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Circuit functionality: towards a new definition

Abstract:

The notion of circuit functionality has received a lot of attention since Thomas' conjectures that a "functional" negative circuit is necessary for sustained oscillations, and a "functional" positive circuit is necessary for multistationarity.

Many definitions of functionality have been proposed, but only the weakest seem to work in both the positive and the negative case. The local functionality definition is perhaps the most used in the literature, but examples have now been found of oscillating systems with no local negative circuit.

In this talk I will propose a new definition of circuit functionality, based on the presence of a circuit along a shortest path in the state transition graph, between mirror states whose images are also mirror states. Using this definition, it can be shown that a positive circuit is indeed necessary for multistationarity. The negative case remains open, and I will discuss our current efforts in this direction.