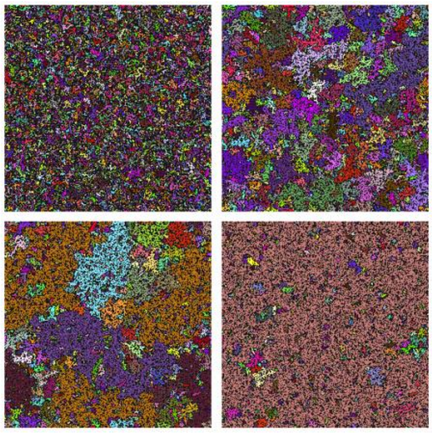
Role of system disorder and thermal noise in fracture growth

Santanu Sinha and Alex Hansen



Material stability is of key importance in industrial applications. Appearance of fractures and their growth in a material depend on the competition between the disorder in the material strength and the local stress concentration. The heterogeneities delocalize the fracture growth and offset the failure point at which a crack becomes unstable. With a bundle of linear elastic fibers, called as a fiber bundle model, it was shown that the transition from a sparse to a localized fracture growth can be of first or second order depending on the type of the disorder distribution [1].

There is another type of fracture process that can cause a material to fail over time even if the applied stress is below the failure point. This is called creep failure which is influenced by external factors such as temperature. Presence of thermal noise can delocalize a localized fracture growth and make it a percolation-like process [2]. One such growth simulated with a local load sharing fiber bundle model is shown in the figure where the black and colored pixels correspond the intact and broken fibers respectively.

A fiber-bindle model consists of a set of elastic fibers placed in between two clamps under an external force. Each fiber has an elongation threshold beyond which it fails and the load it was carrying is distributed to all (equal load sharing) or nearby (local load sharing) intact fibers. The aim of this MSc project will be use a fiber bundle model to study the creep failure for different types of threshold distributions and find out how the two types of disorders, one related to the thermal noise and the other related to the thresholds, control the fracture growth.

[1] S. Sinha, S. Roy and A. Hansen, Physica A **569**, 125782 (2021).
[2] S. Sinha, S. Roy and A. Hansen, Phys. Rev. Res. **2**, 043108 (2020).