CoCo Seminar Series
Fall 2015

Modeling Individual Behavioral State Transitions from Experimental Observations of Termite Collectives

Dr. Hiroki Sayama
Systems Science and Industrial Engineering
Binghamton University

Wednesday November 11th, 2015
8:30-9:30am at Engineering Building R-3 (SSIE Conference Room)

Animal motion tracking and behavioral characterization is a highly interdisciplinary research topic that has recently attracted a lot of attention. Earlier studies typically assumed that behavioral labels were given a priori by researchers, and they were also limited in terms of the consideration of behavioral heterogeneity over time and space. Here we present our modeling framework for detecting and classifying multiple distinct behavioral states of individuals within a collective, and describing their transitions and interactions over time and space, solely and directly from experimental observations. Our framework analyzes a regular top-down view video recording of insect collectives behaving in a two-dimensional experimental environment. The positions of individuals are extracted from the recording using a semi-automated interactive feature tracking application we developed. Behavioral traits are characterized by the power spectra of short segments of individual trajectories. This allows us to automatically label the trajectories with distinct behavioral states, which are typically heterogeneous across individuals as well as over time. From this result, a stochastic model of behavioral transitions is constructed. By including the effects of interactions with other nearby individuals, the resulting model is represented by a third-order tensor that returns a Markovian transition probability matrix when the numbers of local neighbors in different behavioral states are given. We demonstrated this approach by applying it to video recordings of termite collectives moving in a Petri dish.

Dr. Hiroki Sayama is an Associate Professor of Systems Science and Industrial Engineering, and Director of the Center for Collective Dynamics of Complex Systems, at Binghamton University. His research interests include complex dynamical networks, human and social dynamics, collective behaviors of swarms, artificial life/chemistry, interactive systems, and complex systems in general.

http://coco.binghamton.edu/