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Generalized Polynomial Models of Biochemical Systems

A common mathematical model of reaction networks, mass action kinetics, uses polynomials to model the concentrations of the chemical species involved in biochemical systems. More general models exist: e.g., Michaelis-Menten kinetics (with rational functions) and generalized mass action kinetics (with generalized polynomials or power-law functions). In any case, these highly non-linear systems can exhibit behaviours as tame as convergence to steady state, oscillation, and as wild as chaos. One of the goals is to draw conclusion about the dynamical system from information about the network alone, which consists of a directed graph and a map assigning a stoichiometry vector to each vertex. We provide a condition for when a generalized mass action system has a unique (vertex-balanced) steady state up to conservation law. In addition, we discuss how generalized mass action systems can be used to study mass action systems. (Joint work with Gheorghe Craciun, Stefan Müller, Casian Pantea.)