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Experimental characterization and modeling of contractile behavior and fluid flows in an optically-controlled microtubule network[1] ZIJIE QU, JIALONG JIANG, JACK STELLWAGEN, ZITONG WANG, MATT THOMSON, California Institute of Technology — Cells perform physical tasks (genome segregation, movement) by organizing the activity of force-generating, active molecules in time and space. Most experimental active matter systems of biological or synthetic molecules are capable of spontaneously organizing into structures and generating global flows while lacking the spatiotemporal control found in cells, limiting their utility for studying non-equilibrium phenomena and bioinspired engineering. Here, we use an optically-controlled active matter system, consisting of stabilized microtubule filaments and kinesin motors, to demonstrate a series of simple operations by projecting various light patterns including both concave and convex polygons. The light patterns activate a reversible link between the kinesin motors which pull on microtubules. A two-phase contracting behavior is observed. The first phase includes a fast formation of microtubule network and its uniform contraction. The second phase is dominated by the steady state flow established afterwards. Two separate mathematical models are proposed to study these behaviors.

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