Abstract Submitted
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Bio-inspired microfluidics: The case of the velvet worm[1] ANDRES CONCHA, PAULA MELLADO, Adolfo Ibanez university, BERNAL MORERA-BRENES, Laboratorio de Genetica Evolutiva, Universidad Nacional de Costa Rica, CRISTIANO SAMPAIO-COSTA, University of Sao Paulo., L. MAHADEVAN, School of Engineering and Sciences, Harvard University., JULIAN MONGE-NAJERA, Tropical Biology, Universidad de Costa Rica. — The rapid squirt of a proteinaceous slime jet endow velvet worms (Onychophora) with a unique mechanism for defense from predators and for capturing prey by entangling them in a disordered web that immobilizes their target. However, to date neither qualitative nor quantitative descriptions have been provided for this unique adaptation. We have investigated the mechanism that allows velvet worms the fast oscillatory motion of their oral papillae and the exiting liquid jet that oscillates with frequencies $f \sim 30-60$ Hz. Using anatomical images and high speed videography, we show that even without fast muscular action of the papilla, a strong contraction of the slime reservoir and the geometry of the reservoir-papilla system suffices to accelerate the slime to speeds up to $v \sim 5$ m/s in about $\Delta t \sim 60$ ms. A theoretical analysis and a physical simulacrum allow us to infer that this fast oscillatory motion is the result of an elastohydrodynamic instability driven by the interplay between the elasticity of oral papillae and the fast unsteady flow during squirting. We propose several applications that can be implemented using this instability, ranging from high-throughput droplet production, printing, and micro-nanofiber production among others.

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Andres Concha
Adolfo Ibanez university

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