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Coordinated Swimming: Hydrodynamic interactions between multi-flagellated bacteria NOBUHIKO WATARI, RONALD LARSON, University of Michigan — Multi-flagellated bacteria, such as Escherichia coli, often have flagella attached at random locations to the cell body, which drive swimming behavior. To study the effect of hydrodynamic interactions on the swimming behavior, we develop a bead-spring model which represents both the body and the flagella using up to 240 Stokeslets, or hydrodynamic drag centers. These beads are bonded by 1) a spring potential, 2) a bending potential, and 3) a torsional potential to adjacent beads. This modeled bacterium swims by rotating the flagella with constant torques. We find that the number and arrangement of the flagella along the bodies of the swimmers affects how two such swimmers approach each other, when swimming either in a line, or side by side, and affects whether or not flagellar rotations are synchronized or not. We show how the flow field generated by each swimmer can be represented using a low order multipole expansion, which can capture the qualitative features of their interactions. With this simple low order expansion, simulations of hundreds or thousands of such swimmers can be carried out, allowing the effects of numbers and locations of flagella on swimming pattern formation to be captured.

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