

## Recent progress in multiscale systems of plasticity in a data-driven perspective

Recently, data-driven approaches have gained significant importance in the field of computational mechanics. The data-driven mechanics approach introduced by Kirchdoerfer and Ortiz in 2016 provides an alternative to the conventional use of material models by utilizing datasets comprising stress-strain pairs. This approach centers on minimizing the distance between material states, which are derived from these datasets, and mechanical states, which adhere to equilibrium and kinematic compatibility.

In this contribution, we will focus on the recent progress in our project, namely the extension of the original approach towards a two-dimensional data-driven framework for path-dependant material behavior. We developed the theoretic foundation via the introduction of a history surrogate and accompanying propagator, which acts as an update rule, in the recent past. The practical implementation, however, requires the application of our accumulated knowledge of the recent years. While we were able to find an intuitive propagator for the one-dimensional case, which provides accurate results for various classes of material behavior, finding such a generally applicable propagator for the two-dimensional case is challenging. A neural network propagator proved itself as a possible solution to this problem by yielding accurate results for the one-dimensional case. While the extension of the networks architecture to two dimensions is straight forward, the effective utilization of the network within a two-dimensional data-driven framework for inelasticity is not.

In our talk, we will present results of our well-working framework for the one-dimensional case, introduce the extension of this framework to two-dimensions and present its current results. We will discuss our work in progress and give an outlook on the next steps towards the goal of our project, a data-driven FE<sup>2</sup> method for inelastic material behavior.

