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ABSTRACT:

A Variationally-Based Consistent Model for a of Mode I Type Fatigue Damage-Elasto-Plastic Interface

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We present a variationally consistent model for a 1D continuously distributed interface. For the sake of simplicity and to emphasize the consequences of the present approach, the two materials across such an interface are assumed as follows. One material is rigid and the other is an elastic axially deformable beam. In other words we model an elastic truss anchored to a fixed environment with a bed of axially distributed damage-elasto-plastic springs. The bed of springs is equipped with two plastic accumulation fields, one for each direction of the 1D space, and with a damage field. The thresholds of damage and plastic fields are coupled in the dissipation potential. This constitutive coupling makes each loading cycle slightly irreversible and progressively more damaging so that fatigue effects are achieved. The evolution problem is stated as a hemivariational inequality, which ensures thermodynamic admissibility and irreversibility of the internal fields. Numerical simulations show: (i) pull out test; (ii) progressive narrowing and degradation of hysteretic loops; (iii) monotonic growth of damage and dissipation potential for each points of the 1D domain; (iv) failure propagation and identification of the Paris law parameters; (v) Wöhler curves and identification of Basquin-type relation parameters. The proposed formulation can therefore be regarded as a minimal, yet physically interpretable.

[1] Placidi, L. (2016). A variational approach for a nonlinear one-dimensional damage-elasto-plastic second-gradient continuum model. Continuum Mechanics and Thermodynamics, 28(1), 119-137.
[2] Fabbrocino, F. (2026). A fatigue damage-elasto-plastic oscillator treated with a hemivariational approach. International Journal of Non-Linear Mechanics, 105353.