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Capillary Machines for Manipulating Small Objects: Theory MARTIN FALK, University of Chicago, ROZHIN HAJIAN, J. MILES FAABORG, CHENG ZENG, MING XIAO, AHMED SHERIF, Harvard University, YOHAI BAR-SINAI, Google Research, MICHAEL BRENNER, VINOTHAN MANOHARAN, Harvard University — Capillary interfaces can robustly assemble geometrically non-trivial structures at milli- and microscales. We apply the principles of capillary assembly to enable the design of arbitrary 3D paths for particles bound to 2D interfaces. Specifically, we consider flat polymer "floats" which are repeatedly raised and lowered through a 3D-printed device. Repulsive capillary interactions between the floats and the device walls translate and rotate the floats. In this talk, we discuss and verify a simple numerical method to elucidate the design principles of the corresponding experimental results. These include a ratcheted twisting effect due to contact angle hysteresis, and the formation of a microscale 3-stranded braid. Our designs enable a gentle yet robust method to programmatically assemble thin fibers into braided topologies.

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