Computational Mechanics Group
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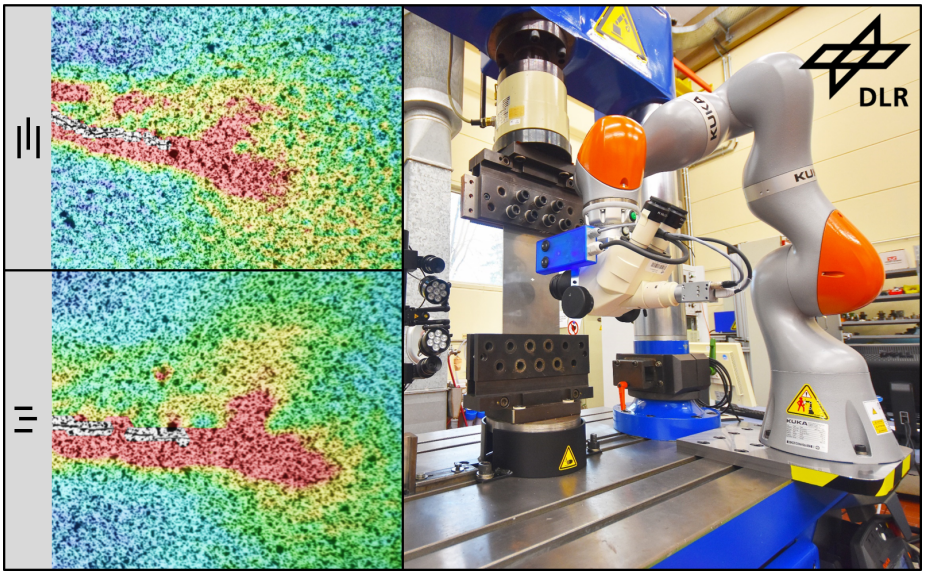
Master's thesis

Unsupervised discovery of anisotropic plasticity models

The material model discovery framework EUCLID (Efficient Unsupervised Constitutive Law Identification and Discovery) was recently applied to discover plastic yield surfaces and hardening laws from full-field displacement measurements and global reaction forces (see Flaschel et al., npj Computational Materials 2022), however, under the assumption of material isotropy. As many elasto-plastic materials used in practical applications exhibit anisotropic material behavior, the objective of this project is to extend the EUCLID framework to anisotropic elasto-plasticity and to validate it with experimental data in collaboration with the Institute of Materials Research of the German Aerospace Center (DLR) in Cologne, Germany. To this end, a general material model library, i.e., a large set of candidate material models, needs to be formulated and the EUCLID framework needs to be adopted such that it selects a model from the set of candidates, which exhibits both a high agreement with the provided data as well as a concise mathematical form.

Subtasks

1. Literature study on anisotropic elasto-plasticity, EUCLID, the virtual field method and sparse regression
2. Formulation of a general yield surface ansatz for anisotropic elasto-plasticity under the preliminary assumptions of infinitesimal strains and perfect plasticity
3. Integration of the general material model ansatz in a finite element solver (forward problem)
4. Implementation of EUCLID (inverse problem) to discover closed-form material models from the general yield surface library through sparse regression
5. Generalization of the material model ansatz such that it considers hardening material behavior
6. Application to experimental data from the Institute of Materials Research of the DLR



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