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The Whole Elephant: A Synoptic View of Liquid Rope Coiling
NEIL RIBE, Lab FAST, CNRS/Univ Paris-Sud — Liquid rope coiling is the instability that occurs when e.g. a thin stream of honey is poured onto toast. While we now have a fine-grained understanding of each of the four principal coiling modes (viscous, gravitational, inertio-gravitational and inertial), we still lack a global view of how the modes cohere to form a larger whole. Using a numerical continuation procedure, I determine how the dimensionless coiling frequency depends on the dimensionless fall height and flow rate, for several values of the dimensionless nozzle diameter. Starting with the onset of coiling, I propose a purely geometrical definition of the critical surface between coiling and no coiling as the locus of points where the radius a_1 of the rope at the contact point is just equal to the coil radius R. Coiling with $a_1 > R$ is impossible because the rope would intersect itself. I characterize the asymptotic limits of the critical surface as well as the structure of the supercritical volume inside that surface. The procedure reveals a new mode of coiling onset that has not yet been identified.

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