Theory

Fracture mechanics (3h Dag)
All the texts cover some of the same topics in fracture mechanics.
General geoscience oriented text: Scholz: “The Mechanics of Earthquakes and Faulting”gives introduction to how geologists discuss this subject.

In the lectures I will try to cover:
-The stress tensor, principal values, scalar invariants, the Mohr circle
-Strain, differential strain, large strain
-Linear elasticity of isotropic material: stress-strain relationship and strain energy
-Griffith criterion
-Energy release rate, stress intensity factor, fracture toughness
-Coloumb criterion expressed in Mohr diagram
-Dimensional analysis

Discrete modelling (2h, Anders)

-How simple models of the physics on a small scale can be averaged to
produce the correct behaviour in the continuum limit.
-Ex: Newtons laws + intermolecular interactions = MD -> Physics of fluids
-Atomic length scale is impractical/impossible for real problems
-Choice of scale
-Fluctuations
-Ex: Spring network model
-Small scale physics in -> Griffith criterium out

Algorithmic modelling (2-3h Joachim)

-Rule based models
-Data analysis, averaging, system size dependence
-Scaling
-Ex: Briefly mention models yielding "Gutenberg-Richters law"?
-Universality?
-Ex: Random walker
-Ex: DLA

Quantification of fracture patterns from the field (1h, Karthik)

-Geology background and field observations
-Image analysis -> Refined data set describing fracture network

Experiments (3h, Dag)

Image analysis (1h, Torbjørn, Karthik, Espen)

All three of them have spent time lately performing image analysis in order to separate domains in the images by continuous lines. The objects represented by the lines were different: fractures, steps or grain boundaries, but the desired end result was the same in all cases. They will present shortly one of their own images and in a few essential steps what they did to obtain a cleaned up data set in form of:
-numbered clusters representing the domains AND/OR
-boundaries separating the domains

+List of the most important Matlab functions used. This is meant as a series of hints for the students, not as a complete guide to the students. They will afterwards spend the next couple of days playing with their own images.

Practical exercises:

Fracturing experiment: (Dag)
-Fracturing material attached to an isotropically expanding substrate
-Imaging
-Image analysis -> Refined data set describing fracture network
-Statistical analysis of fracture network

Spring network modelling: (Anders)
-Fracturing material attached to an isotropically expanding substrate
-Averaging, realisations, system size dependence
-Statistical analysis of fracture network
-Comparison with experiment

Algorithmic hierarchical fragmentation modelling (Joachim)
-Implementation of model
-Averaging, realisations, system size dependence
-Statistical analysis of fracture network
-Comparison with Karthik's data sets