

## **Exploring the Swarmalators with Data Driven Approach**

R. Senthamizhan

*Department of Physics, SASTRA Deemed University, Thanjavur, Tamil Nadu, India.*

This study explores the dynamics of swarmalators, focusing on incorporating second-order harmonics in phase interaction. Employing both analytical and data-driven methods, we identified transitions between static and active dynamical states, including the emergence of an active asynchronous state. Through convolutional neural networks, specifically the U-Net model, we delineated stability boundaries, demonstrating the efficacy of machine learning in analyzing complex dynamical systems. This multifaceted investigation provides insights into the behavior of swarmalators under harmonic coupling and highlights the role of advanced computational techniques in uncovering intriguing collective phenomena.

### **References**

- [1] Senthamizhan R., Gopal R., Chandrasekar V. K., “Data-driven Exploration of Swarmalators with Second-Order Harmonics.” *Physical Review E*, vol. 109, no. 6, 2024.