Coiling of elastic rods from a geometric perspective MOHAMMAD
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Technology — We present results from a systematic numerical investigation of the
pattern formation of coiling obtained when a slender elastic rod is deployed onto a
moving substrate; a system known as the elastic sewing machine (ESM). The Discrete Elastic Rods method is employed to explore the parameter space, construct
phase diagrams, identify their phase boundaries and characterize the morphology of
the patterns. The nontrivial geometric nonlinearities are described in terms of the
gravito-bending length and the deployment height. Our results are interpreted using
a reduced geometric model for the evolution of the position of the contact point with
the belt and the curvature of the rod in its neighborhood. This geometric model
reproduces all of the coiling patterns of the ESM, which allows us to establish a universal link between our elastic problem and the analogous patterns obtained when
depositing a viscous thread onto a moving surface; a well-known system referred to
as the fluid mechanical sewing machine.

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