9:45 – 10:00 **Opening Remarks**

10:00-10:30

Ramakrishna Ramaswamy

Control strategies for designed synchrony in dynamical systems

Control techniques can be viewed as strategies designed to confine dynamics to lower dimensional invariant subspaces in the phase space. Generalized synchronization in spatio-temporal systems is one instance where such control methods are applicable. A framework for such time-dependent control methods will be discussed.

10:30-11:00

K Murali

Harnessing dynamical patterns

We discuss how a controlled chaotic system can be used as a versatile pattern generator that can be harnessed to implement the full array of logic gates. We then describe how to design a dynamical computing device that can be rapidly repurposed to become any desired logic gate. In addition to reviewing the basic design principles, we extend the formalism by exploiting the hopping between the dynamical states of the bi-stable system, assisted by the noise floor, in response to the transformed inputs, as a basis for the implementation of a dynamical computing element.

11:00-11:30 **Tea / Coffee**

11:30-12:00

Neelima Gupte

Climate network analysis of extreme events: Tropical Cyclones

We construct climate networks based on surface air temperature data to identify distinct signatures of tropical cyclones in the region of the Indian Ocean, which have serious economic and ecological consequences. The climate network shows a discontinuous phase transition in the size of the normalised largest cluster and the susceptibility during cyclonic events. We analyze these quantities for a year (2016) which had three successive cyclones, viz. cyclone Kyant, cyclone Nada and cyclone Vardah, and compare these with a year (2017) where a single cyclone, cyclone Ockhi was seen. The microtransitions in these two cases show distinct patterns. The signatures of the cyclones can be seen in other quantities like the degree distributions and other network characterizers. We discuss the implications of these results for further analysis.

12:00-12:30

Aradhana Singh

Navigating the mammalian brain ensemble

Studying brain structure is important for understanding brain functioning and its organizing principle. Brain networks (BNs) are embedded in space, they have the cost associated with the connections. The spatial arrangement leads to a non-trivial trade-off between cost, which increases as fibers become longer, and efficiency, which favors the short network pathways. The tradeoff between the two makes brain networks spatially small-world. We studied patterns in the mammalian BNs of more than 100 species of sizes varying from 10^{-1} ml to 10^{3} ml. We find that the mammalian brain networks are not just spatially small-world but are the superposition of two subnetworks, one having the features of the spatial small-world networks and the other having random network architecture. Overall, our study describes the general and specific structural organization principles of the mammalian brain.

12:30-13:00

Punit Parmananda

Emergent dynamics for active rotators

Active (self-propelled) rotators are designed using camphor laden paper strips. These strips, when pivoted judiciously, can exhibit both clockwise and counter-clockwise sense of rotation. Subsequently, two or more such rotators are appropriately configured to characterize, experimentally, the different synchronization domains including the chimera-like states.

13:00 – 14:15 **Lunch**

14:15-14:45

Shakti N Menon

Can Oscillators Think?

In recent years there has been much interest in the idea of "unconventional computing", wherein computational logic can, in principle, be implemented using a variety of different physical substrates. One potential class of candidates are nonlinear chemical oscillators, such as the Belousov–Zhabotinsky (BZ) reaction. Recent experiments using BZ droplets in microfluidic devices revealed that lateral inhibition can give rise to complex spatiotemporal patterns, including a collective dynamical state characterized by the coupling-induced arrest of the activity of individual BZ beads, which we term spatially patterned oscillator death (SPOD). Using a generic model for relaxation oscillators, we show that perturbation-induced transitions between such SPOD states, which can be mapped to binary strings through coarse-graining, can provide a basis for computation. Our results yield an experimentally testable framework that suggests a means through which far-from-equilibrium systems can encode a computational logic.

14:45-15:15

Soling Zimik

Mechanics enhances synchronized electrical activity in heterogeneous excitable media

Synergistic interaction between electrical and mechanical activity is crucial in many biological excitable media such as the heart, uterus, and gastrointestinal tract that require coordinated excitation of cells to perform their normal contractile functions. In this talk, I will discuss how electromechanical coupling can promote such synchronized excitation and also show that complex spatiotemporal patterns of excitations (clustered oscillation, traveling waves, coherence, etc.) can emerge in a heterogeneous medium with oscillators and excitable cells as we vary the relative density of oscillators and coupling strength between the cells.

15:15-15:45

M S Santhanam

Transport and extreme events on complex networks

Extreme events are the ones that display pronounced deviation from typical events. Examples of extreme events range from droughts and floods to flash market crashes. This talk will provide a brief review of results related to extreme events and transport properties on networks. For most part, we will consider random walk dynamics, and finally discuss two applications which do not involve random walk type dynamics on networks.

15:45 – 16:00 **Vote of Thanks**

16:00 – 17:00 **Tea / Coffee**

17:00-18:00

IMSc Diamond Jubilee Distinguished Lecture @ Ramanujan Auditorium

Sudeshna Sinha

Chaos and Noise in the aid of Logic

We discuss how understanding the nature of chaotic dynamics allows us to manipulate these complex systems, and such a controlled chaotic system can then serve as a versatile pattern generator that can be used for a range of applications. Specifically we will discuss the application of chaos to the design of reconfigurable logic gates. Further we indicate how one can exploit the interplay of nonlinearity and noise to obtain more consistent and robust logic operations. We also suggest how these concepts may be applied to systems ranging from electronic circuits and synthetic genetic circuits to nanomechanical oscillators.