

From: Inform
Subject: EM: Dept. of Natural Sciences Seminar Announcement: Friday 09/05

From: Lauran Soto

DEPARTMENT OF NATURAL SCIENCES SEMINAR ANNOUNCEMENT:

Emergent Swarm Behavior in Living and Robotic Systems, and How Machine Learning Can Capture This in a Geometry-Agnostic Way

Dr. Trung (Average) Phan
Assistant Professor of Physics
Department of Natural Sciences

Department of Natural Sciences Seminar Series
September 5, 2025
12:15-1:15 pm
Burns Lecture Hall (Nucleus E007)

Abstract: Real-world phenomena are inherently complex, often irreducible to just a few basic principles. Nevertheless, intelligent behavior can still emerge in biological systems, shaped by billions of years of evolution, to solve natural challenges. In this talk, I will present some realizations of collective intelligence observed in a swarm of communicative single-cell organisms (*E. coli* bacteria) as they navigate through complex topologies (such as mazes and fractal networks) and avoid existential dangers in the form of a hydrodynamic “black hole”. Inspired by these biological capabilities, I will then explore the potential of swarm robotics, in which each robot can be fully understood and customized for enhanced control and adaptability. I will show a robotic community where autonomous robots, equipped with bio-inspired functions, move across a programmable adaptive landscape. These robots can self-organized to optimize resource consumption and survive stressful conditions by emulating organic biology, exhibiting what we call robobiology. There, novel swarm states of active matters and new insights into the evolutionary dynamics of highly mutable populations were found. Finally, I will sketch a coordinate-free and manifold-independent neural network approach that can learn emergent swarm behavior as effective fields and transfer predictions across settings regardless of coordinates, dimensionality, curvature, or boundary conditions. I am looking for research students, so if you are interested, please let me know!

Department of Natural Sciences
Seminar Series

***Emergent Swarm Behavior in Living
and Robotic Systems, and How
Machine Learning Can Capture This
in a Geometry-Agnostic Way***



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Department of Natural Sciences
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For more information, contact Pete Chandrangsue (pchandrangsue@natsci.claremont.edu)

Additional Seminar information will be sent out soon!

Best,

Lauran Soto - Administrative Assistant (she/they)

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(Luran Soto