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Spatiotemporal optimal control of active nematics actuated by activity strength and vorticity[1] MICHAEL NORTON, Pennsylvania State University, PIYUSH GROVER, University of Nebraska - Lincoln, MICHAEL HAGAN, SETH FRADEN, Brandeis University — Active nematics are an important class of active fluids comprising stress-generating, anisotropic constituents. When the active stress generated is extensile, buckling instabilities create motile topological defects that drive chaotic hydrodynamics. Understanding how to control the fluid flows created by these materials will further our understanding of biological processes and inform design of active, synthetic materials. We demonstrate the use of two different spatiotemporal control fields: applied vorticity and activity strength (considered separately), to shape the dynamics of an extensile active nematic that is confined to a disk. In the absence of control inputs, the system exhibits two attractors, clockwise and counterclockwise circulating states characterized by two co-rotating topological $+\frac{1}{2}$ defects. We identify spatiotemporal inputs that switch the system from one attractor to the other; we also examine phase-shifting perturbations. Control inputs are identified by optimizing a penalty functional with three contributions: total control effort, spatial gradients in the control, and deviations from the desired trajectory.

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