Bistability and Chaos in the Discrete Two–Gene Andrecut–Kauffman Model

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We conduct numerical analysis of the 2–dimensional discrete–time gene expression model originally introduced by Andrecut and Kauffman [1]. In contrast to the previous studies, we analyze the dynamics with different reaction rates α_1 and α_2 for each of the two genes under consideration. We explore bifurcation diagrams for the system with α_1 varying in a wide range and α_2 fixed. We detect chaotic dynamics by means of the positive maximum Lyapunov exponent and we scan through selected parameters to detect those combinations for which chaotic dynamics can be found in the system. Moreover, we find bistability in the model, that is, the existence of two disjoint attractors. Both situations are interesting from the point of view of applications, as they imply unpredictability of the system. Finally, we show some specific values of parameters of the model in which the two attractors are of different kind (a periodic orbit and a chaotic attractor) or of the same kind (two periodic orbits or two chaotic attractors).

[1] M. Andrecut and S. Kauffman. Chaos in a discrete model of a two-gene system. *Phys. Lett. A* **367** (2007), 281—287. https://doi.org/10.1016/j.physleta.2007.03.074