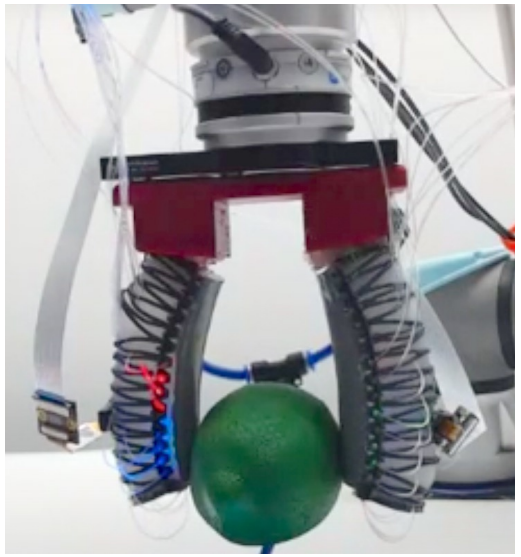
DeepSoRo: High-dimensional Proprioceptive and Tactile Sensing and Modeling for Soft Grippers

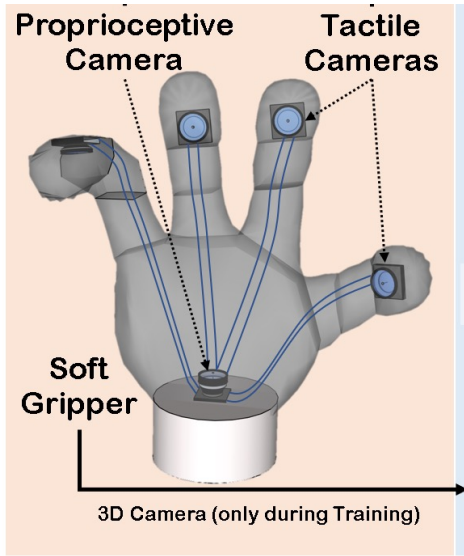
Wenzhen Yuan (CMU); Chen Feng (NYU)

NYU TANDON SCHOOL OF ENGINEERING

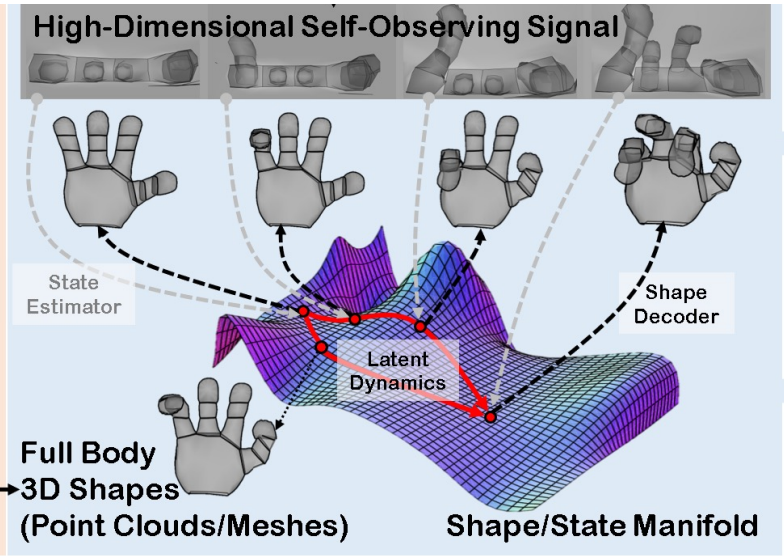
Carnegie Mellon University THE ROBOTICS INSTITUTE

Our goal: building a system that enables high-dimension **proprioception sensing** and **tactile sensing** for soft grippers





Joint Sensing System



Latent Space Modeling

Method:

- Embedded cameras for high-dimensional input
- Optical design
- Data-driven deep models

Progress highlight:

- Sim-to-real framework for design optimization and data collection
- Sensor fabrication

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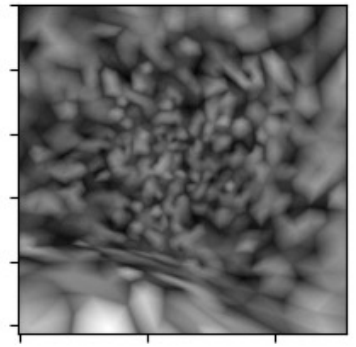
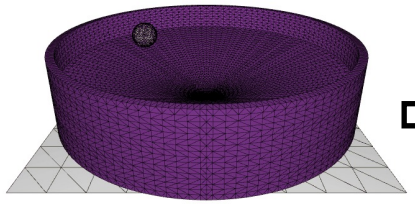
Proprioception sensing:

- Embedded cameras for high-dimensional input, and data-driven deep learning model to predict high-resolution shapes
- Sim-to-real framework: IPC simulation to model the physics of soft bodies, and Blender simulates the camera view
- Test example: a small ball rolling in a closed space. We try to predict the motion based on deformation

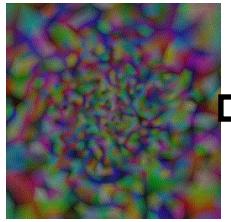


Embedded Observation: 0



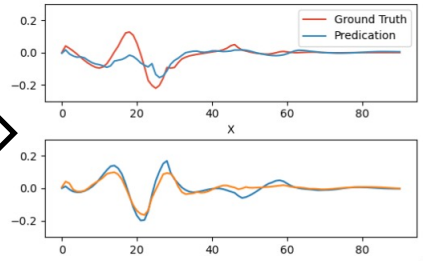
Simulated motion of a soft ball with IPC

Simulator of the embedded camera

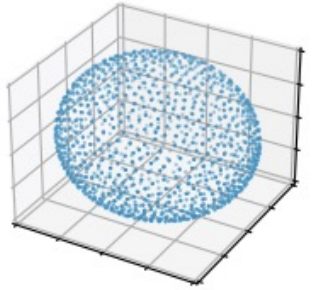


Simulated camera's view

Deep neural network



Predicated motion



Intermediate Point Cloud Estimation: 0

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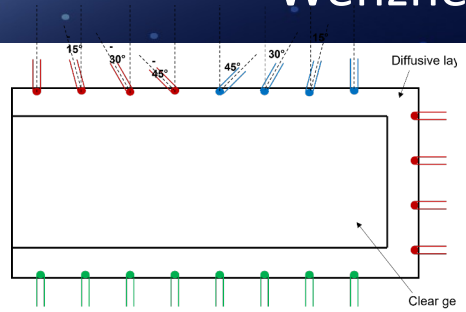
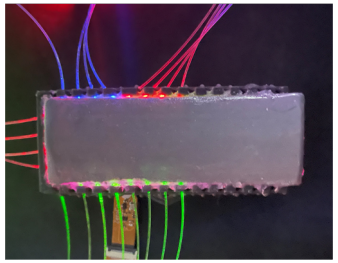
Fiber-reinforced soft finger design

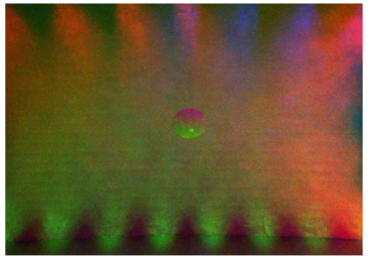


Optimized illumination design

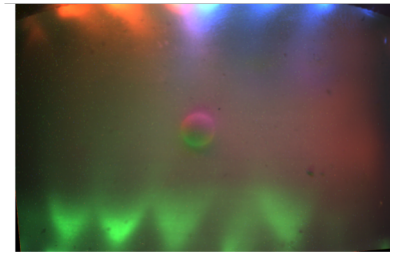
Embedded camera from the back



Illumination with optics fiber



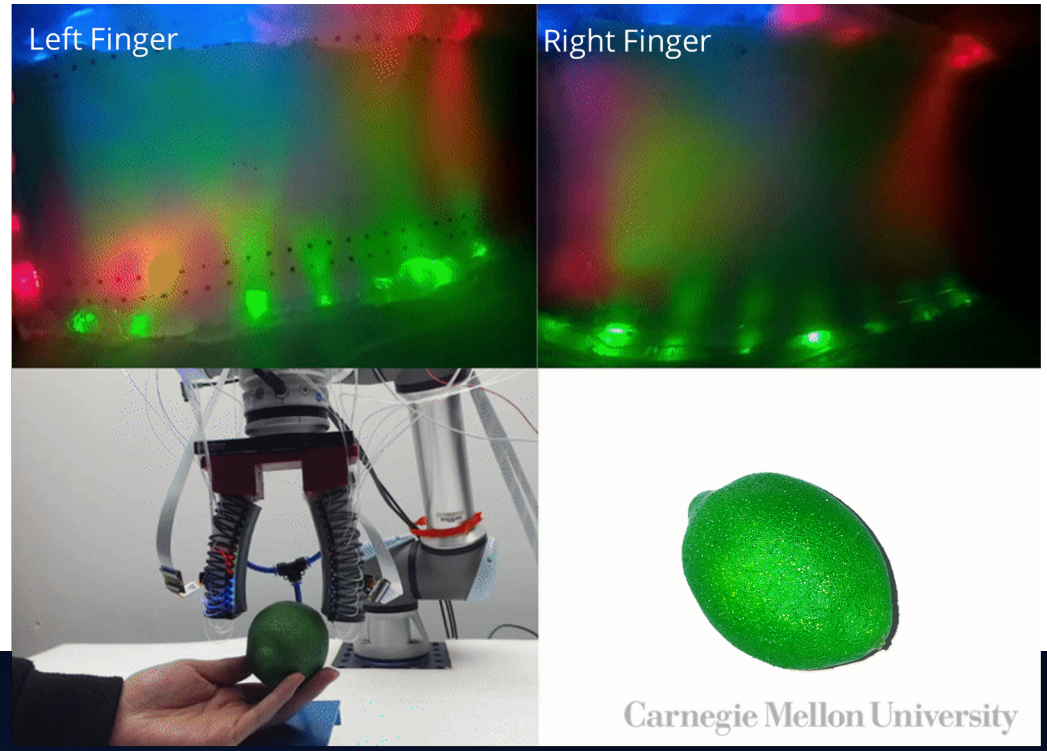
Simulated sensor reading



Real sensor reading

High-resolution tactile sensing:

- GelSight design: an embedded camera captures the change of reflection on the sensing surface
- Challenge: compact optic design
- Method: optimizing the optic design in simulation and transfer to real robots



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