

SEMINAR ANNOUNCEMENT

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
COLLEGE OF DESIGN AND ENGINEERING
Website: <https://cde.nus.edu.sg/ece>

Area: Control, Intelligent Systems & Robotics (CISR)

Host: Dr Shi Fan

TOPIC	:	Few-Shot Neural Differentiable Simulator: Real-to-Sim Rigid-Contact Modeling
SPEAKER	:	Mr Huang Zhenhao Graduate Student, ECE Dept, NUS
DATE	:	Wednesday, 11 March 2026
TIME	:	4:00PM-5:00PM
VENUE	:	Join Zoom Meeting https://nus-sg.zoom.us/j/89631598104?pwd=sxKbTuda4W4cui9abIPibSriTh5e4W.1 Meeting ID: 896 3159 8104 Passcode: 132810

ABSTRACT

Accurate physics simulation is essential for robotic learning and control, yet analytical simulators often fail to capture complex contact dynamics, while learning-based simulators typically require large amounts of costly real-world data. To bridge this gap, we propose a few-shot real-to-sim approach that combines the physical consistency of analytical formulations with the representational capacity of graph neural network (GNN)-based models. Using only a small amount of real-world data, our method calibrates analytical simulators to generate large-scale synthetic datasets that capture diverse contact interactions. On this foundation, we introduce a mesh-based GNN that implicitly models rigid-body forward dynamics and derive surrogate gradients for collision detection, achieving full differentiability. Experimental results demonstrate that our approach enables learning-based simulators to outperform differentiable baselines in replicating real-world trajectories. In addition, the differentiable design supports gradient-based optimization, which we validate through simulation-based policy learning in multi-object interaction scenarios. Extensive experiments show that our framework not only improves simulation fidelity with minimal supervision but also increases the efficiency of policy learning. Taken together, these findings suggest that differentiable simulation with few-shot real-world grounding provides a powerful direction for advancing future robotic manipulation and control.

BIOGRAPHY

Mr. Huang Zhenhao is currently pursuing a Ph.D. degree in Prof. Fan Shi's group in the Department of Electrical and Computer Engineering at National University of Singapore (NUS). His research interests include learned simulator and contact-rich manipulation.

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