Reduced model for the crash simulation

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The car crash simulation contains of many complexities: the geometrical and material nonlinearities, the contact management and the dispersion. In order to represent well all local physical phenomenon (plasticity, spot-weld crack…), a crash model needs a fine mesh (from 5 to 20 M finite elements for a whole vehicle). The crash solver using explicit algorithm takes small time step because of the Courant's condition. Consequently, it takes time for the car crash simulation (till 24 hours), particularly in the context of design parameters change. We are interested in a reduced model which cuts back the total cost of an optimization study. More precisely, we hope a reduced model not only to reconstruct an already done simulation but to estimate a new simulation interpolating between existing simulation(s) in a Design Of Experiments. Recently, lot of teams have studied reduced models by Reduced Basis, POD (Chatterjee, 2000) or PGD (Amine *et al*., 2012) but until now no one have achieved for a car crash model, both in intrusive and nonintrusive methods.

In this presentation, we would like to present:

- the specifications of the crash simulation in a design space through two use-cases : a BoxBeam and a Tbeam which represent side member (the most important part for energy absorption) and the motor compartment;
- our context of reduction. The final aim is to divide at least by two the cost of an optimization study. The experimental design is essential;
- the use of the SVD (Singular Value Decomposition) to see if a reduced model can detect some particularities in our case, for example the symmetry when we change parameters.

Amine et al. (2012). Proper generalized decomposition of time multiscale models. *Internaltional Journal For Numerical Methods In Engineering*.

Chatterjee, A. (2000, April). An introduction to the proper orthogonal decomposition. *Current Science, 78*(7), 808-817.

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