INTERDISCIPLINARY CENTRE FOR
ADVANCED MATERIALS SIMULATION

ICAMS Seminar

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The general crystal plasticity framework 'DAMASK'

The solution of a continuum mechanical boundary value problem requires a constitutive response that connects deformation and stress at each material point. Such connection can be regarded as three separate hierarchical problems. At the topmost level, partitioning of the (mean) boundary values of the material point among its microstructural constituents and the associated homogenization of their response is required, provided there is more than one constituent present. Second, based on an elastoplastic decomposition of (finite strain) deformation, these responses follow from explicit or implicit time integration of the plastic deformation rate per constituent. Third, to establish the latter, a state variable-based constitutive law needs to be interrogated and its state updated.

The Düsseldorf Advanced Material Simulation Kit (DAMASK) reflects this hierarchy as it is built in a strictly modular way. This modular structure makes it easy to add additional constitutive models as well as homogenization schemes. Moreover it interfaces with a number of FEM solvers as well as an FFT-based spectral solver.

We demonstrate the versatility of such a modular framework by considering three scenarios: Small scale simulations using a non-local constitutive law, selective refinement of the constitutive material description within a single geometry, and component-scale forming simulations comparing different homogenization schemes.

Finally some of the capabilities of the spectral solver in comparison to the FEM solvers are demonstrated.