Bacteria use type-VI pili to ‘slingshot’ on surfaces

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Summary: A combination of the high spatiotemporal resolution tracking and a novel two-point tracking algorithm, we reveal that how does a single bacterium crawl on a surface by using multiple type-IV pili.

Type-IV pili (TFP) are linear actuators that enable bacteria to crawl on surfaces. We show that TFP-mediated crawling in P. aeruginosa always alternates between two distinct movements: a translation of constant velocity and a combined translation-rotation that is ~20× faster in instantaneous velocity. Orientational distributions of these movements suggest that the former is due to pulling by multiple TFP, whereas the latter is due to release by single TFP, leading to a fast ‘slingshot’ motion. This process can turn the cell body efficiently by over-steering. Furthermore, the large velocity of the ‘slingshot’ motion enables bacteria to move efficiently through environments that contain shear-thinning viscoelastic fluids, such as the extracellular polymeric substances (EPS) that bacteria excrete on surfaces during biofilm formation.