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Persistence and the Global Attractor Conjecture: Recent Approaches

We describe recent approaches to proving the Persistence Conjecture (which describes a class of mass-action systems for which variables do not approach zero) and the Global Attractor Conjecture (which describes a class of mass-action systems for which trajectories converge to a single positive equilibrium). We introduce the class of "endotactic" networks (which contains the class of weakly reversible networks), and formulate the Extended Persistence Conjecture, which says that endotactic mass-action systems are persistent, even if the reaction rate parameters are allowed to vary in time (to incorporate the effects of external signals). We describe a proof of the Extended Persistence Conjecture for systems that have two-dimensional stoichiometric subspace. In particular, we show that in weakly reversible mass-action systems with two-dimensional stoichiometric subspace all bounded trajectories are persistent. These ideas also apply to power-law systems and other nonlinear dynamical systems. Moreover, we use these results to prove the Global Attractor Conjecture for systems with three-dimensional stoichiometric subspace. This is joint work with Gheorghe Craciun and Fedor Nazarov.