

Title : **Multi-net analysis and nonlinear dynamics: some methods and results in complexity science**

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Many complex systems are composed by multi-nets, i.e., multiple networks undergoing change in time series. Understanding the behavior of multi-net systems poses some basic questions:

1) how should we represent and model multiply layered and evolving networks (multi-nets) so as to discover their instabilities and nonlinear dynamics?_2) what are some of the common properties induced by dependence on co-evolution with network topologies?_3) does a generalized Boltzmann-Gibbs entropy, that takes into account network dependencies and hence long-range correlations, have applicability to modeling complexity in social systems?_4) what is the contribution of a combination of multiply layered networks, time series, methods of study for nonlinear dynamic interactions (identifying oscillations and instabilities), simulation, nonextensive BG entropy, and tracking co-evolution of network topology?_The examples illustrated are city attributes and networks, industrial networks, agent search behavior, and marriage choice; each includes issues of the co-evolution of network topology and micro-macro linkages. Five sets of results are discussed:

1. A simulation that shows how modeling of results with generalized Boltzmann-Gibbs (q -) entropy takes long range correlations into account in known network dynamics relating to agent search behavior. <http://arxiv.org/abs/cond-mat/0508028>

2. A q -entropy worldwide scaling of the 28 historically estimated city-size distributions is investigated for nonlinear instabilities in urban systems.

3. Investigation of a multi-net coding and longitudinal analysis of agrarian civilizations as dynamical networks (Medieval European and Eurasian datasets) showing nonlinear dynamic interactions.

4. Analysis of collaborative multi-nets in the world biotech industry shows an interactive dynamics of recruitment for innovation and organizational consolidation. AJS 210(4): 1132-1205.

5. Multi-net construction of social structure through mate choice and co-evolution of social network topologies. Complexity 8(1):72-81.