Title: Collective response and information propagation in coordinated groups

Speaker: Mr. Siddhant Mohapatra (ME19D701)

Biography of the Speaker:

Ph. D. Research Scholar in the Department of Mechanical Engineering, IITM.

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Affiliation of the Speaker:

Guide: Prof. Pallab Sinha Mahapatra

DC Members:
Prof. Srinivas Reddy K, ME (DC Chairperson)
Prof. Shaligram Tiwari, ME
Prof. Sarith P Sathian, AM
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Abstract:

Collective behaviour is a ubiquitous natural phenomenon involving coordination among organisms to minimise response time to external perturbations such as obstacles and predatory cues. Staying in groups is found to reduce the individual risk of predation, presumably due to the many-eyes hypothesis, which links the decrease in the probability of predation per head to the increased number of vigilant group members. My work revolves around the collective response of a prey group to one or more predators under various systemic conditions. To comprehensively understand the prey response in such situations, it is vital to understand the dynamics of information transfer in animal groups, which could then be utilised in applications such as herd control. In this seminar, I will propose a minimalistic protocol for controlling and guiding animal groups towards a stationary target in a predator-prey framework. Our model considers agents whose activity is connected to their inherent state and allows for a stochastic transition of the agent from one state to another on exposure to an external cue (as such a predator). The information about the predator's presence propagates across the group of agents, eventually leading to collective motion in a direction dictated by inter-prey alignment interactions and repulsive interaction with the predator. Using overdamped Langevin dynamics for the simulations, we find a linear correlation between the attributes of the first activated agent and the global escape angle of the group. An analytical solution is also derived from first principles and corroborates well with the numerical solution in the absence of noise. The work can provide insights into simple guidance mechanisms for natural and artificial flocks