Evaluation of Different Material Models to Predict Material Failure in LS-DYNA

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Due to the global objective to reduce CO_2 emissions from the automotive industry, focus is pointed at decreasing the weight of the cars. A demanding issue is to decrease the weight and still let the crashworthiness be remained. One way of examining the opportunities of this, is to visualize a car's behaviour during a crash by computer simulation.

CEVT has requested a benchmarking of existing material models[1] due to some drawbacks with their current model, CrachFEM. Firstly, CrachFEM has a total license cost, based on the number of CPUs that are compatible with the model, at approximately 4000000 SEK a year. Even if it would take long time before CEVT annul all of the licenses, it is possible to reduce this cost based on the results of the thesis. Secondly, the material model takes a substantial amount of time to simulate and the CPU capacity of the cluster is limited.

The objective of the thesis is to implement a material failure model called GISSMO to be used for computer simulations. The implementation requires to define a set of material parameters and to obtain these, a characterization of the material is needed. The characterization is done by simulated material tests where the material behaviour is modelled by CrachFEM. Furthermore, when GISSMO is implemented it is to be compared with CrachFEM. The comparison is done with two different complex load cases. The first load case is of a simplified B-pillar. This test primarily measure the difference in simulation time. During the second load case, the loading is subjected to a car's rear end and the behaviour of the bumper is to be analyzed. GISSMO's accuracy is the primary measurement for the second load case. Figure show the equivalent plastic strain distribution of the rear bumper when failure has initiated when the bumper material is modelled by CrachFEM and GISSMO.

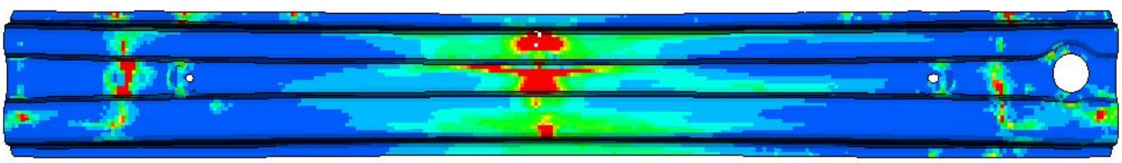

Figure 1: First element failed. Modelled with CrachFEM.

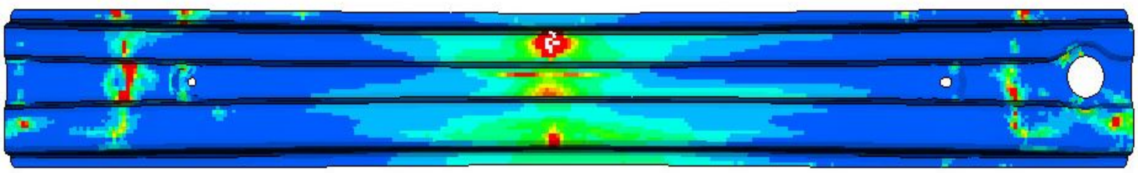

Figure 2: First element failed. Modelled with GISSMO.

The results prove that GISSMO provide results with similar accuracy as CrachFEM and reduces

[1]The material model decides how the material behave during loading and is thereby crucial for faithful results of the simulations.

the simulation time extensively. The thesis do also include a manual of how to implement GISSMO in an efficient manner, which facilitate the engineers at CEVT to expand the material database of GISSMO. The work could be used to replace CrachFEM with GISSMO during simulations considering material failure.

There are some difficulties encountered when using simulations with CrachFEM, instead of experimental data, as reference to the material behaviour. The input parameters to the CrachFEM material model are encrypted and since CrachFEM support a vast variety of material criterion, it is difficult to know the exact configuration of the model. This information is important to address to make GISSMO's properties as similar as possible. The information has been obtained by an examination of CrachFEM through a theory study and test simulations to make up for the encryption.