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Hydrodynamic effects on the tumbling of flagellated bacteria near a solid surface[1] MEHDI MOLAEI, JIAN SHENG, Aerospace Engineering and Mechanics, University of Minnesota — Peritrichously flagellated bacteria use semi-rigid helical flagella to form a bundle during a run to swim forward and to trigger the unbundling during a tumble to change their swimming direction. It is accepted that the hydrodynamic interactions play a significant role in these processes. Recently, using digital holographic microscopy and microfluidics, we discovered that the tumbling events are substantially suppressed near a solid wall. In this paper, we present a two flagellum rigid model to elucidate the hydrodynamic wall interaction mechanism behind the phenomenon. Further implications on cell attachment and detachment during the biofilm formation will be discussed. We apply Slender Body Theory (SBT) to quantify the flow flagellum interaction. The no-slip boundary imposed by the wall is modeled using the image system of the SBT model for the stoke-flow singularity. We show that in the bulk, a repulsive force among flagella initiates the unbundling and consequently tumbling; however, in presence of the wall, the force is strongly mitigated that stabilize the bundle and suppress the tumbling.

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