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CONTINUUM DISLOCATION MICROPLASTICITY MODELING OF SINGLE CRYSTALS

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Modern continuum approaches for microplasticity applications try to fill the gap between size-independent plasticity models for macroscopic applications and microplasticity models based on discrete objects like ab-initio methods or discrete dislocation dynamics. The formulation of phenomenological strain gradient plasticity models is the most popular approach for continuum mechanical microplasticity theories.
Additionally, several dislocation density-based theories have emerged that account explicity for dislocation transport and production. For example, the kinematical theory of Hochrainer *et al.* [1] averages the collective motion of three-dimensional discrete, connected and curved dislocation lines. As the theory is numerically expensive in three-dimensional multislip applications, a simplified version is considered.
In this framework, the dislocation velocity couples the dislocation field problem to the elasto-visco-plastic crystal plasticity framework via Orowan's equation. The kinentic coupling based on phenomenological hardening approaches like the Taylor-relation as well as plastic strain gradient contributions [2] is also discussed.
In addition, promising plastic strain gradient energy candidates are investigated [3]. In this context, the major objective is the identification of accurate defect energy functions. The characteristics of the energies are investigated by an example.

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