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

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

NYU TANDON SCHOOL OF ENGINEERING

Carnegie Mellon University

Soft grippers are intrinsically safe to collaborate with humans and handle delicate objects such as fruits. But their very **high degree-of-freedom** leads *to the lack of proper modeling and sensing methods*, constraining their capabilities in collaborative manipulation.

Existing challenges in soft gripper modeling and sensing:

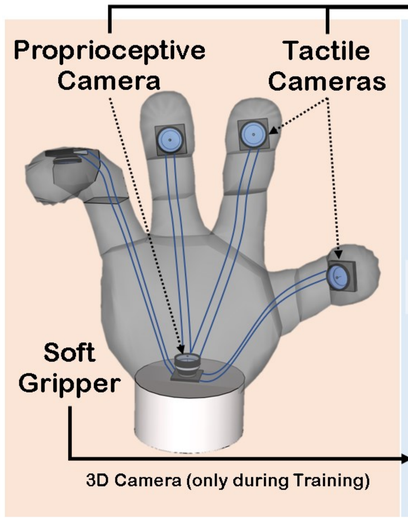
- Over-simplified low-resolution representation
- High-resolution but low-speed representation
- Scalability and adaptability to various gripper designs
- Gap between proprioceptive and tactile sensing

? *Dexterous and safe manipulations in complex environment*

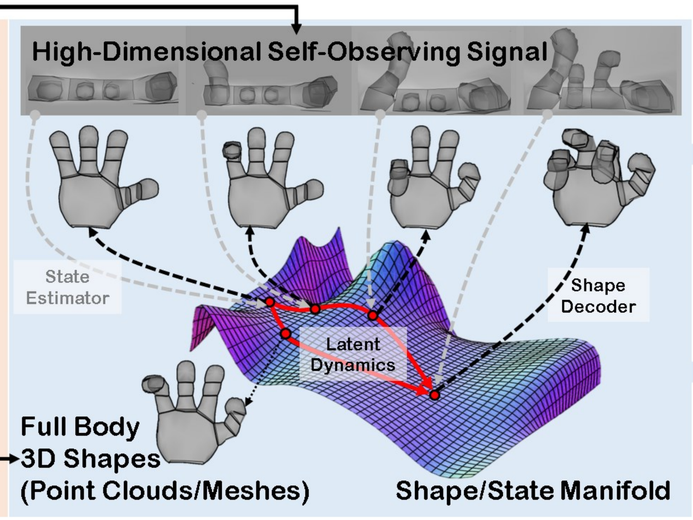
Scientific impact and contributions of this project to NRI 2.0:

- High dimensional shape modeling in a latent space
- Joint proprioceptive and tactile sensing
- Sensor design and integration in hardware prototypes
- Build perception-action loops for collaborative soft robots

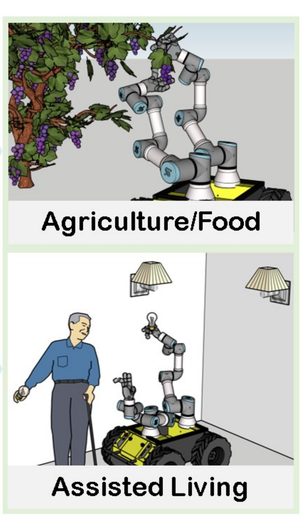
✓ *Scalability, Customizability, Lowering Barriers*



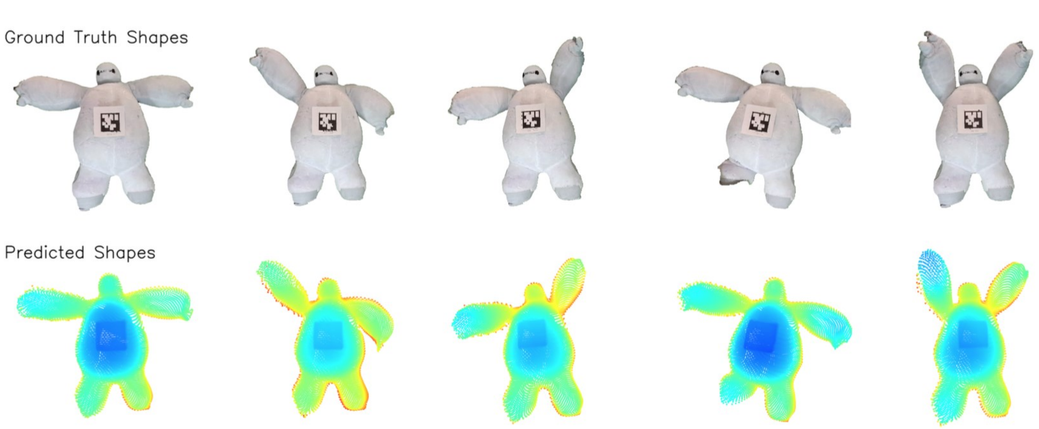
Joint Sensing System



Latent Space Modeling



Broader Impact



Preliminary results on proprioception sensing for a passive soft body
Wang, et al. "Real-time soft body 3D proprioception via deep vision-based sensing". IEEE RA-L, 2020.

Our key ideas:

- High-dimensional proprioception and tactile sensors
- Physics-based deep learning for perception modeling
- Integrated design and sensing

Education & Outreach:

- Robotic grape-picking competition and workshop
- Affordable and open-source educational DeepSoRo kit
- Interactive demo on USA Science and Engineering Festival

2021 NRI & FRR Principal Investigators' Meeting
March 10-12, 2021

NSF Award ID#: 2024882