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Stability analyses of the model for photosensitive self-oscillating polymer gels PRATYUSH DAYAL, Indian Institute of Technology Gandhinagar, OLGA KUKSENOK, ANNA C. BALAZS, University of Pittsburgh — Via theory and simulations, we investigate the behavior of polymer gels undergoing Belousov-Zhabotinsky (BZ) reaction. Driven by periodic reduction and oxidation of the ruthenium catalyst, which is grafted to the polymer network, BZ gels undergo rhythmic mechanical oscillations and thereby exhibit chemo-mechanical transduction. The oscillations within the BZ gels, however, can be completely suppressed with light of a certain intensity and wavelength. We simulate the behavior of photosensitive BZ gels by our 3D gel lattice spring model. Using this model we have successfully demonstrated that it is possible to direct the movement of BZ gels, along complex paths, guiding them to bend, reorient and turn. The mechanism of chemo-mechanical transduction, however, works for a particular set of conditions. Through linear stability and normal form analyses, we isolate parameters for which the gel switches from oscillatory mode to stationary mode and vice versa. Specifically, we characterize the nature of Hopf bifurcations and identify regimes where this bifurcation is subcritical or supercritical. We also determine several other types of bifurcations within our system. These analyses allow us to establish optimal conditions required to guide the movement of BZ gels along complex paths.

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