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The use of sequences of pillars to engineer fluid cross-sectional shape *via* inertial flow deformations HAMED AMINI, MAHDOKHT MASAELI, ELODIE SOLLIER, UCLA, YU XIE, BASKAR GANAPATHYSUBRAMANIAN, Iowa State University, HOWARD A. STONE, Princeton University, DINO DI CARLO, UCLA — Control of fluid streams is useful in biological processing, chemical reaction engineering, and creating structured materials. We use cylindrical pillars to induce significant deformations in laminar flow. Numerical simulations predict that as fluid passes centrally positioned pillars in a straight microchannel, the fluid parcels near the channel centerline move towards the side walls, while fluid parcels near the top and bottom walls move towards the center. This inertial phenomenon ($1 \lesssim Re \lesssim 100$) in effect creates a set of *net* rotational secondary flows within the channel. The existence of four dominant operating modes (based on the number and direction of the induced secondary flows) is also demonstrated. We show how using the basic deformations on miscible co-flows of water and fluorescent dye we can manipulate and shape the cross-section of the colored stream. Hierarchical flow deformation operations can be integrated to execute sophisticated programs and render complex flow-shapes. We can numerically predict the deformation near a single pillar with high precision and accordingly, predict the total transformation function of any potential program. Consequently, a user can use a library of pre-simulated motions and engineer a flow-shape of interest quickly, at a low cost, and with high accuracy, an ability which we demonstrate.

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