

Regularity Lost: the Fundamental Limitations and Constraint Qualifications in the Problems of Elastoplasticity

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Abstract

The connection between plasticity phenomenon in mechanics and the sweeping process was noticed since the very discovery of the sweeping process as a mathematical problem. Using the ideas of J.-J. Moreau, we describe abstract frameworks for elastoplasticity in terms of Helmholtz- or Beltrami-type decomposition, and convert them to equivalent formulations in terms of differential inclusions with normal cones.

However, with the seemingly simplest constitutive law of perfect plasticity it is, in general, impossible to find the strain rate as a L_2 -function. Although some examples with such phenomenon are already known, we provide an example where the lack of a function-valued strain is caused by a displacement loading. This loss of regularity can be explained by the lack of additivity of the normal cones and the failure of Slater's constraint qualification [1].

Various constraint qualifications can help to establish the additivity of the normal cones and show well-posedness of the similar models, such as spatially discrete models and plasticity with asymptotically linear hardening.

References

- [1] Gudoshnikov I., Regularity lost: the fundamental limitations and constraint qualifications in the problems of elastoplasticity, *Discrete. Contin. Dyn. Syst.*, early access, doi: 10.3934/dcds.2026034