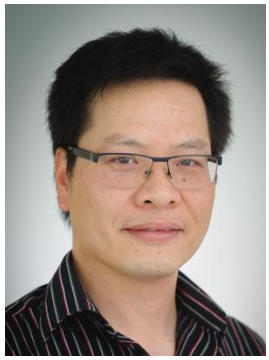
香港大學 機械工程系
Department of Mechanical Engineering
THE UNIVERSITY OF HONG KONG

SEMINAR

A General Framework for Modeling and Control of Soft Manipulators



Date: 7 December, 2026 (Monday)
Time: 11:00 a.m.
Venue: Room 7-35
Haking Wong Building
HKU

Speaker: Dr. Gang Zheng
Defrost Team
French National Institute for Research in Digital Science and Technology
France

Abstract:

Soft robotics has attracted growing interest due to its potential to address tasks that are challenging for conventional rigid robots. Their flexibility, adaptability, and ability to interact safely with humans and complex environments make soft robots particularly promising for applications such as grasping fragile objects and manipulation in confined spaces. However, their continuous deformation, highly nonlinear behavior, and theoretically infinite degrees of freedom make accurate modeling and real-time control particularly challenging. This talk presents a general framework for modeling and controlling soft manipulators based on the Piecewise Linear Strain (PLS) Cosserat rod model. First, the formulation of the PLS Cosserat model will be introduced, providing an efficient representation of robot deformation and dynamics, including bending, elongation, shear, and torsion. Building on this model, static model-based control strategies will be presented, followed by a general dynamic control framework with theoretical convergence guarantees. Finally, the framework will be extended to account for interactions with the environment, including contact and external forces, paving the way for the control of soft manipulators in complex environments. The overall objective is to establish a unified, physics-based approach that bridges continuum mechanics and control theory for the modeling and control of soft robotic systems.

Biography:

Dr. Gang ZHENG is a Research Director at Inria, the French National Institute for Research in Digital Science and Technology, where he leads the Defrost team. His research focuses on the modeling, simulation, estimation, and control of complex dynamical systems, with particular emphasis on soft and deformable robotics. He is an IEEE Senior Member and serves as a Senior Editor of IEEE Transactions on Soft Robotics. His research contributions span nonlinear systems and control, continuum mechanics, Cosserat-based modeling, and model-based control of soft robotic systems. He is the author of a Springer book and has published more than 300 scientific papers in leading international journals and conference proceedings in robotics and control. His recent work aims to bridge continuum mechanics and control theory, developing physically grounded and computationally efficient frameworks for the modeling, estimation, and real-time control of soft manipulators.

ALL INTERESTED ARE WELCOME
For further information, please contact Prof. Peng Lu at 3910 2548.