TECHNICAL COMMITTEE FOR

MODEL-BASED OPTIMIZATION FOR ROBOTICS

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2025-2026 TC Seminar Series

Time: March 25th, 2026, 9AM EDT
Zoom: https://dartmouth.zoom.us/j/94765993258?pwd=aErnkjFBqQaOTEgonxZkeNTbojHRbp.1

Dr. Yan Gu

Purdue University

Prediction & Reaction in Motion: Humanoid Control for Non-Inertial Worlds and Athletic AI

Abstract: Humanoids must predict and react in unpredictable, fast-changing environments. This talk presents a unified perspective on whole-body control across two complementary fronts: dynamic locomotion and manipulation when the support surface accelerates, and athletic behavior in table tennis that compresses perception-action cycles to sub-second horizons. These fronts define an emerging research frontier in acceleration-aware, time-critical control that prioritizes anticipation, coordination, and reliable execution.

In non-inertial settings such as moving ships, airplanes, and trains, platform accelerations act as unknown, time-varying disturbances that invalidate common assumptions in modeling, state estimation, planning, and control. I will describe my group's recent advances in both model-based and learning-based approaches that enable robust locomotion on accelerating terrains. These results target high-impact applications such as shipboard operations and public-transit interventions, where reliable function requires reasoning in accelerating frames.

As a complementary stress test, athletic humanoid table tennis exposes limits in the timing and precision of existing perception and decision-making approaches. I will present an end-to-end reinforcement learning framework that maps ball observations and robot proprioception directly to coherent arm swing and footwork, relaxes common hitting-plane constraints, and achieves rapid, accurate returns with versatile two-dimensional footwork in simulation and in zero-shot hardware deployment. This work is part of an ongoing collaboration with Prof. Karthik Ramani at Purdue University.

I will close by synthesizing lessons across both regimes, emphasizing prediction under tight time constraints and reaction through coordinated whole-body motion, and by outlining open problems for generalizable humanoid control in highly dynamic real-world contexts.

Biography: Dr. Yan Gu received her B.S. degree in Mechanical Engineering from Zhejiang University in 2011 and her Ph.D. degree in Mechanical Engineering from Purdue University in 2017. She was with the Department of Mechanical Engineering at the University of Massachusetts Lowell (UML) as an Assistant Professor between 2017 and 2022. She joined the School of Mechanical Engineering at Purdue University as an Associate Professor in 2022. Her long-term research goal is to realize autonomous and intelligent humanoid locomotion and manipulation in dynamic, complex open-world environments. She received the ONR YIP award in 2024, the NSF CAREER award in 2021, Verizon's 5G Robotics Challenge Award in 2019, Excellence in Teaching Award from UML's College of Engineering in 2019, and Magoon Teaching Award from Purdue's College of Engineering in 2013. Dr. Gu is an Associate Editor for IEEE/ASME Transactions on Mechatronics, IEEE Robotics and Automation Letters, and IFAC Mechatronics.