justify its formulation. Another interesting macroscopic emergent behavior from the model proposed is the observation of a regime of population divergence at a finite time. It is interesting that this characteristic is observed in humanity's global population growth.
The presentation is based on two recent published papers: 1. RIBEIRO, F. L. ; RIBEIRO, K. N. . A one dimensional model of population growth. Physica. A (Print), v. 434, p. 201-210, 2015. 2. RIBEIRO, F. L. . A Nonphenomenological Model of Competition and Cooperation to Explain Population Growth Behaviors. Bulletin of Mathematical Biology (Print), v. 77, p. 409-433, 2015.
I would like to acknowledge the financial support from FAPEMIG.

[03/11/2015 - 15:20 - Room Vitória]
Evolving cellular automata for diversity generation and pattern recognition: deterministic versus random strategy, MARCIO ARGOLLO DE MENEZES, *UFF - Niteroi - Brazil*, EDGARDO BRIGATTI, *UFRJ - RJ - Brazil*, VEIT SCHWAEMMLE, *University of Southern Denmark - Odense - Denmark* ■Microbiological systems evolve to fulfil their tasks with maximal efficiency. Modelling efforts depend crucially on this assumption and adaptation is the key element for evolution to take place. The immune repertoire is a remarkable example of an adaptable, evolving system whose main role is the defense of living organisms against pathogens (antigens), where the distinction between self and non-self is made by means of molecular interactions between proteins and antigens, triggering affinity-dependent systemic actions. Specificity of this binding and the infinitude of potential antigenic patterns call for novel mechanisms to generate antibody diversity. Inspired by this problem, we develop a genetic algorithm where agents with antibody information encoded as bit strings evolve their repertoire in the presence of random antigens (encoded as random strings) and reproduce with affinity-dependent rates. We develop a population dynamics with stationary populations constrained by size-dependent, Verhulst-like death rates. We ask what is the best strategy to generate diversity if agents can rearrange their strings a finite number of times. We find that endowing each agent with an inheritable cellular automaton rule for performing rearrangements makes the system more efficient in pattern-matching than if transformations are totally random. In the former implementation, the population evolves to a stationary state where agents with different automata rules coexist.

[03/11/2015 - 15:35 - Room Vitória]
Interplay between wildfires and forest age structure in steady state., REBECA CABRAL DE NOVAES, GUSTAVO CAMELO NETO, SÉRGIO COUTINHO, *Universidade Federal de Pernambuco* ■Stationary forests can be characterized by a spatiotemporal distribution of species of trees in respect of its location and age. Several external factors like wildfires, recurrent plagues and forest managements for harvesting of timber, should perturb the dynamics of the evolution of the populations of tree species, superimposed to the inherent topographical and hydrological factors as well as the climate seasonal variations. We investigate the interplay between the distribution of long-term and large-scale forest fires and the forest tree age distribution, using a cellular automata model. For this, we associate the age of a tree with its robustness and hence to its degree of flammability, so that much younger or older trees, shall be more susceptible to burning than those at the ripe age. Particularly, we investigate the effects of wildfires in the most simplest case of single-species forests focusing on the dynamic regime where the probability of interaction between fires is null. In such scenario, the density of trees can evolves in large time scales to one of two possibles steady state attractors, *dense forest* or *savana forest*, regardless of the initial configuration of trees. The time dependent profile of the density of trees and its steady-state age-frequency histograms and fire-size distributions were estimated through various simulations and the records analyzed according to the model parameters.
The *dense forest* state is characterized by a high density of trees with an uniform age histogram for almost all classes, except for the one of the very young trees and those of the senescence period, the later exhibiting an exponential decay. Moreover a typical exponential decay for the fire-size distribution function appears indicating that the presence of a massive number of mature trees prevents the spread of large fires. On the other hand, the *savana forest* state is characterized by a low density of very young trees exhibiting an power-law like behavior for the fire-size distribution function. In short, the inclusion of correlation between the age of trees and its flammability even in a mono-species forest environment, leads to a possible dynamic phase transition between dense forest to a savanna forest state. An outline of the phase diagram according the model parameters is discussed.

[03/11/2015 - 15:50 - Room Vitória]
Percolation and cooperation with mobile agents: Geometric and strategy clusters, MENDELI H. VAINSTEIN, CAROLINA BRITO, JEFERSON J. ARENZON, *UFRGS - RS - Brasil* ■We study the conditions for persistent cooperation in an off-lattice model of mobile agents playing the Prisoner's Dilemma (PD) game with pure, unconditional strategies (C: cooperate, D: defect) [1]. Each agent has an exclusion radius r_P that accounts for the population viscosity, and an interaction radius r_{int} that defines the instantaneous contact network for the game dynamics. The agents undergo random diffusion and the strategy evolution follows the finite-population analog of the replicator dynamics. We show that, differently from the $r_P = 0$ case (pointlike agents), the model with finite sized agents presents a coexistence phase with both cooperators and defectors. Moreover, there are also two absorbing phases in which either cooperators or defectors dominate. We provide, in addition, a geometric interpretation of the transitions between phases and present a phase diagram of the PD dynamics as a function of both parameters, r_P and r_{int}. To determine the phases, we performed a finite-size analysis and studied the probability of percolation of D clusters as a function of time. In analogy with lattice models, the geometric percolation of the contact network (i.e., irrespective of the strategy) enhances cooperation. More importantly, we show that the percolation of defectors is an essential condition for their survival. Differently from compact clusters of cooperators, isolated groups of defectors will eventually become extinct if not percolating, independently of their

size. Our results are robust for a great range of mobilities and of the temptation parameter in the PD game.

[1] M. H. Vainstein, C. Brito and J. J. Arenzon, *Phys. Rev. E.*, **9**0, 022132 (2014).

Oral sessions (17:05-18:15)

BRAINS AND NEURONS

[03/11/2015 - 17:05 - Room Vitória]
If the brain is critical, what is the phase transition?, MAURO COPELLI, *UFPE - PE - Brazil* ■Neuronal avalanches were experimentally observed in vitro a decade ago, lending support to a long-held conjecture that the brain as a dynamical system might be operating near a second-order phase transition. Nontrivial statistics, such as power law distributions and other scale-invariant properties, have been the essential connection between the theory of critical phenomena and neurophysiological data. Many models which have been used to simulate neuronal collective behavior share common features, displaying a phase transition from an absorbing (quiescent) to an active (but otherwise unstructured) phase. Most of these belong to the directed percolation universality class, which has served as a theoretical workhorse in the field.

I will discuss the strength and limitations of this theoretical framework in light of experimental results, which have since been extended to in vivo experimental setups, including both anesthetized and non-anesthetized animals. More generally, I will highlight the need of theoretical developments in Neuroscience, which offers theoretical physicists a fertile ground for interdisciplinary research. For instance, how can we model the long-range time correlations and universal scaling functions observed in the brain activity of freely-behaving animals? Or, given that current recording techniques severely undersample neuronal activity, is it possible to come up with a model that yields scale-invariant statistics even under similar sampling conditions? Can we reconcile these ideas with the plethora of oscillatory activity which is observed in the brain?

[03/11/2015 - 17:25 - Room Vitória]
Resilience and Synchronization of Brain Networks, MAURO COPELLI, *UFPE - PE - Brazil* ■

[03/11/2015 - 17:45 - Room Vitória]
Thermo-Comparative Analysis of Texts: Translations and Target Readerships, HÊNIO HENRIQUE ARAGÃO RÊGO, *Departamento de Física/Instituto Federal de Educação, Ciência e Tecnologia do Maranhão - IFMA, São Luís/MA/Brazil*, LIDIA A. BRAUNSTEIN, *Departamento de Física, Facultad de Ciencias Exactas y Naturales, Instituto de Investigaciones Físicas de Mar del Plata (IFIMAR), Universidad Nacional de Mar del Plata-CONICET, Mar del Pla*, H. EUGENE STANLEY, *Center for Polymer Studies/Boston University/Boston/MA/USA*, SASUKE MIYAZIMA, *Department of Natural Sciences/Chubu University/Kasugai/Aichi/Japan* ■Scaling laws have been an important topic in the physics community across a wide range of Fields. The dynamics of several complex systems in biology, economics, and natural phenomena, have been described with relative success using scaling laws. Scaling phenomena also emerge in the analysis of data associated with human behavior, especially those containing a statistically distributed component, such as the number of links in the World Wide Web or the size of