Solution Space Methods for Side Crash

Motivation
In the past years, passive safety has become an important aspect of the development of new cars. A huge variety of crash procedures exists in order to test crashworthiness. Some of them are part of safety ratings that should give the customers advice through a star rating like the EURO NCAP. Others are part of regulations and must be fulfilled by new cars in order to get homologation for road service.

Nowadays the test procedures can be simulated in detailed finite element simulations and the results are normally of high validity. Nevertheless, it takes huge modeling and computational effort to perform such simulations. That is why these models are not likely to be used for optimization and for the early stage of development where only limited information about the design is available. Instead simplified models like lumped-mass models are used. Solution-Space methods, for example, use such simplified models for optimization. They can provide corridors for force-deformation curves for frontal and rear crash scenarios. The basic idea of corridors is that, if the force-deformation curve of every crash relevant component of the car is in its corridor, then the whole structure fulfills the requirements of the crash procedure [1-3].

Methods providing corridors are well-known for front and rear crash scenarios in which the vehicle structures are only loaded in their longitudinal axis. For crash scenarios with structures that are loaded perpendicularly to their longitudinal axis like doors in side crash scenarios, there is still a lack of knowledge (Fig. 1) and therefore a need for further development.

Objectives
- Develop a modeling method for perpendicularly loaded structures that can be used for solution-space methods.
- Derive a modeling method for side crash relevant structures like the B-Pillar and non-structural components like crash dummies,
plastic revetments or deformable crash barriers for solution space methods.

- Validate model and the methods.

In order to build up a solution-space model for side crash scenarios, multiple steps must be done. First of all the side-crash relevant structural and non-structural components of the car have to be identified. After that, a modeling technique for all the relevant components is required that can be used in solution-space methods. Especially, a method for non-axial loaded structures is required, like for example for the bending collapse of a beam with round shaped cross-sections (Figs 2-3) in impact situations. Finally, the new model and method must be validated.

![Moment-curvature characteristic of a bending collapse.](image)

**Fig. 3:** Moment-curvature characteristic of a bending collapse.

**References**


