

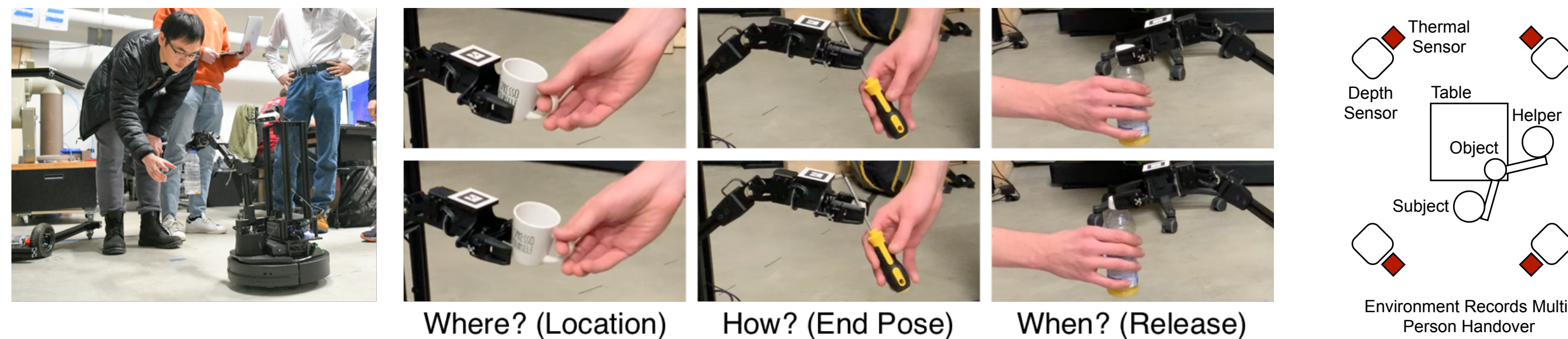
Using Multi-Modal Data to Enable Learning-Based Awareness of Human Grasp Preferences in Co-Robot Manipulators

PI: Natasha Banerjee, co-PI: Sean Banerjee, Start Date: 10/15/2020
 Terascale All-sensing Research Studio <https://tars.clarkson.edu>, Clarkson University



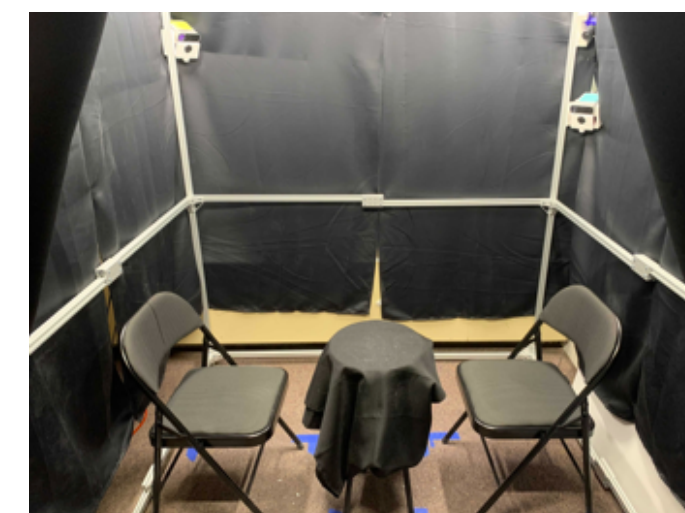
Key Problem: Imbibing robotic manipulators with understanding on human preferences for object handover

Significance: Enabling safe human-aware collaborative HRI in the wild



Novel Contributions:

- Set up Cube capture environment with
 - 4 Microsoft Azure Kinect sensors
 - 4 high-speed FLIR Point Grey BlackFly S color cameras
 - 4 Sierra Olympic Viento-G thermal cameras
 - 1 FLIR Boson radiometric camera
- Collected multi-modal data on 32 subjects engaging in dyadic interactions with 96 dyad sessions of 16 handovers per session
 - 200TB worth of data generated
 - Per dyad, handers and receivers rate the interaction. Interaction is repeated by switching hander/receiver role where receiver demonstrates preferred handover



Key Innovations:

- Lead 3D capture and empirical studies of dyadic handover interactions with 32 subjects interacting with 204 objects using Cube
- Provide deep learning algorithms to recognize human handover preferences from input 3D representations of objects
- Enhance grasp algorithms to be human-aware

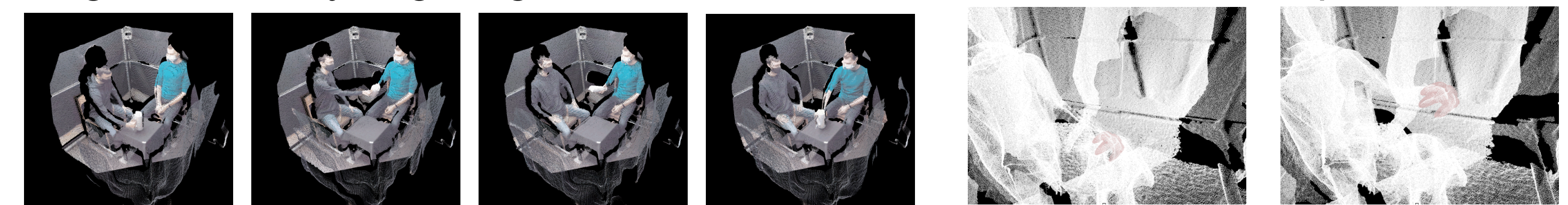
Scientific Impact:

- Informs robotics work on use of multimodal data for collaborative HRI, e.g., handover, lift, and transference of control
- Results can be propagated to multiple agents both human and artificial

- Acquired 204 objects in 17 categories, with 31 3D printed models and 173 high-resolution 3D scans using the Einscan scanner



- Created algorithms to fuse multi-modal data into 3D textured point clouds and to geometrically align high-resolution 3D scanned models to 3D point clouds



Broader Impact on Society

Enables co-robots to provide safe help in assisted living, warehousing, retail, assembly, and repair

Broader Impact on Education

Project funds 2 graduate students and supports research of 12 undergraduates, including 6 females and 1 URM

Enhancement of Research Infrastructure

Datasets on handover and high/low-resolution scans and capture set up plans will be publicly released