The University of Texas at Austin
TEXAS Robotics

THE UNIVERSITY OF UTAH
MECHANICAL ENGINEERING

UT Southwestern Medical Center

NRI: FND: Customizable, Haptic Co-Robot for Training Emergency Surgical Procedures

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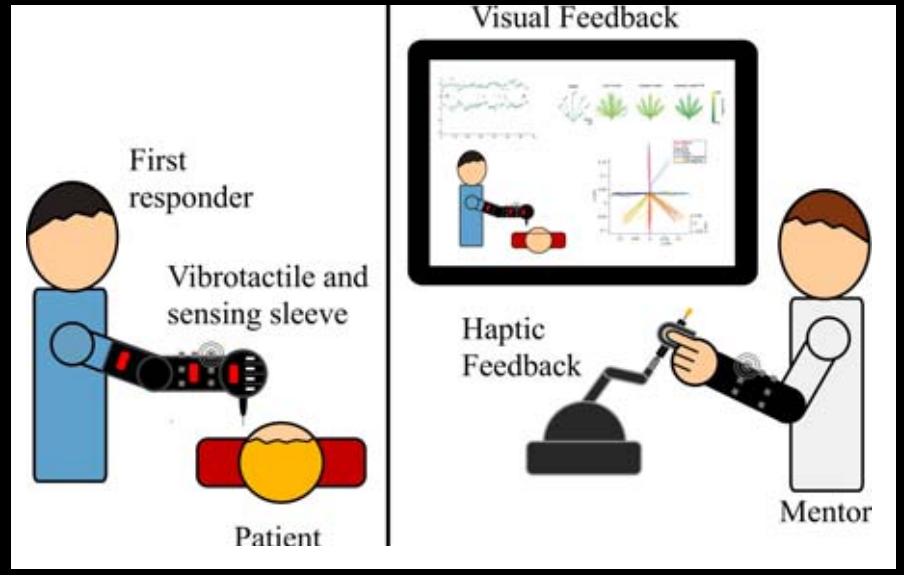
Challenges in Training Trauma Surgical Skills

Needle Decompression

Chest Tube Placement

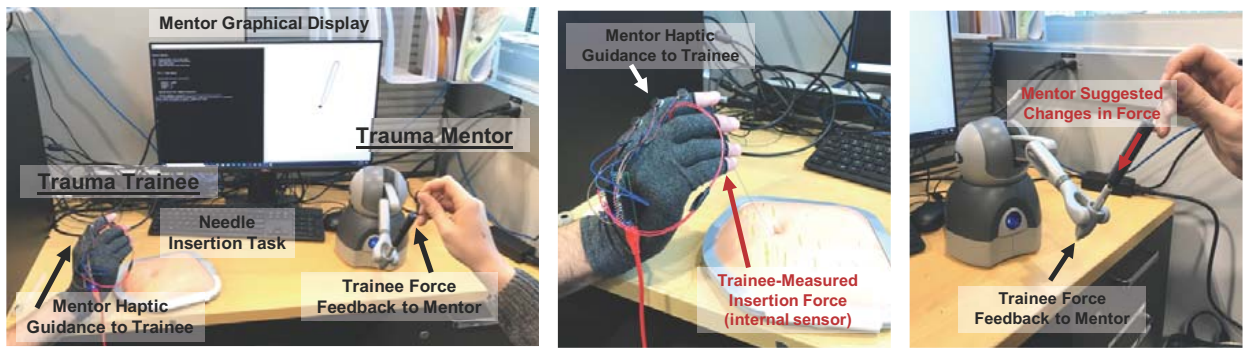
- Requires excellent spatial coordination
- Correct tool placement depends on **sense of touch**
- **Emergent nature** of trauma limits time for training

Long-Term Goal: Augment Mentored Complex Skill Acquisition through Shared Haptic Guidance



Specific Aims:

1) Kinematic and Kinetic **Sensing** for Trainee-Patient Interactions
2) Intuitive **Haptic Guidance** for Tool Manipulation by Trainees
3) Evaluate **Effectiveness** of Haptic Co-Robotic Training



(a) Haptic Telementoring for Needle Insertion (b) Trainee Interface (c) Mentor Interface

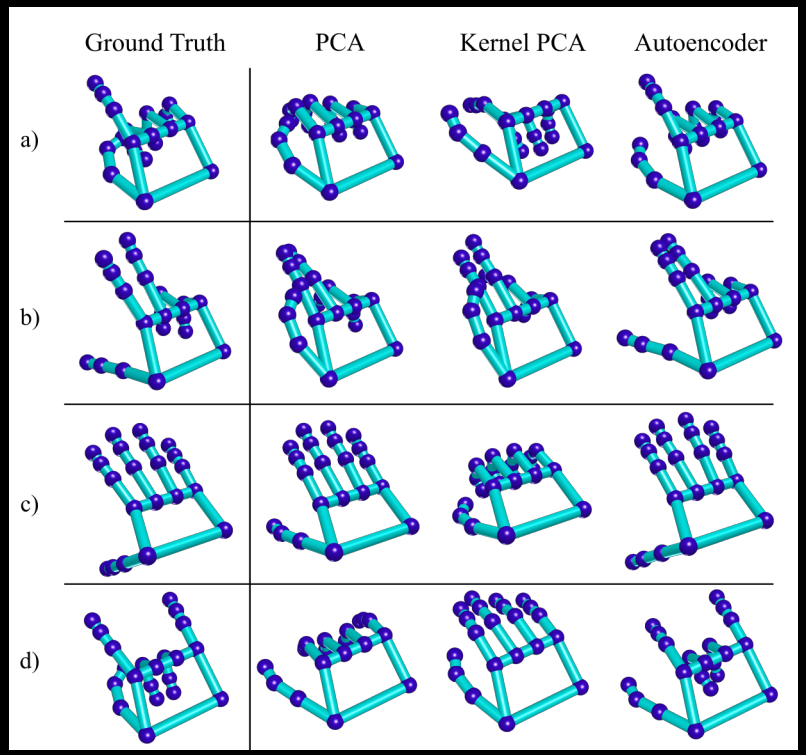
(a) Percutaneous Needle Insertion (b) Chest Tube Placement (c) Open Suturing

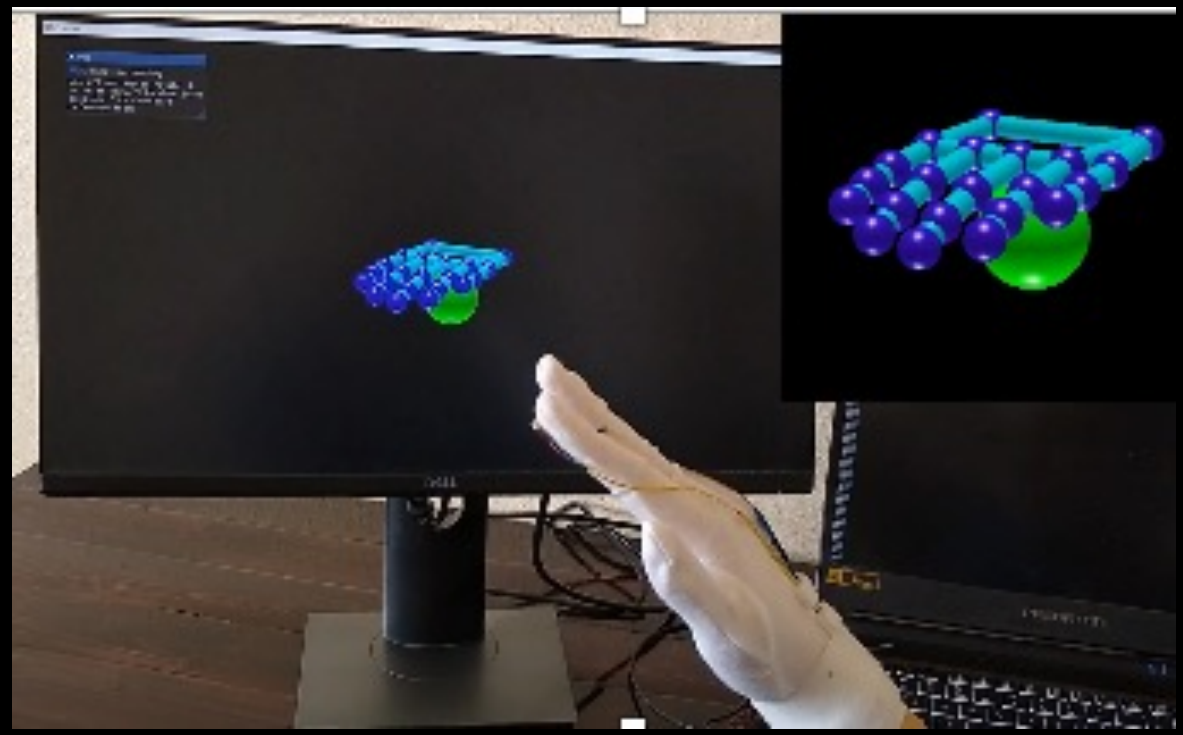
Aim 1: Kinematic and Kinetic Sensing for Trainee-Patient Interactions

Scientific Objective #1:
Develop Analytical Techniques to Minimize Necessary Sensors (ISMR 2022)

Long-Term Goal #1: Simple, Unobtrusive Sensing System

Reconstructing Hand Pose with Under-sensed Hand
(Submitted Conference Paper)





Novel Approach

50% better than PCA, 25% better than KPCA

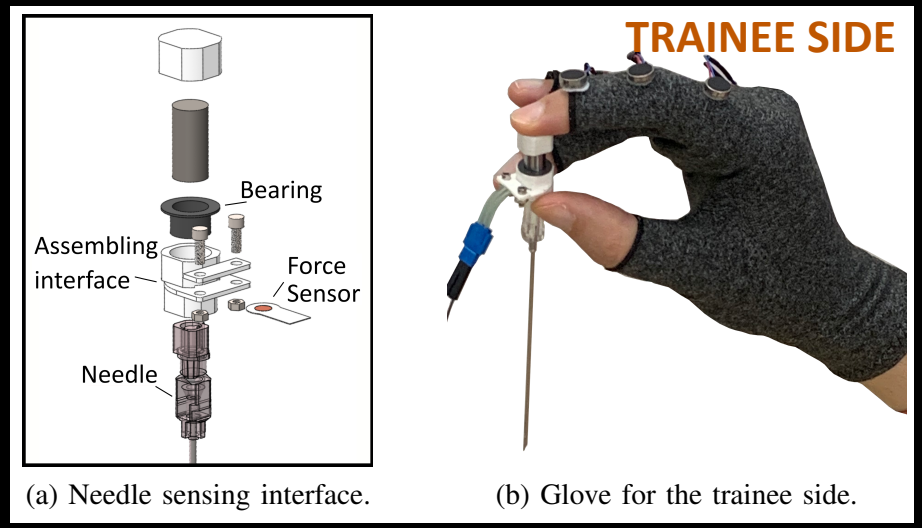
Open-Source Hand Visualizer for CHAI3D Haptics Library (Haptics WIP 2020)

https://github.com/ebattaglia/cHand/

Aim 1: Kinematic and Kinetic Sensing for Trainee-Patient Interactions

Scientific Objective #2:
Understanding Mentor Perception of Trainee Forces (HAPTICS 2022)

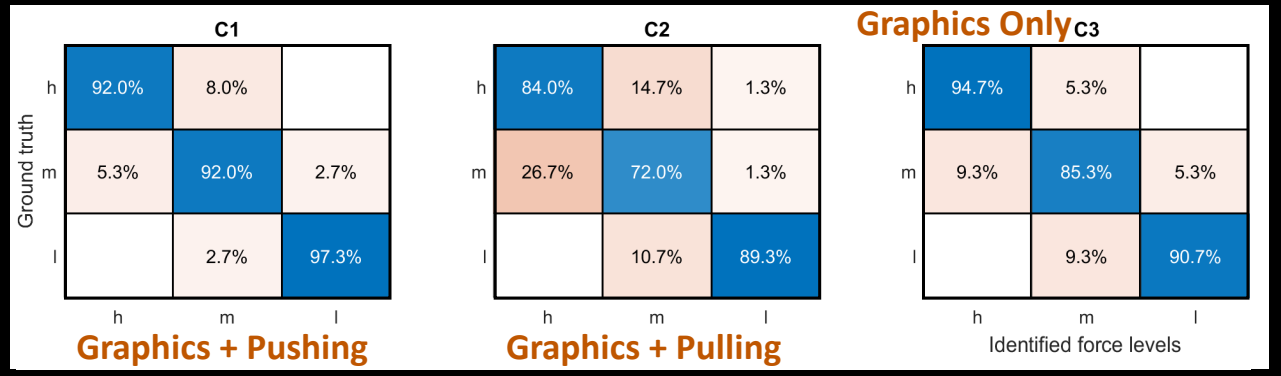
Long-Term Goal #2: Intuitive Visuohaptic Telementoring System with Shared Haptics



(a) Needle sensing interface. (b) Glove for the trainee side.

SHARED HAPTICS

(a) Pushing. (b) Pulling. (c) Visual feedback.



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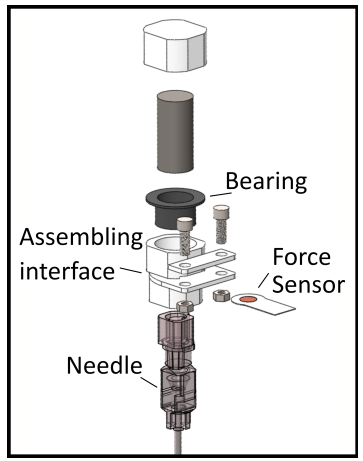
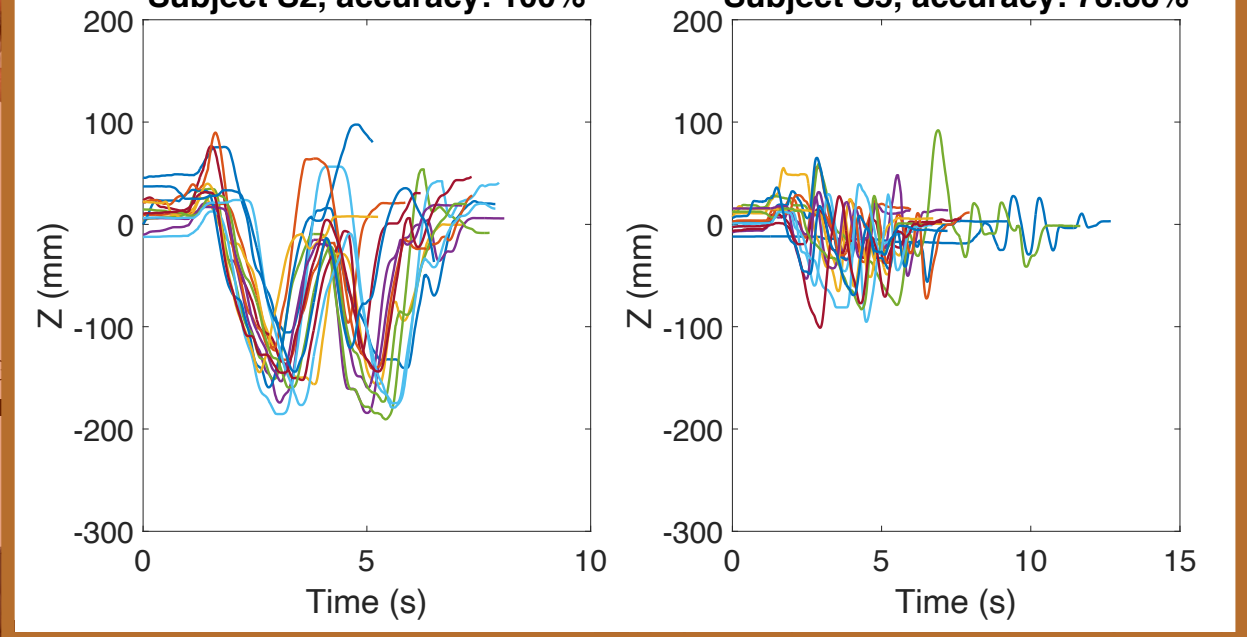


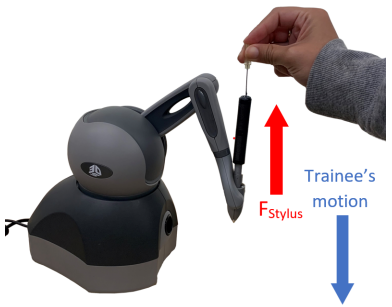
(a) Needle sensing interface.

TRAINEE SIDE


(b) C



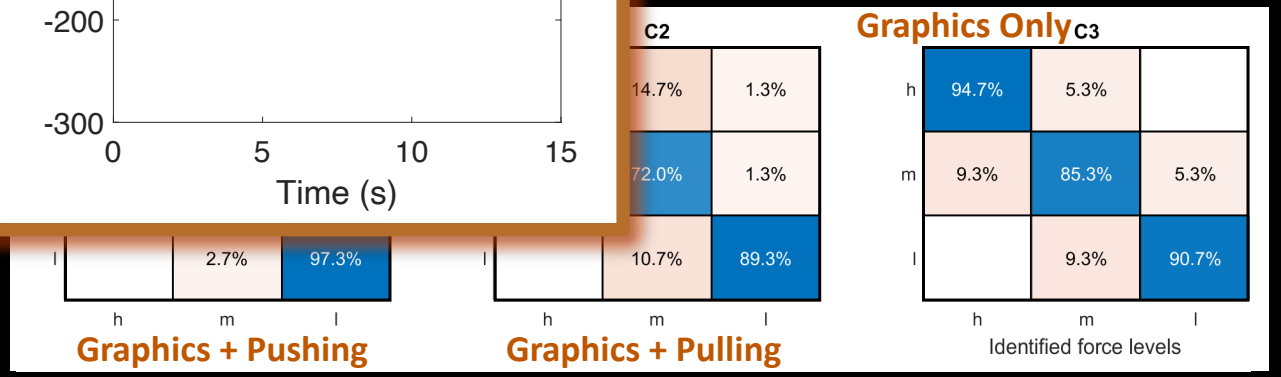
MENTOR SIDE



(a) Pushing.


(b) Pulling.

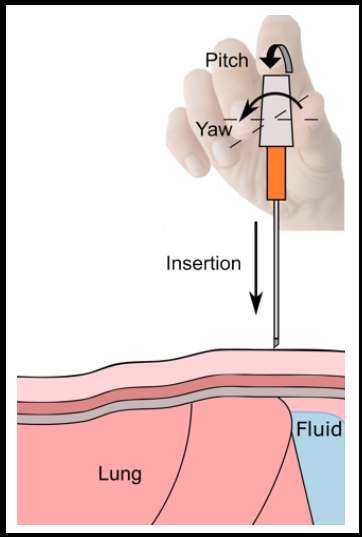
(c) Visual feedback.

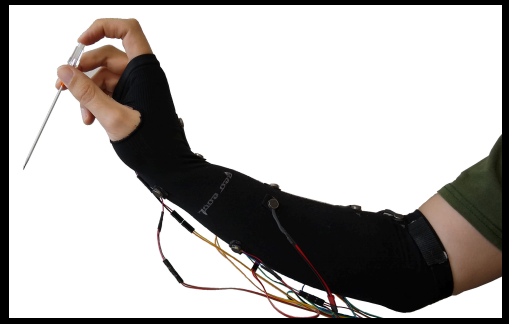


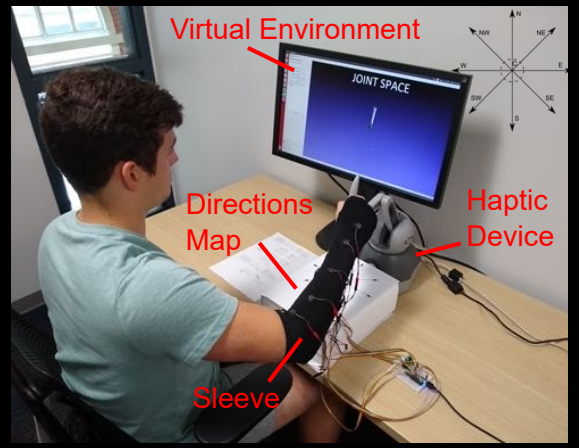
Aim 2: Intuitive Tactile Guidance Cues for Tool Manipulation

Scientific Objective:

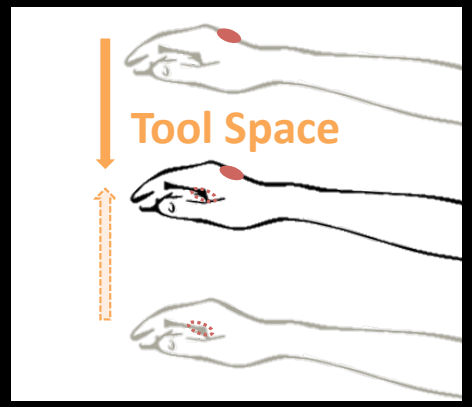
Finding intuitive and natural vibrotactile cues for 3D tool motion *(submitted)*

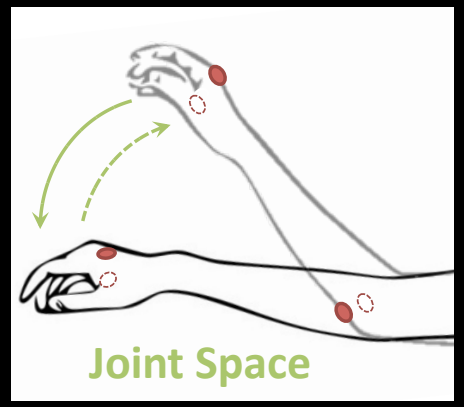


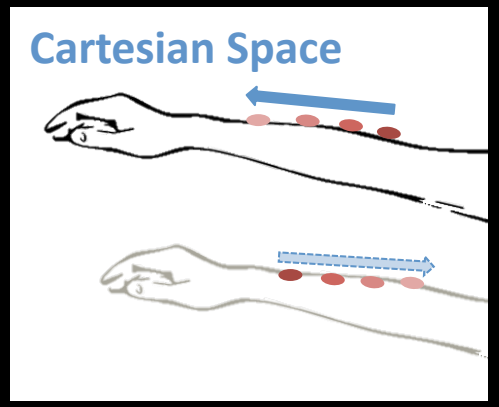




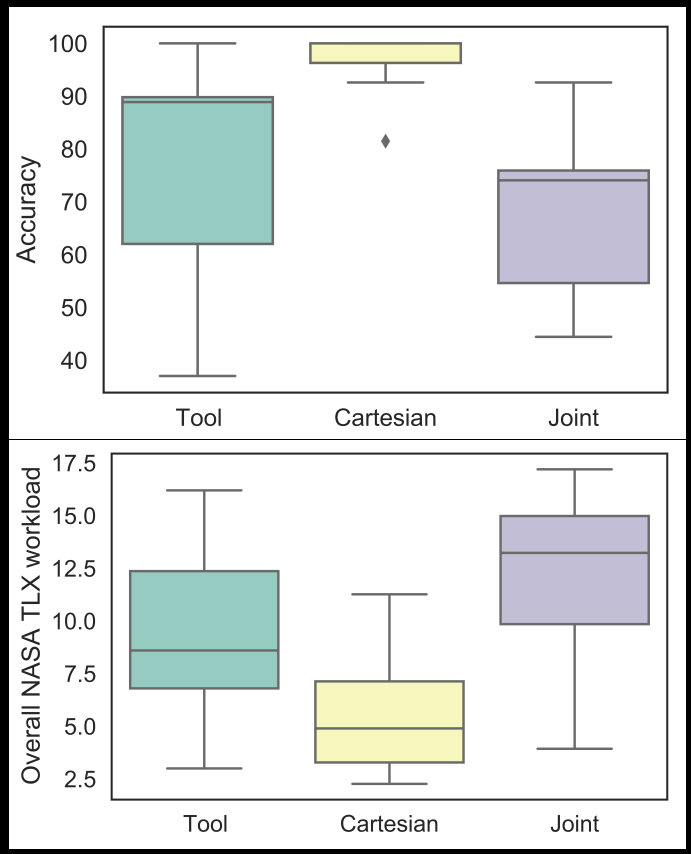
Up/Down Guidance Cues







Cartesian Space cues had highest accuracy and lowest workload.



Next Steps: Integration and Evaluation of Mentor-Trainee System for Aim 3