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Forming the limits of damage predictions
From fundamentals to application WP4

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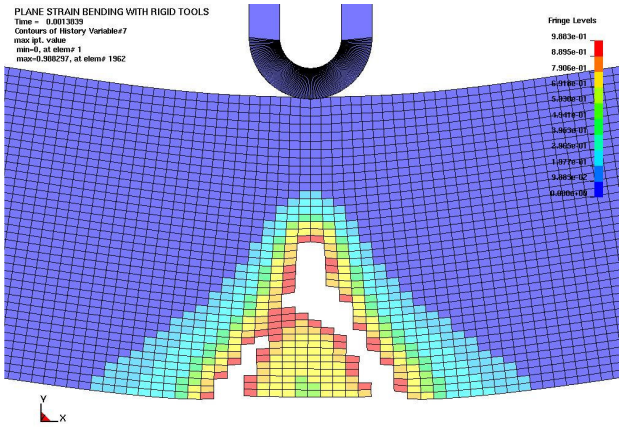
Introduction

Damage and fracture are important criteria in the design of products and processes. In most cases cracks must be avoided. However, some products and processes, rely on the controlled growth of damage and/or cracks in order to obtain a certain functionality or shape.

Figure 1: Failure of sheet of 1mm thickness in three point bending test with the nonlocal damage model (LS-DYNA).



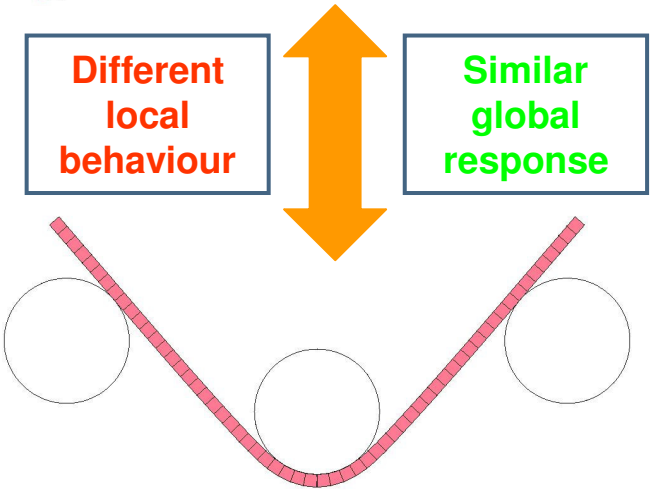


Figure 2: Three point bending test modelled with solid shell elements.

Future work & Valorisation

An effort will be made to tailor the developed techniques to materials and applications put forward by NIMR's industrial partners.

Objective

The objective is to develop tools which allow one to make quantitative predictions of ductile failure in industrially relevant materials and applications.

Methods

An operator split nonlocal ductile damage model, as developed in previous NIMR projects, has been implemented in DiekA and LS-DYNA for 2D and 3D solid elements.

For large scale simulations of sheet metal forming processes and crash tests mainly shell elements are used. Details, as shown in Figure 1, cannot be captured with these elements. Therefore the use of cohesive elements, which contain the fracture behavior, together with normal shell elements is studied for these applications.

By using a combination of experiments (MC2.05205_1) and detailed simulations of simple bending and tension tests a validated model will be obtained, which predicts the correct moment of fracture and the absorbed fracture energy in simulations with shell elements (Figure 3).

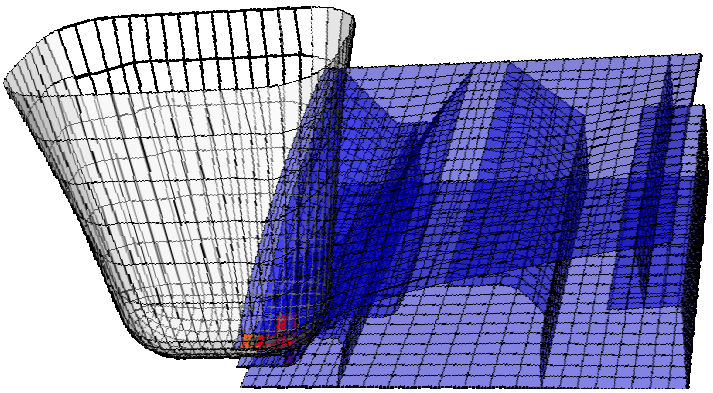


Figure 3: An example of a large scale crash simulation (ship collision).

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