Abstract Submitted
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Using stability analyses to predict dynamic behaviour of self-oscillating polymer gels[1] VAIBHAV PALKAR, GAURAV SRIVASTAVA, Indian Institute of Technology Gandhinagar, OLGA KUKSENOK, ANNA C. BALAZS, University of Pittsburgh, PRATYUSH DAYAL, Indian Institute of Technology Gandhinagar — Use of chemo-mechanical transduction to produce locomotion is one of the significant characteristics of biological systems. Polymer gels, intrinsically powered by oscillatory Belousov-Zhabotinsky (BZ) reaction, are biomimetic materials that exhibit rhythmic self-sustained mechanical oscillations by chemo-mechanical transduction. Via simulations, based on the 3D gel lattice spring model, we have successfully captured the dynamic behaviour of BZ gels. We have demonstrated that it is possible to direct the movement of BZ gels along complex paths, guiding them to bend, reorient and turn. From a mathematical perspective, the oscillations in the BZ gels occur when the gel's steady states loose stability by virtue of Hopf bifurcations (HB). Through the use of stability analyses, we predict the conditions under which gel switches from stationary to oscillatory mode and vice versa. In addition, we characterize the nature of HB and also identify other types of bifurcations that play a critical role in governing the dynamic behaviour of BZ gels. Also, we successfully predict the frequency of chemo-mechanical oscillations and characterize its dependency on the model parameters. Our approach not only allows us to establish optimal conditions for the motion of BZ gels, but also can be used to design other dynamical systems.

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