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Strain stiffening of *Salmonella* flagella measured by flow-induced deformations

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The mechanical properties of the bacterial flagellum are essential for understanding bacterial locomotion. We analyze experiments in which a *Salmonella* flagellum, attached to the bottom of a microfluidic channel, is stretched due to the hydrodynamic forces. We reconstruct the 3D geometry of the flagellum from microscopic images. Using the method of regularized Stokeslets, we determine hydrodynamic forces acting on the flagellum. Coupling the forces to a Kirchhoff rod model allows us to predict the deformed shape of the flagellum, taking as inputs the background flow, the undeformed geometry of the flagellum, and its bending stiffness. Previous studies suggest that flagella can take 12 different polymorphic forms, distinguished by the pitch and radius of their helical shapes. However, in absence of any flow, we observed flagella with a different pitch and radius not comparable to any known form. We determine the critical force and torque at which the flagellum changes polymorphic form. We also find that a bending stiffness which increases as the flagellum is deformed best describes the deformation of Salmonella flagella.