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Nature-Inspired Active Mixing in a Microchannel[1] VINAYAK KHATAVKAR, PATRICK ANDERSON, HAN MEIJER, JAAP DEN TOONDER, Eindhoven University of Technology — Many applications of microfluidics require efficient mixing of two or more liquid streams. Mixing at the microscale mostly occurs through a rather slow diffusion process given the inherent laminar flow conditions. To speedup mixing, we propose an active mixer configuration, inspired by the motion of ciliated micro-organisms, that consists of an array of individually addressable micro-flaps covering microchannel walls, that can be actuated by an external stimulus. We developed a computational fluid-structure interaction model based on a fictitious domain method that simulates both the micro-flap motion as well as the concomitant fluid flow. We will first demonstrate the feasibility of our concept through a simple two micro-flap design in a cavity. We found that when a proper actuation scheme is used, two micro-flaps can indeed induce effective mixing by chaotic advection in a microchannel. For optimal mixing, it seems that the two micro-flaps should be placed as close to each other as possible, obviously taking care to avoid collision, and they should preferably be actuated 90° out of phase. Next, the simulated 2D flow field from multiple elements is translated to a 3D scenario to assess the design as a continuous micromixer.

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