Special Session 54: Dynamics in Complex Networks

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Complex Networks constitutes a theoretical framework that allows modeling the complexity of the systems that can be found in fields as diverse as biology, ecology, sociology or neuroscience. Although Complex Networks became a research line only 10 years ago, the number of disciplines in which their tools are useful is continuously increasing, being at the present moment one of the more active research fields. Its fundamental premise is that the understanding of a real system made of an ensemble of components should consider not only the nature of these units but also the distribution and features of the interactions.

Following the chronology of the Complex Networks development, the studies were initially focused on the topological and structural characteristics of networks, considered like graphs, regardless of the nature of its units. Later, the interest shifted to dynamics in networks, where each node represents now a dynamical unit interacting with the rest of the network according to certain complex distribution of links. This process results in the emergence of certain properties (synchronization, activation, diffusion, propagation) that cannot be deduced from the unit features.

In the last years, the research in this field is focused on the role that network modularity has in the emergence of a specific function. In other words, the study of how the organization in communities that bridge between the local dynamics and the global statistic affects the collective behavior of a system; issue in which not only the community functioning and structure is being debated, but also its detection at different scales. The functioning of many biological (neuronal, metabolic, genetic...), social and technological networks is precisely based on the coordination of parallel processes carried out by different communities. For example, vision depends on the emergence of a collective behavior in two different brain areas, thus perception implies the simultaneous coordination of both processes. How this process coordination takes place and which are its inner (topological and dynamical) mechanisms are still opened questions, although it is already well known that the information processing in the brain combines the distribution (to different points from the network) and segregation (in communities) of this information.

The integration/segregation phenomena from the complex networks viewpoint

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We study the integration/segregation problem from the viewpoint of complex networks, but considering that the network topology is not static but there is an adaptive mechanism acting on the links. Our goal is to identify under which conditions network synchronization occurs and what structural properties are present in the network topology when this happens. In particular, we experimentally compute the main descriptive structural properties of the network when it has been modified with the proposed mechanism, and it is elucidated the relationship between these results and the observed synchronization at both the local and global scale. Our main finding is that modularity, a global feature, can naturally emerge in a network when evolving links are considered, that is, by means of dynamical properties at the local scale.

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Dynamics in a social network surrounding an online political protest

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Over the past years, new technologies and specially online social networks have penetrated into world's population at an accelerated pace. In this talk we analyze collected data from the web application Twitter, in order to describe the structure and dynamics of the emergent social networks, based on complexity science. We focused on a Venezuelan protest that took place exclusively by Twitter during December, 2010. We found community structure with highly connected hubs and three different kinds of user behavior that determine the information flow dynamics. We noticed that even though online social networks appear to be a pure social environment, traditional media still holds loads of influence inside the network.

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