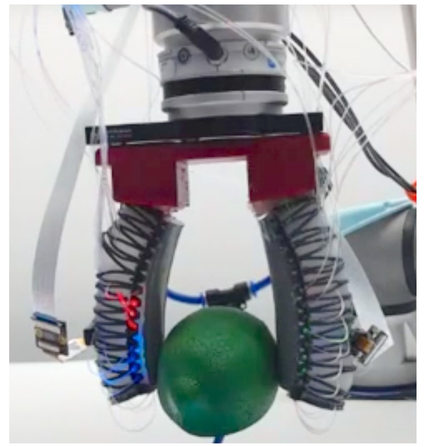
DeepSoRo: High-dimensional Proprioceptive and Tactile Sensing and Modeling for Soft Grippers

Wenzhen Yuan (CMU); Chen Feng (NYU)
https://github.com/DeepSoRo

We propose building a sensing system that help **soft grippers** to better interact with the physical world. The system contains **proprioception sensing** and **tactile sensing**, and it adapts to the high DoF deformation of the soft robots. Our solution integrates innovation in both sensor hardware and algorithms.



Key challenges in soft gripper modeling and sensing:

- The high-dimension status of soft grippers can hardly be represented by low-dimension sensors and algorithms

Our solutions:

- Vision-based sensor design for high-dimension sensing input
- High-dimensional shape modeling in a latent space
- Data-driven approach
- Sim-to-real framework for system optimization and large-scale data collection

Impact on Society:

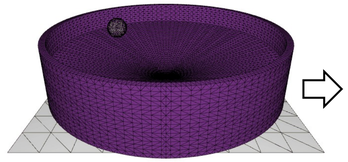
- Autonomous system for agriculture and food industry
- Safe robots for health-care purpose

Education & Outreach:

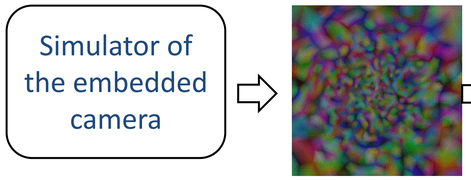
- Organized workshop on soft robot state estimation
- Organized special issue journal edition on soft robot state estimation
- Supported research of undergraduate students and students from underrepresented groups

Scientific impact :

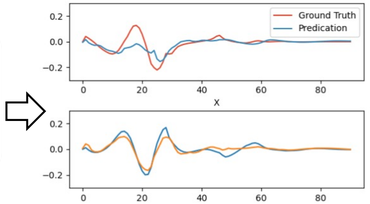
- Joint proprioceptive and tactile sensing for safe and dexterous manipulation with soft grippers
- Build perception-action loops for collaborative soft robots



Simulated motion of a soft ball with IPC*



Simulated camera's view



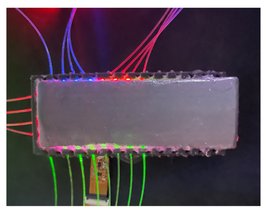
Predicated motion

Demo of proprioception sensing: We build a simulation environment for soft robot state estimation, using the example of a rolling soft ball. Based on the simulated reading of the embedded camera, we can predict the deformation of the ball and therefore predict its motion.

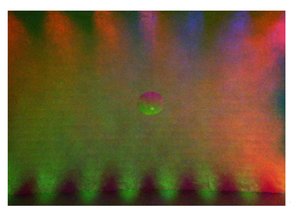
Design of the vision-based tactile sensor: we use an internal camera for sensing and optic fibers for illumination. We firstly optimize the optic design in simulation and build the real sensor.

* Li et al. SIGGRAPH'20

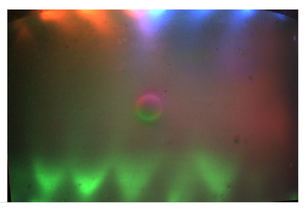
Embedded camera to observe the contact surface



Illumination with optics fiber



Simulated sensor reading when touching a sphere



Real sensor reading when touching a sphere

2022 NRI & FRR Principal Investigators' Meeting
April 19-21, 2022

Award ID#: 2024882

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