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Designing actuated cilia pumping fluids in microchannels ALEXANDER ALEXEEV, Georgia Institute of Technology, JULIA YEOMANS, University of Oxford, ANNA C. BALAZS, University of Pittsburgh — Using three-dimensional computational modeling, we examine the motion of actuated cilia in a fluid-filled microchannel. The cilia are modeled as deformable, elastic filaments, which are initially tilted with respect to the channel surface. A sinusoidal force normal to the microchannel wall is applied at the free ends of the tilted cilia and induces periodic oscillations of these flexible filaments. To capture the complex fluid-structure interactions among these filaments, the channel walls and the surrounding solution, we employ our hybrid computational approach that combines a lattice Boltzmann model for hydrodynamics of vicious fluids and a lattice spring model for the micromechanics of elastic solids. We find that the actuated cilia give rise to a unidirectional flow in the microchannel and by simply altering the frequency of the applied force, we can controllably switch the direction of the net flow. The findings suggest that beating elastic cilia could be harnessed to regulate the fluid streams in microfluidic devices.

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