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Analysis of the fluid mechanical sewing machine PIERRE-THOMAS BRUN, Institut Jean le Rond dAlembert/Lab. FAST, UPMC, Univ Paris-Sud, CNRS, BASILE AUDOLY, Institut Jean le Rond dAlembert, UPMC, CNRS, NEIL RIBE, Lab FAST, UPMC, Univ Paris-Sud, CNRS — A thin thread of viscous fluid falling onto a moving belt generates a surprising variety of patterns, similar to the stitch patterns produced by a traditional sewing machine. By simulating the dynamics of the viscous thread numerically, we can reproduce these patterns and their bifurcations. The results lead us to propose a new classification of the stitch patterns within a unified framework, based on the Fourier spectra of the motion of the point of contact of the thread with the belt. The frequencies of the longitudinal and transverse components of the contact point motion are locked in most cases to simple ratios of the frequency Ω_c of steady coiling on a surface at rest (i.e., the limit of zero belt speed). In particular, the "alternating loops" pattern involves the first five multiples of $\Omega_c/3$. The dynamics of the patterns can be described by matching the upper (linear) and the lower (non-linear) portions of the thread. Following this path we propose a toy model that successfully reproduces the observed transitions from the steady dragged configuration to sinusoidal meanders, alternating loops, and the translated coiling pattern as the belt speed is varied.

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