**Introduction**

Damage and fracture are important criteria in the mechanical design of virtually every product and process. In most cases cracks must be avoided because they compromise the integrity and functionality of the product. Some products and processes, however, also rely on the controlled growth of damage and/or cracks in order to obtain a certain functionality or shape.

**Objective**

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

This requires a further development of our physical understanding of ductile failure and the capability to translate this understanding into constitutive models. Furthermore experimental parameter identification methods need to be developed (WP1), which enable the application of these models to industrial cases.

**Methods**

Ductile damage models developed in previous NIMR projects (MC2.98067) will be made available to the partners. A staggered approach, in which the nonlocal damage is kept constant during an equilibrium step has been implemented in DiekA (Figure 1) and is currently being implemented in the commercial FEM code LS-Dyna. Nonlocal models solve the problem of mesh dependency of local models.

For large scale simulations of sheet metal forming processes and crash tests mainly shell elements are used. Details like the shear bands shown in Figure 1 cannot be captured with these elements, however the fracture energy should be predicted correctly. The use of a micro structurally based length scale (1-100µm) can become difficult for these kind of simulations as elements sizes (>thickness) should be smaller than the length scale.

**Future work & Valorisation**

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