Information theory can provide powerful tools for studying, understanding and designing complex systems. Examples span from physics and biology to social and artificial systems. Some attempts to formalize self-organization and emergence have also been undertaken from an information-theoretic perspective. Indeed, complex systems can be studied with the aim of enlightening the processes and the structures involving information elaboration within the system and between the system and its environment. In particular, the dynamics of a complex system is often driven by the interplay among its subsystems, which may also emerge during the evolution of the system and change the overall dynamics. Despite the presence of these structures, complex systems show an high level of coherence: probably the most fascinating example of this sort of unity is the human brain, which show an immense variety of behaviors by maintaining at the same time the internal awareness of a single experience. Interestingly, recent outcomes in neurosciences suggest that an information theory approach is a good candidate to investigate these particular emergent dynamical organizations inside complex systems. We think that the generalization of the approach in different disciplines is of paramount importance to catch the foundation of the synergy among the different complex systems parts beyond the peculiarities of the distinct contexts. This workshop is aimed at fostering the discussion on information-theoretic perspectives to the study of the dynamics of complex systems, with emphasis on the detection of relevant integrated structures or subsystems and the understanding of their relation with the dynamics of the whole system.

**Topics of interest**

Contributions cover a variety of topics including but not limited to the use of information theoretical measures and information theory in general for:

- detecting integrated dynamical structures
- understanding the dynamics of integrated subsystems
- discovering, designing and driving hidden dynamical structures
- providing tools for complex systems design
- understanding emergence and self-organization
- studying the dynamics of meso-level structures
- studying the emergence of meso-level structures
- studying the emergence of boundaries, sensors and actuators
- providing models of the dynamics of systems internally showing both integrated and segregated subsystems
- investigating the emergence of level between levels (“sandwiched” emergence)

**Invited speaker**

Daniel Polani, University of Hertfordshire, UK

http://www.unive.it/dyecs
Dynamical Structures in Complex Systems: an information theoretic perspective (DySCS)

THURSDAY 25th – AFTERNOON 14:00-18:40  
CAPPELLA GUINIGI (SAN FRANCESCO)

Program

14:00-14:10 Welcome
14:10-14:50 Invited talk: Daniel Polani, “Informational Principles in the Perception-Action Loop”

Session 1

- 14:50-15:10 Analysis of emergent competence networks in a regional innovation system: what can we learn from alternative methods? (Caloffi et al.)
- 15:10-15:30 Information adaptation: toward a cognitive-information theoretic approach to cities as complex adaptive systems (Portugali and Haken)
- 15:30-15:50 Information theory for complex systems: what is the entropy? (Thurner et al.)
- 15:50-16:10 Searching for dynamically relevant subsets in complex systems (Filisetti et al)
- 16:10-16:30 Uncovering individual node’s contribution to the segregation and integration of information in neural networks (Zamora-López et al.)
- 16:00-16:50 Does training lead to the formation of modules in threshold networks? (Nicolay et al.)

16:50-17:30 Break

Session 2

- 17:30-17:50 A dynamical approach to assess synthetic modularity (M. Zattoni)
- 17:50-18:10 Topological Shape and Formal Languages for Studying RNA Folding (Mamuye and Merelli)
- 18:10-18:30 A self-adaptive method for detecting brain pathologies: the epilepsy case study (Merelli et al.)

18:30-18:40 Wrap-up and conclusion of the workshop

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