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Active flows on trees ADEN FORROW, Department of Mathematics, MIT, FRANCIS G. WOODHOUSE, DAMTP, University of Cambridge, JRN DUNKEL, Department of Mathematics, MIT — Coherent, large scale dynamics in many nonequilibrium physical, biological, or information transport networks are driven by small-scale local energy input. We introduce and explore a generic model for compressible active flows on tree networks. In contrast to thermally-driven systems, active friction selects discrete states with only a small number of oscillation modes activated at distinct fixed amplitudes. This state selection can interact with graph topology to produce different localized dynamical time scales in separate regions of large networks. Using perturbation theory, we systematically predict the stationary states of noisy networks. Our analytical predictions agree well with a Bayesian state estimation based on a hidden Markov model applied to simulated time series data on binary trees. While the number of stable states per tree scales exponentially with the number of edges, the mean number of activated modes in each state averages $\sim 1/4$ the number of edges. More broadly, these results suggest that the macroscopic response of active networks, from actin-myosin networks in cells to flow networks in Physarum polycephalum, can be dominated by a few select modes.

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