Plenary Talk PV XIV Thu 16:30 Audimax 1

Wanderings at the Crossroad between Nonlinear Dynamics and Systems Biology — •Alain Karma — Northeastern University, Boston, USA

Insights into biological systems have been historically obtained by two very different approaches. Nonlinear dynamics has primarily focused on understanding the temporal behavior of specific sub-systems at a single level of biological organization using mathematical models, often represented by a set of differential equations with fixed parameters such as those describing gene regulatory circuits, metabolic networks, or intra- and inter-cellular signaling and communication pathways. While this approach can shed light on the behavior of specific subsystems, it does not generally describe the coupling between different levels of biological organizations, which severely limits its scope. Systems biology, in contrast, attempts to understand biological systems globally by using high-throughput technologies and bioinformatics to probe the interaction of large ensembles of genes, proteins, and small molecules acting across different levels of biological organization. This approach has proven useful to identify genes and signaling pathways underlying diseases but does not predict how living organisms maintain their function and adapt to changing environments. This talk will describe recent progress to combine those two approaches to understand the dynamical coupling between different levels of biological organizations in the context of cardiac excitable dynamics. The results provide a fundamental basis for personalized therapies of heart rhythm disorders and other human diseases.