Book of Abstracts

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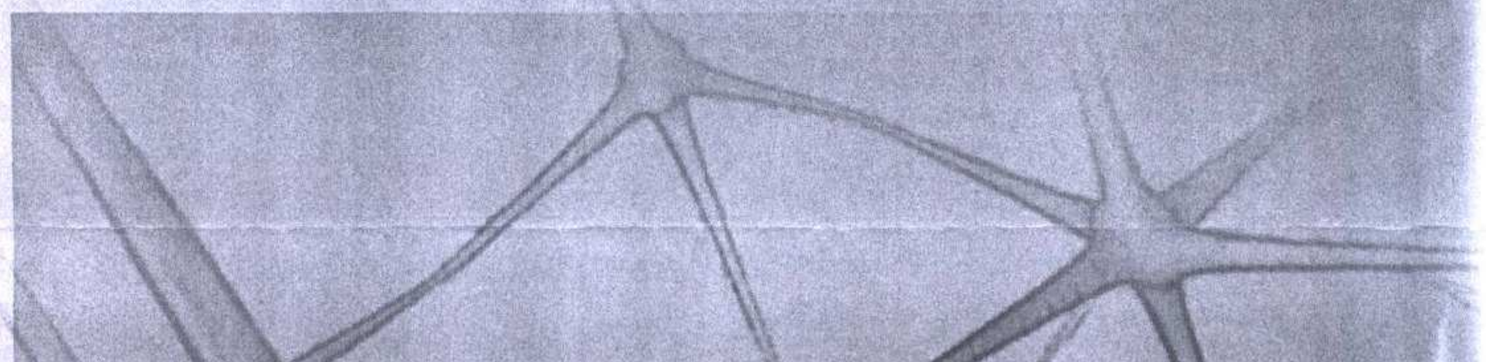

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Löcker

reduced, since the behavior is now spatially homogeneous. For instance, in diffusively-coupled systems, the synchronized network behaves exactly like the individual isolated units, so no new behavior emerges from synchronization. How can one then reconcile the concepts of synchronization and emergence? I will present two mechanisms as answer. The first mechanism is the presence of time delays in the network and the second one is non-diffusive coupling. In the first case, the units are only aware of a past state of the network, in the second case their interaction is not designed for cooperation. Hence, it is not obvious that such systems can synchronize their actions at all. It surprisingly turns out that both systems can indeed exhibit synchronization under appropriate conditions. Furthermore, the synchronized network can display a rich range of complex behavior much different from that of individual units. The complexity can manifest itself temporally, as in chaotic oscillations, or spatially, as in the recently-discovered phenomenon of chimera states, where both synchronized and incoherent behavior co-exist in the same system at different spatial locations.

Topological instabilities in complex glass-forming networks

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Chalcogenide compounds prepared by alloying from a melt are known to possess unique ability to form glassy-like networks distinguished by full saturation of interatomic covalent bonding, they attaining three distinct phases dependently on relation between average number of bonds and Lagrangian constrains per atom: floppy, elastically rigid but unstressed and enthalpically-stressed rigid. The floppy networks clearly reveal topological instabilities showing strict relaxation towards thermodynamically equilibrium state. This process proceeds in time tending sometimes to a few decades as in a case of vitreous arsenic selenides. That is why its guiding is one of a necessary condition to ensure high reliability for these network solids in possible device applications. In this report, we shall consider mathematical formalism to describe evolution "stretched"kinetics (non-exponential) in real glassy-like compounds using classical first-order rate equation.

Characterizing spatial interactions in European R&D network communities

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Collaborations between firms, universities, and research organizations are crucial in the modern knowledge-based economy. Systems of such collaborations constitute R&D networks, which may be meaningfully segmented using recent methods for identifying network communities, subnetworks whose members are more tightly linked to one another than to other members of the network. We identify communities in the European R&D network using data on joint research projects funded by the fifth European Framework Programme. We characterize the identified communities according to their thematic orientation and spatial structure. By means of a Poisson spatial interaction model, we estimate the impact of various separation factors –such as geographical and technological distance –on the variation of cross-region collaboration activities in a given community. The European coverage is achieved by using data on 255 NUTS-2 regions of the 25 pre-2007 EU member-states, as well as Norway and Switzerland. The results demonstrate that European R&D networks are not homogeneous, showing distinct, relevant substructures characterized by thematically homogeneous and spatially heterogeneous community groups.

A mathematical approach to medical complexity

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Health is a complex interaction of individual characteristics, treatment characteristics and organisational characteristics of the healthcare delivery system. Complexity science studies such systems to understand them and to discover if the emergent behaviour we see can be directed or controlled. Tailoring treatments to patients has potential to improve patients quality of life and reduce resource consumption. The power of mathematics is used to drive efficient and provably robust machine learning, which has the capacity to predict outcomes in the case of complex interactions, such as in healthcare. The ability to predict outcomes