

THE STRUCTURE OF MESSI BIOLOGICAL SYSTEMS

Mercedes Pérez Millán

Universidad de Buenos Aires, Argentina

mpmillan@dm.uba.ar

We introduce a general framework for biological systems that describe Modifications of type Enzyme-Substrate or Swap with Intermediates, which we call MESSI systems. Many post-translational modification networks are MESSI systems. For example: the motifs in Feliu and Wiuf (2012), sequential distributive and processive multisite phosphorylation networks, phosphorylation cascades, or the bacterial EnvZ/OmpR network. We prove that, under mass-action kinetics, MESSI systems are conservative. We simplify the study of steady states of these systems by explicit elimination of intermediate complexes and we define an important subclass of MESSI systems with toric steady states. We show, for MESSI systems with toric steady states, an algorithm that determines whether the system has the capacity for multistationarity, and when it does, it shows two positive steady states and reaction rate constants that witness multistationarity.

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