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Following the equilibria of slender elastic rods ARNAUD LAZARUS, JAMES MILLER, PEDRO REIS, Massachusetts Institute of Technology — We present a novel continuation method to characterize and quantify the equilibria of elastic rods under large geometrically nonlinear displacements and rotations. To describe the kinematics we exploit the synthetic power and computational efficiency of quaternions. The energetics of bending, stretching and torsion are all taken into account to derive the equilibrium equations which we solve using an asymptotic numerical continuation method. This provides access to the full set of analytical equilibrium branches (stable and unstable), a.k.a bifurcation diagrams. This is in contrast with the individual solution points attained by classic energy minimization or predictor-corrector techniques. We challenge our numerics for the specific problem of an extremely twisted naturally curved rod and perform a detailed comparison against a precision desktop-scale experiments. The quantification of the underlying 3D buckling instabilities and the characterization of the resulting complex configurations are in excellent agreement between numerics and experiments.

Arnaud Lazarus
Massachusetts Institute of Technology

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