
An incompatibility-based model of small-strain elastoplasticity

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Abstract

In this contribution we present an iterative model of small-strain elastoplasticity. A novel deformation field E is defined, our first kinematic variable, the second kinematic variable being $\text{inc } E = \text{curl}(\text{curl} E)$, which, as we shall prove, is directly related to Kröner's incompatibility η . Our method consists in computing E at each time step, *strain decomposition of the strain field* $\epsilon = \epsilon_e + \epsilon_p$, which raises known intermediate configuration issues. Despite the eventual macroscopic perspective of the model, we believe it is first illuminating to show the mesoscopic interpretation of the various quantities involved, as they differ from the classical ones. The reworking of the usual quantities is explained in the case of a single crystal containing one single dislocation. The aim is to treat in a mathematically clean manner an elementary dislocation case. The subsequent construction of our new field E will be shown.

Whereas the mesoscopic interpretation enriches it, the model's initial purpose is to deliver macroscopic elastoplasticity results. Through the Clausius Duhem inequality, we define the parameter θ , *which will be the sole parameter*. *The model is there for an iterative one. We validated it on different numerical benchmarks. First, a simple loading–unloading cycle has been performed in the case of perfect plasticity. The theory is appropriate for an incremental setting, so that*

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