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Non-equilibrium signal integration in hydrogels[1] C. NADIR KAPLAN, Virginia Polytechnic Institute and State University, PETER A. KOREVAAR, Radboud University, ALISON GRINTHAL, REANNE M. RUST, JOANNA AIZENBERG, Harvard University — Soft multiphase materials that perform controlled actuation and complex sensing are ubiquitous in living systems, and their synthetic analogs would transform developments in areas such as bioengineering or soft robotics. We introduce a fluid mechanical framework that predicts the minimal set of components needed to integrate bioinspired signal processing capabilities into a simple hydrogel that is activated upon transport and reaction of chemical stimuli. For a common polyacrylic acid hydrogel, with copper cations and acid as representative chemical stimuli, the theory explains the experimentally observed unique cascades of mechanical and optical responses. These results suggest simple hydrogels, already built into numerous systems, have a much larger sensing space than currently employed.

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