

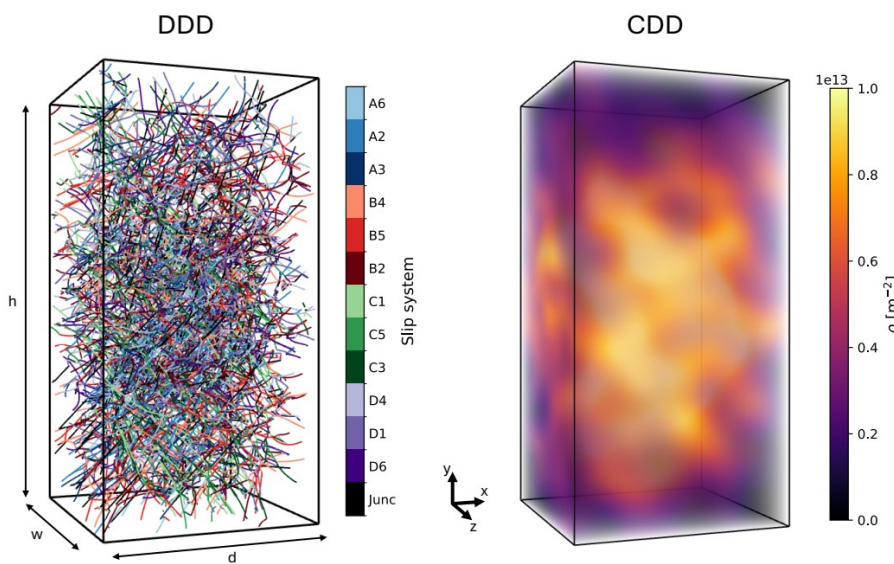
## Master-Thesis

# Transformation of discrete microstructures to continuum and back

### Background:

At our institute, we conduct dislocation based crystal plasticity simulations on different length scales. The two used methods are DDD (Discrete Dislocation Dynamics) and CDD (Continuum Dislocation Dynamic). Both methods are based on microstructure defect mechanisms. In DDD, dislocations are simulated as discrete dislocation lines while CDD uses dislocation densities. To couple these different types of simulations, a method is needed which transforms states between one domain into the other. For this reason, two transformations are needed:

1. DDD-dislocation network is homogenized into the density based CDD domain
2. A CDD dislocation density configuration is transformed into a DDD dislocation network



left: DDD structure; right: homogenized CDD structure

While the DDD to CDD transformation is a homogenization which delivers a unique solution, the transformation from continuum to discrete offers multiple solutions. To verify the developed model an initial discrete condition is transformed into the continuum and back. This transformed configuration is then compared to the initial condition. The physical properties of the transformed configuration are then compared with the initial configuration.

### Objective:

- Develop a deterministic method to transform discrete data to continuum
- Develop an algorithm to find a discrete state for a given continuum state
- Comparison of the physical properties of both transformations

### Requirements:

- Good knowledge of data-driven methods
- basic knowledge in material science is an advantage
- Programming knowledge python and git are beneficial

### Contact

Prof. PD. Dr.-Ing. Katrin Schulz

(katrin.schulz@kit.edu)

Constantin Kübler-Tesch

(constantin.kuebler-tesch@kit.edu)

Julian Bender

(julian.bender@kit.edu)