Statistical Analysis in Materials Simulation

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Strain Correlation Functions

When are strain correlation functions needed?

- analysing tensile tests of amorphous specimen
  - formation of localized shear bands

What is the prerequisite for shear band formation?

- J_2-plasticity

How is the yield stress of the gaussian quadrature points in an FEM simulation of an amorphous material?

- randomly uniform distributed

Why do shear bands form at 45°-angle?

- along this direction the shear strain is maximum (is that true?)

What do the shear bands tell us?

- that the shear strain is maximum in 45°-angle direction w.r.t. the loading direction

What is the (spacial) strain correlation function?

- a quantitative tool that allows to detect correlations without the need for visual inspection of the simulation result

How do you build the strain correlation function?

- by comparing the deviation of strain at two points from the average strain

$$C(s_x, s_y) = \langle [\varepsilon(\boldsymbol{r}) - \varepsilon][\varepsilon(\boldsymbol{r} + \boldsymbol{s}) - \varepsilon] \rangle_r$$

How do you know from the strain correlation function plot that there is a correlation in a certain direction?

- the correlations are long ranged

How is the algorithm for calculating the strain correlation function?

- choose an inner box of the specimen which you want to visualize (some distance to the boundary is needed for algorithmic convenience)
- begin with one element in the inner box and calculate the strain correlations for this point with all other points inside a certain distance (e.g. inside a square or circle)
- loop through all the points of the inner box
- take the average of the correlations for all the points of the inner box