Simulating plane deformations of elastoplastic Cosserat rods using a variational approach

Joachim Linn*[1], Fabio Schneider-Jung , Davide Manfredo , Vanessa Dörlich , and Martin Arnold

[1]Fraunhofer Institut für Techno- und Wirtschaftsmathematik (ITWM) – Germany

Abstract

In our contribution, we outline a variational procedure that provides stable solutions of quasistatic sequential plane deformations of Cosserat rods possessing elastoplastic constitutive properties. The variational procedure can be interpreted as an algorithmic generalization of the computation of stable equilibira of elastic Cosserat rods by energy minimization. We demonstrate our approach with an elastoplastic Cosserat rod model, where the constitutive law yields the bending moment as a rate independent functional of the current bending curvature, combining nonlinear elastic bending stiffness characteristics with plastic curvature evolution modeled via an inverse Prandtl-Ishlinskii (PI) hysteresis operator. We show some illustrative numerical examples of plane bending with the resulting hysteretic effects. Wealso indicate how the model parameters can be identified from results of cyclic plane bending experiments, with composite cables as a concrete application example.

*Speaker