Seminar

Institute for Plasma Research

Title: Analysis of spatially extended dynamical systems

Speaker: Dr. Promit Moitra
Institute for Plasma Research, Gandhinagar

Date: Nov 10, 2021 (Wednesday)

Time: 15.30

Link: https://meet.ipr.res.in/PDFExtensionTalk-PromitMoitra

Abstract:

There will be two main components to this talk. Firstly, we will discuss an algorithmic technique to systematically and exhaustively parse the phase space of cellular automata (CA) systems. This is accomplished by designing a mapping procedure to uniquely identify each spatial configuration of any general CA, with a positive integer. This method is then utilized to explore properties of a spatial sub-system, which implements a specific rule set known as the Greenberg-Hastings model. This model provides a neat description of physical phenomena, namely spatiotemporal oscillations, often observed in chemical, biological or social contexts, such as cardiac or neural tissue, spatially extended reaction-diffusion phenomena, and epidemic spread of infectious diseases. We utilize the technique described on the model and demonstrate certain fundamental properties of such systems. We also describe the future scope of mathematical analysis of dynamical trajectories in discrete high dimensional spaces such as the phase space of CA systems.

Secondly, we describe a novel coupling framework for coupled map lattice (CML) systems. Such systems have successfully modeled fluid phenomena such as convection, boiling and cloud formation, apart from being used to study pattern formation. The usual approach to coupling in CML assumes uniform coupling across the neighbourhood of each map. Our framework enables the implementation of spatially non-uniform coupling using continuous functions. We demonstrate that in the limit of uniform coupling, the novel coupling framework yields results consistent with previously published results on uniformly coupled systems. We then demonstrate the implementation of feedback mechanisms using our coupling framework, and analyse the impact of such mechanisms on the overall spatiotemporal behaviour of the CML.