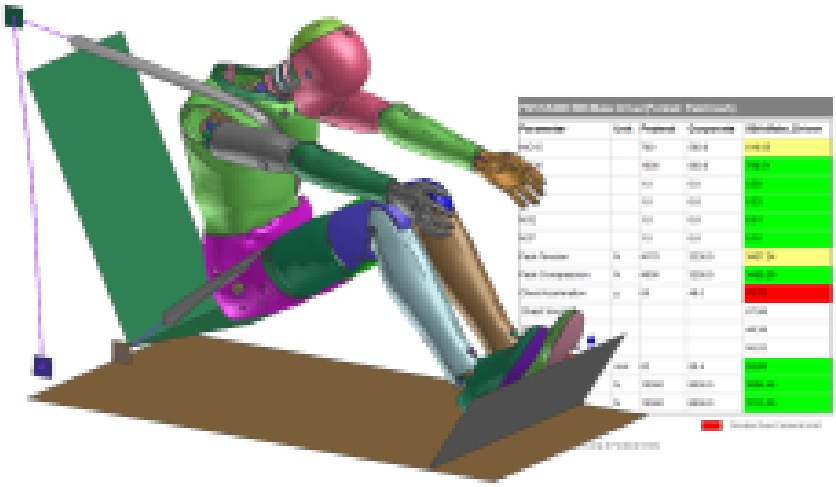
VPS helps engineers:

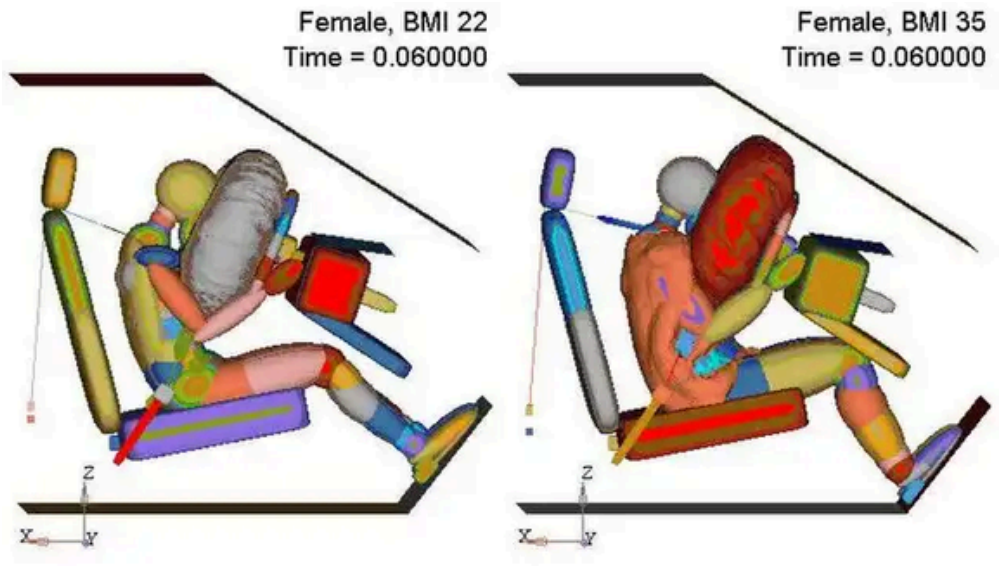
- Reduce the number of physical crash tests needed
- Meet safety standards across different countries (Euro NCAP, FMVSS, GTR)
- Identify weak points early and make design changes quickly
- Ensure that both internal components and external structures perform well in real accidents

By offering real-time insight and accurate predictions, VPS helps manufacturers stay ahead in the competitive world of vehicle safety. Global automakers and suppliers use VPS during both concept and development stages. One example is how a major European OEM used VPS to develop a lightweight SUV. By simulating different crash events, engineers were able to redesign key load paths and optimize crash boxes, resulting in a 15% reduction in vehicle weight without compromising safety. Another case involved an EV maker who used VPS to study battery impact during side collisions. The simulation allowed them to reposition battery modules, add shielding structures, and meet new safety regulations for thermal runaway.

VPS brings precision and performance to crash simulation. It enables automakers to move from reactive testing to proactive design, reducing risks before they become real-world problems. As vehicles become more complex, especially with the rise of EVs and autonomous systems, tools like VPS will be key to keeping people safe on the road. It stands out as a multi-domain crash and safety simulation tool, supporting critical applications such as pedestrian safety, belt and airbag development, and seat and cabin design.

One of VPS's major advantages is its ability to integrate seamlessly with other manufacturing process simulation tools like Sysweld and SimulationX, enabling a unified digital thread from material behavior to system performance. This end-to-end simulation capability helps engineers make smarter decisions earlier, reduce reliance on physical prototypes, and accelerate compliance with international safety standards.





(Source: Keysight Technologies)

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