

Emergence of Granular Dynamics in Collections of Robotic Microrollers

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Faculty host: Jaime Juarez

Seminar on February 27th, 2024 at 11:00 AM in 2004 Black Engr.

Abstract

The field of miniaturized robots is advancing quickly for the purpose of developing noninvasive medical procedures and exploration of geometrically complex systems. This experimental research explores the collective response of field-responsive microrollers. These microrollers are manipulated by rotating magnets that generate torque at the particle-scale and influence magnetic particle-particle attraction that can be loosely correlated as influencing friction in the system. Our lab has developed techniques to make large quantities of these microrollers and we study their bulk properties. The resulting kinematics are swarms of microrollers whose motion behave as granular flows that readily flow uphill with a negative angle of repose, driven by a negative coefficient of friction, and generate uncommon collective behavior that can only be understood in the context of granular dynamics. Several novel applications will be demonstrated that are achieved through their collective granular-like behavior.

Prof. James Gilchrist is the Ruth H. and Sam Madrid Professor of Chemical and Biomolecular Engineering. He manages the Laboratory for Particle Mixing and Self-Organization, where he and his team investigate rheology and assembly of colloidal and granular systems. Researchers in the lab identify prototypical complex systems including suspension transport in chaotic flows, suspension rheology and microstructure, convective deposition, and functional coatings. Gilchrist received his B.S. in Chemical Engineering from Washington University in St. Louis and Ph.D. from Northwestern University. Prior to joining the faculty of Lehigh University in 2004, he was a postdoctoral research associate in the Department of Materials Science and Engineering at University of Illinois. Gilchrist was a visiting professor in the Department of Chemical Engineering at the California Institute of Technology for the 2011-2012 academic year and a Visiting Professorial Fellow at University of New South Wales in 2016. In 2022, Gilchrist was elected a Fellow of the American Institute of Chemical Engineers.

This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.

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