



Scale-free homophilic network

M. L. de Almeida, G. A. Mendes, G. Madras Viswanathan, L. R. da Silva

An important aspect governing the growth of complex networks is homophily, which is defined as the tendency of sites to link with others which are similar to themselves. Here, we modify the preferential attachment from Barabási-Albert model by including a homophilic term. Comparisons are made with the Barabási-Albert model, fitness model and our present model considering its topological properties: degree distribution, time dependence of the connectivity, shortest path length and clustering coefficient. We verify the existence of a region where the characteristics of sites play an important role in the rate of gaining links as well as in the number of links between sites with similar and dissimilar characteristics.

Anomalous diffusion, Fractional Diffusion Equations, Electrical response

E. K. Lenzi

We present our recent results obtained for fractional diffusion equations and extensions, e.g., in presence of geometric constraints (comb-model), and their applications in the analysis of the experimental data of the electrical response obtained for liquid crystals.

Is there any connection between the network morphology and the fluctuations of the stock market index?

A. A. P. Faria

Behavioral aspects of the investors have become an important field of study in Finance and Econophysics. In this work we have considered an agent based model which is able to reproduce most of the actual characteristics of the stock market. We proposed an extension of this model to analyze different network morphologies (regular, random, small-world) for the investors trust network, different initial conditions for the state of the investors (buying, holding selling) and three scenarios for behavioral profiles (imitator, anti-imitator, indifferent) and then to analyze their influence in the stock market fluctuations. Employing tools from statistical mechanics as cellular automata, finite size analysis, Monte Carlo and fractal analysis, we obtained and characterized the stationary limit for each scenario tested, focusing on the changes introduced when complex lattices were used.

Simulations showed interesting results suggesting a link between the fluctuations of the stock market index and the network morphology.

Modelagem Computacional da propagação da Leishmaniose: Efeito do ruído ambiental no comportamento dos vetores

A. A. P. Faria

A Leishmaniose é uma doença infecciosa e endêmica, está presente em todo o mundo e pode ser letal. No Brasil, ocorre praticamente em todas as regiões, e é transmitida pela picada da fêmea do mosquito palha, sendo o homem e o cachorro doméstico os hospedeiros mais comuns na zona urbana.

Neste trabalho, estendemos um modelo baseado em agentes para estudar a propagação da doença e da dinâmica do mosquito considerando o caso de o ambiente apresentar ruído congelado. Utilizando técnicas usuais como autômatos celulares, passeio aleatório e voo de Levy, o modelo busca reproduzir ambientes reais com alto grau de fidelidade a fim de propor medidas eficazes de controle.

Intransitivity and coexistence in four species cyclic games

J. J. Arenzon

Intransitivity is a property of connected, oriented graphs representing species interactions that may drive their coexistence even in the presence of competition, the standard example being the three species Rock-Paper-Scissors game. We consider a generalization with four species, the minimum number of species allowing other interactions beyond the single loop (one predator, one prey). We showed (Lütz, Risau-Gusman and Arenzon, *J. Theor. Biol.* **317** (2013) 286) that, contrary to the mean field prediction, on a square lattice the model presents a transition, as the parameter setting the rate at which one species invades another changes,

from a coexistence to a state in which one species gets extinct. Such a dependence on the invasion rates shows that the interaction graph structure alone is not enough to predict the outcome of such models. In addition, different invasion rates permit to tune the level of transitivity, indicating that for the coexistence of all species to persist, there must be a minimum amount of intransitivity. We also consider the effects of dilution, either quenched or annealed, and mobility in the coexistence conditions of the four species.

q-Estatística em rochas reservatório de petróleo: modelagem direta de dados de RMN

M. Duarte

A Ressonância Magnética Nuclear (RMN) é uma importante ferramenta na prospecção de hidrocarbonetos. Em praticamente todos os poços do pré-sal corre-se uma ferramenta de ressonância. Com dados de RMN pode-se obter informações sobre a porosidade, tipo de fluido (água, gás ou óleo) e até mesmo permeabilidade da rocha [1]. Contudo, um dos problemas associados à interpretação dos dados de RMN é a técnica de inversão do decaimento para o cálculo da distribuição de T2. Em geral assume-se que o decaimento da magnetização é uma multi-exponencial e utiliza-se a regularização de Tikhonov para inversão [2]. Nesse trabalho propomos uma modelagem direta baseada na q-estatística e na superestatística [3,4], na qual ajustamos no máximo 3 q-exponenciais aos dados experimentais, e a partir desse ajuste temos os parâmetros para prever a distribuição de T2, de onde se extrai as interpretações petrofísicas. Mostramos que o valor de q é uma medida da razão entre o quadrado da média pela largura da distribuição das taxas de relaxação.

Generalized Allee effect model

L. S. dos Santos, B. C. T. Cabella, A. S. Martinez

The Allee effect consists of a positive correlation between very small population size and fitness. Offering a new view point on the weak and strong demographic Allee effect, we propose to combine them with the Richards growth model. In particular, a peculiar anifestation of the Allee effect is analytically predicted and still ot validated by experiments. Model validation with ecological data is presented for some special situations.

Quasispecies dynamics with network constraints

Valmir C. Barbosa, Raul Donangelo, Sergio R. Souza

A quasispecies is a set of interrelated genotypes that have reached a stationary state while evolving according to the usual Darwinian principles of selection and mutation. Quasispecies studies invariably assume that it is possible for any genotype to mutate into any other, but recent finds indicate that this assumption is not necessarily true. Here we revisit the traditional quasispecies theory by adopting a



network structure to constrain the occurrence of mutations. Such structure is governed by a random graph model, whose single parameter (a probability p) controls both the graph's density and the dynamics of mutation. We contribute two further modifications to the theory, one to account for the fact that different loci in a genotype may be differently susceptible to the occurrence of mutations, the other to allow for a more plausible description of the transition from adaptation to degeneracy of the quasispecies as p is increased. We give analytical and simulation results for the usual case of binary genotypes, assuming the fitness landscape in which a genotype's fitness decays exponentially with its Hamming distance to the wild type. These results support the theory's assertions regarding the adaptation of the quasispecies to the fitness landscape and also its possible demise as a function of p .

Entropia de Permutação e Complexidade Estatística: aplicações na análise de sinais biomédicos e econômicos

[R. Riera Freire](#)

A Entropia de Permutação é uma medida que leva em conta os valores relativos dos elementos sucessivos de uma série temporal. Sendo assim, fornece informação sobre as possíveis configurações temporais, que não são captadas pelas medidas de entropia tradicionais.

Por outro lado, a Complexidade Estatística é um quantificador que fornece informação adicional em relação à entropia e é capaz de discriminar os comportamentos dinâmicos periódico, caótico e estocástico. Apresentaremos as formulações generalizadas das medidas de Entropia de Permutação e de Complexidade Estatística, assim como suas aplicações mais recentes na área biomédica e no mercado.

Ion-acoustic double-layers in nonthermal plasmas

[L. A. Rios](#)

A double-layer (DL) is a nonlinear structure in a plasma which consists of a positive/negative Debye sheath, connecting two quasineutral regions of the medium. These structures can be found in a variety of plasmas, from discharge tubes to space plasmas, and their study is important for different areas of plasma physics, like plasma processing and propulsion. The concepts related with DLs are also important for areas such as applied geophysics.

There are different kinds of DLs and in the present work the so-called ion-acoustic double-layers are discussed. We investigate the presence of these structures in magnetized nonthermal plasmas, where the hot electron population is modeled by a kappa distribution function.

Different aspects of these structures are analyzed, as well as the effects of nonthermality and the magnetic field. A comparison with previous results is also presented.

Pattern recognition with simulated biomolecular systems: deterministic versus random computation

[M. Argollo de Menezes](#)

Microbiological systems are continuously tuned by selective processes to fulfill their tasks with maximal efficiency. Inspired by the biological problem of antigen recognition, we look for the optimal strategy to achieve the best matching between a stimulating string and a second, initially random detecting string. We introduce a genetic algorithm of multiple detectors that implements an ensemble of different cellular automata which perform the computational task of string recognition.

This ensemble evolves showing an adaptation to the recognition challenge and it ends up with a dynamical state characterized by the emergence of a selected fraction of the whole set of initial rules.

Surprisingly, in this state, the system is capable of outperforming a purely random implementation.



Coevolução Geral da topologia e dinâmica em redes

J. C. Avella

We present a general framework for the study of coevolution in dynamical systems. This phenomenon consists of the coexistence of two dynamical processes on networks of interacting elements: node state change and rewiring of links between nodes. The process of rewiring is described in terms of two basic actions: disconnection and reconnection between nodes, both based on a mechanism of comparison of their states. We assume that the process of rewiring and node state change occur with probabilities P_r and P_c respectively, independent of each other. The collective behavior of a coevolutionary system can be characterized on the space of parameters (P_r, P_c) . As an application, for a voterlike node dynamics we find that reconnections between nodes with similar states lead to network fragmentation. The critical boundaries for the onset of fragmentation in networks with different properties are calculated on this space. We show that coevolution models correspond to curves on this space describing functional relations between P_r and P_c .

The occurrence of a one-large-domain phase and a fragmented phase in the network is predicted for diverse models, and agreement is found with some earlier results. The collective behavior of system is also characterized on the space of parameters for the disconnection and reconnection actions. In a region of this space, we find a behavior where different node states can coexist for very long times on one large, connected network.

Bridging stylized facts in finance and data non-stationarities

S. Camargo, [Sílvia M. Duarte Queirós](#), [Celia Anteneodo](#)

Employing a recent technique by the same authors, which allows the representation of nonstationary data by means of a juxtaposition of locally stationary patches of different length, we introduce a comprehensive analysis of the key observables in a financial market: the trading volume and the price fluctuations.

>From the segmentation procedure we are able to introduce a quantitative description of a group of statistical features (stylized facts) of the trading volume and price fluctuations, namely the tails of each distribution, the U-shaped profile of the volume in a trading session and the evolution of the trading volume autocorrelation function.

The segmentation of the trading volume series provides evidence of slow evolution of the fluctuating parameters of each patch, pointing to the mixing scenario.

Assuming that long-term features are the outcome of a statistical mixture of simple local forms, we test and compare different probability density functions to provide the long-term distribution of the trading volume, concluding that the log-normal gives the best agreement with the empirical distribution.

Moreover, the segmentation of the magnitude price fluctuations are quite different from the results for the trading volume, indicating that changes in the statistics of price fluctuations occur at a faster scale than in the case of trading volume.