Abstract Submitted
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At the end of a moving string JAMES HANNA, CHRISTIAN SANTANGELO, University of Massachusetts, Amherst — We address a basic problem in the dynamics of flexible bodies: the propagation of a shape along a string and its reflection at a free boundary. Although the string equations– inertia balancing stress in an inextensible curve– are quite old, the only exact solutions known for non-trivial geometries are traveling waves with spatially uniform stress. Suitable for closed "lariats," these solutions are incompatible with a free end, where the stress must vanish. It is impossible to drag an open, flexible, curved string along its tangents. This is reflected in the unwrapping motion of a string or chain as it is pulled around an object, and has strong implications for slender structures in passive locomotion, whether industrial cables or the ribbons of rhythmic gymnastics. We consider planar dynamics restricted to time-independent, but spatially varying, stress. We find a new exact solution at a distance $\propto t^{\frac{4}{3}}$ from the free end; continuation to the end requires introduction of a secular error into the positions and velocities and a singularity in acceleration $\propto t^{-\frac{2}{3}}$ at the end, which appears to have a physical basis. This work is an early step towards understanding the dynamics of a wide class of industrial and natural thin-object systems.

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