

Abstract Submitted  
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**Propulsion and Trapping of Micro-particles by Active Cilia Arrays** AMITABH BHATTACHARYA, Department of Chemical Engineering, University of Pittsburgh, GAVIN BUXTON, Department of Science, Robert Morris University, O. BERK USTA, The Center for Engineering in Medicine, 51 Blossom Street, Boston, MA 02114, USA, ANNA BALAZS, Department of Chemical Engineering, University of Pittsburgh — Hair-like cilia are vital for transporting fluid and particulates within and around biological organisms. While the coordinated motion of the cilia is effective at propelling the surrounding fluid, adhesive interaction between the cilia and particulates can be crucial for controlling particle movement. Here, we model transport of a microscopic particle via a regular array of beating elastic cilia, whose tips experience an adhesive interaction with the particle's surface. At optimal adhesion strength, the average particle velocity is maximized. Using simulations spanning a range of cilia stiffness, particle radius, and cilia-particle adhesion strength, we explore the parameter space over which the particle can be “released,” “propelled” or “trapped” by the cilia. We use a semi-analytical theory to predict parameters for which the cilia are able to attach themselves to the particle. This is the first study that shows how both stiffness and adhesion strength are crucial for the manipulation of particles by active cilia arrays. These results can ultimately facilitate the design of synthetic cilia that integrate adhesive and hydrodynamic interactions to selectively trap or repel particulates.

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