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Autonomously Responsive Pumping by a Bacterial Flagellar Forest: A Mean-field Approach JAMES MARTINDALE, HENRY C. FU, Univ of Utah — The design and fabrication of microscale pumps using magnetically actuated bacterial flagella opens the door for many applications such as the pumping and regulation of chemicals. Here, we discuss simulations for a pump consisting of a regular two-dimensional array of rigid helices. Recent work investigating the flows above a small, finite array by numerically calculating the full dynamics showed that having random phase differences between helices seems essential to produce the flow patterns observed in experiments. We developed a model which allows us to treat random phase differences in an infinite array. Using a mean-field approach we define pumping as the existence of a self-consistent tilt angle of the array. Pumping is then examined numerically as a function of several parameters in the magnetic actuation and helical geometry. We demonstrate how this pumping flow may be mechanically halted by way of magnetic actuation or autonomously halted by the polymorphic transformation of bacterial flagella in response to environmental stimuli.

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