Title: Topological entropy of catalytic sets: Hypercycles revisited

Author(s): Sardanyes, Josep[2]; **Duarte, Jorge**[1,3]; **Januário, Cristina**[1]; Martins, Nuno[3]

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Abstract: The dynamics of catalytic networks have been widely studied over the last decades because of their implications in several fields like prebiotic evolution, virology, neural networks, immunology or ecology. One of the most studied mathematical bodies for catalytic networks was initially formulated in the context of prebiotic evolution, by means of the hypercycle theory. The hypercycle is a set of self-replicating species able to catalyze other replicator species within a cyclic architecture. Hypercyclic organization might arise from a quasispecies as a way to increase the informational containt surpassing the so-called error threshold. The catalytic coupling between replicators makes all the species to behave like a single and coherent evolutionary multimolecular unit. The inherent nonlinearities of catalytic interactions are responsible for the emergence of several types of dynamics, among them, chaos. In this article we begin with a brief review of the hypercycle theory focusing on its evolutionary implications as well as on different dynamics associated to different types of small catalytic networks. Then we study the properties of chaotic hypercycles with error-prone replication with symbolic dynamics theory, characterizing, by means of the theory of topological Markov chains, the topological entropy and the periods of the orbits of unimodal-like iterated maps obtained from the strange attractor. We will focus our study on some key parameters responsible for the structure of the catalytic network: mutation rates, autocatalytic and cross-catalytic interactions. (C) 2011 Elsevier B.V. All rights reserved.

Author Keywords: Chaos; Hypercycles; Markov Metrics; Prebiotic Evolution; Topological Entropy

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Reprint Address: Duarte, J (reprint author), ISEL, Dept Math, Rua Conselheiro Emídio Navarro 1, P-1959007 Lisbon, Portugal.

Addresses:
1. ISEL, Dept Math, P-1959007 Lisbon, Portugal
2. Consejo Super Invest Cient UPV, Inst Biol Mol & Celular Plantas, Valencia 46022, Spain
3. Inst Super Tecn, Ctr Anal Matemat Geometria & Sistemas Dinam, Dept Math, P-1049001 Lisbon, Portugal

E-mail Address:

josep.sardanes@upf.edu; jduarte@deq.isel.pt; cjanuario@deq.isel.pt; nmartins@math.ist.utl.pt

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