Matheron and Marsily (Is transport in porous media always diffusive? A counterexample, Water Resources Research, Vol. 16. No. 5, 1980), where the continuous case was studied. This type of model has important applications in research as to the contaminant propagation in aquifers and oil extraction processes, where it is difficult to make a good prediction of the characteristics of the medium by using (for example) conventional methods like the injection and recollection of tracers (inert particles carried by diffusive-advective flow). We show a solution for the MSD in this discrete form, aided by numeric simulations we compare the analytical solution with numerical data. We verify that in this case the MSD from the walkers goes like t^a , where a = 3/2, showing that the advection and diffusion coupling in this type of medium is also a super-diffusive dynamics.

An information theoretical approach to characterize the neural dynamics

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Neurons tend to fire a spike when they are near a bifurcation from resting to spiking activity. Many possible ionic mechanisms can be accounted for as the source of spike generation; moreover the biophysics and the dynamics behind it can be usually described through the phase diagram membrane voltage versus the activation variable of the ionic channel. We present an information theoretical approach to accurately distinguish the most fundamental properties of neurophysiological neurons that were previously described by Izhikevich considering the phasespace trajectory, using a time causal space: Statistical Complexity vs. Fisher Information vs. Shannon Entropy.

Transmission of energy in complex networks

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A fundamental motivation in Complexity Sciences is to understand and predict the implicit relationship between the structure and the behaviour of a complex system. The structure is a topological representation of how the units in the complex system are interconnected, i.e., the

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system's connectivity skeleton. It constitutes the backbone of the system's interactions and it is formally described by the theory of graphs. Behaviour is a functional observable of the collective dynamics that the units in the network have. It shows how the dynamical properties of the complex system evolve and can be measured by a variety of different methodologies. The importance of understanding this relationship is because, in nature and society, both quantities are usually not simultaneously known. For example, in the brain, the behaviour can be measured (e.g., EEG and fMRI) but the exact structure is unknown. On the other hand, the structure of the modern power-grids are known, but the behaviour sometimes is unpredictable (e.g., black-outs and power drops). In this work I am going to focus on the derivation of explicit relationships between the structure and the dynamics of supply-demand networks, in particular, in the results we find for a phase-oscillator model of the power-grid transmission of energy known as the swing equations. Despite our particular choice, the results are unrestricted to power-grids and can be extended to other complex systems of interacting oscillators.

Persistent photoconductivity in SrTiO₃ single-crystalline fibers

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A metastable increase of the dark conductivity caused by short illumination, known as persistent photoconductivity (PPC), has been observed in a variety of semiconductor materials. PPC has mainly been observed in III-V or II-V semiconductors and in crystalline organic semiconductors. Room temperature PPC has been observed in semiconductors such as GaN and GalnNAs, between other materials as polymorph of \alpha-sexithiophene. Recently, room temperature PPC has been observed in Verneuil-grown SrTiO₃ bulk single crystal. We have found persistent photoconductivity in a SrTiO₃ single-crystal fiber. The fiber was obtained using the Laser-Heat Pedestal Growth technique, and after the fiber had been annealed at high temperature with SrCO₃ powder in order to produce vacancy defects. When exposed to laser light of 450 nm wavelength at room temperature, the effect was observed for 24 hours after the light had been turned off.

Nonlinear transport in pump-ratchet hybrids

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Directed transport by means of nonlinear dynamics has been studied in two alternative frameworks, in periodically driven sawtooth potentials ("ratchets") and in the context of driven chaotic scattering ("pumps"). We here consider hybrids between these two types, spatially periodic po-