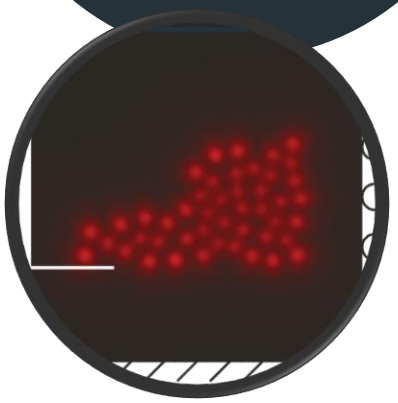
University of Stuttgart
Germany

Department for Stochastic Simulation
and Safety Research for Hydrosystems (LS³)

Predicting Fracture Path Statistics



Project / B.Sc / M.Sc. Topic

No two fractures look alike and in real world applications predicting exact fracture paths proves all but impossible. Nonetheless, it is important to know some characteristics of fractures. One example: In a geothermal energy plants, to exchange a lot of heat, a large surface area of the fractures is beneficial.

In this thesis, we want to use the Mechanical-MNIST Crack Path dataset to predict stochastic characteristics of fractures. In contrast to many others approaches, this does not include a pointwise prediction from one input configuration to one fracture path.

The set-up of the Mechanical-MNIST analogous to the famous MNIST simplifies fast prototyping. Depending on the specific interests of the student and scope of the thesis, different machine learning methods can be tried. Ranging from ordinary CNNs, to more complex VAEs and Normalizing Flows or towards classical ML methods such as Random Forests or GPR, a lot is possible here.

Many of the picture based postprocessing steps (evaluation of curvature, skeletonization, etc) are already implemented from a previous project, but an extension of this library is possible if aligned with the interests of the student.

The project is open for all levels of theses: A first contact with neural networks on a well curated dataset or a deep dive into advanced methods for distributional predictions.

Prospective Tasks

- A literature search on ML methods feasible for the problem at hand
- Implementation of at least one ML method
- Assessment of the quality of the results

General Information

- Advisor: Tim Brünnette (LS3), Examiner: Wolfgang Nowak (LS3)
- Relevant link: https://github.com/Lejeune-Lab/Mechanical-MNIST-Crack-Path

Desirable Skills

- computer programming, preferably Julia or Python
- solid understanding of statistics
- Interest in ML methods

Apply now!

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