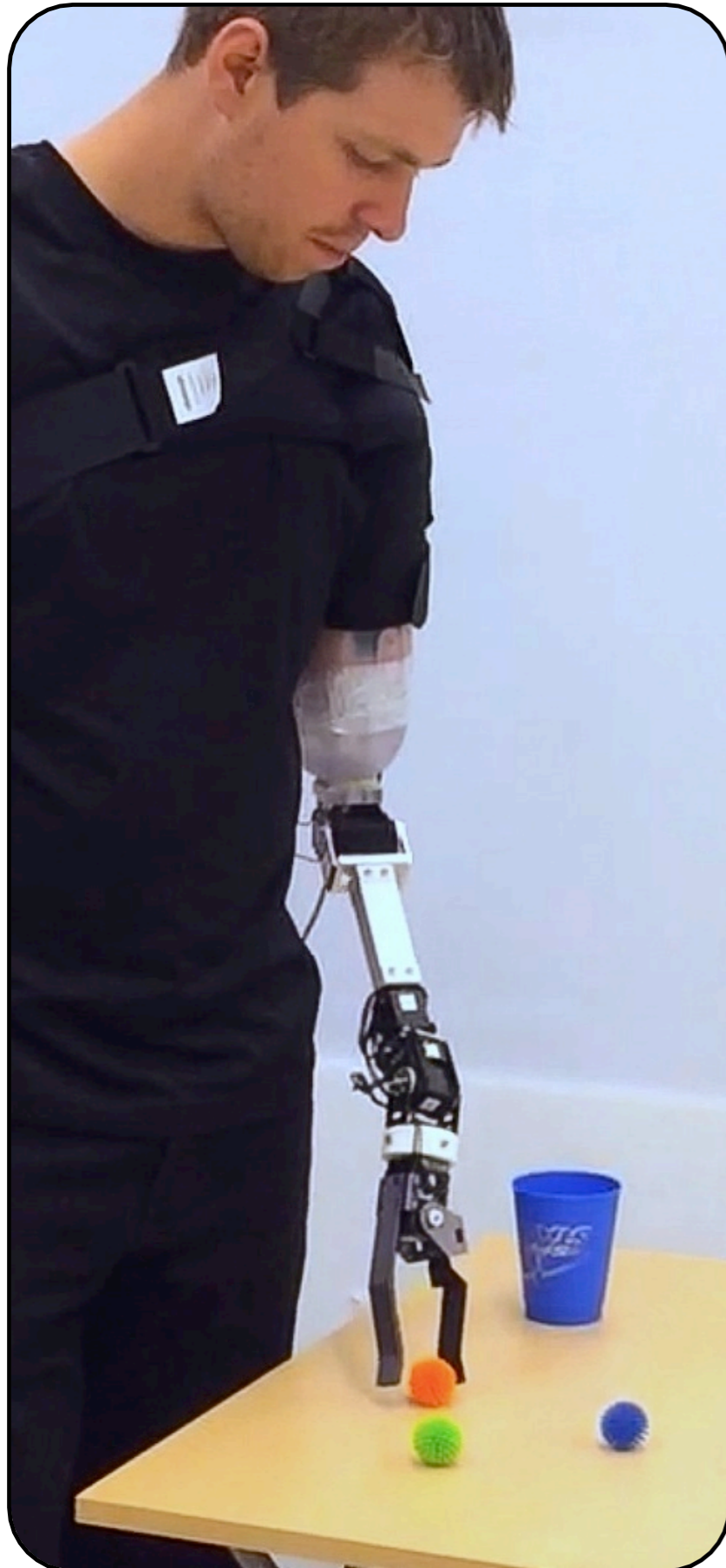


Direct Predictive Collaborative Control (Shared Human-Machine Decision Making Supported by TD Prediction Learning)

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Department of Computing Science
Division of Physical Medicine & Rehabilitation*





Objectives

- Discuss a low-level, intimate case of **human-machine decision making**.
- Focus not so much on the mind (the brain, AI) but on **the interface**.
- View interfaces as full **goal-seeking agents**, that can be evoked with RL.
- Present one small but important step today: **collaborative control** for more natural prosthetic motions.



Upper-limb Prosthetics

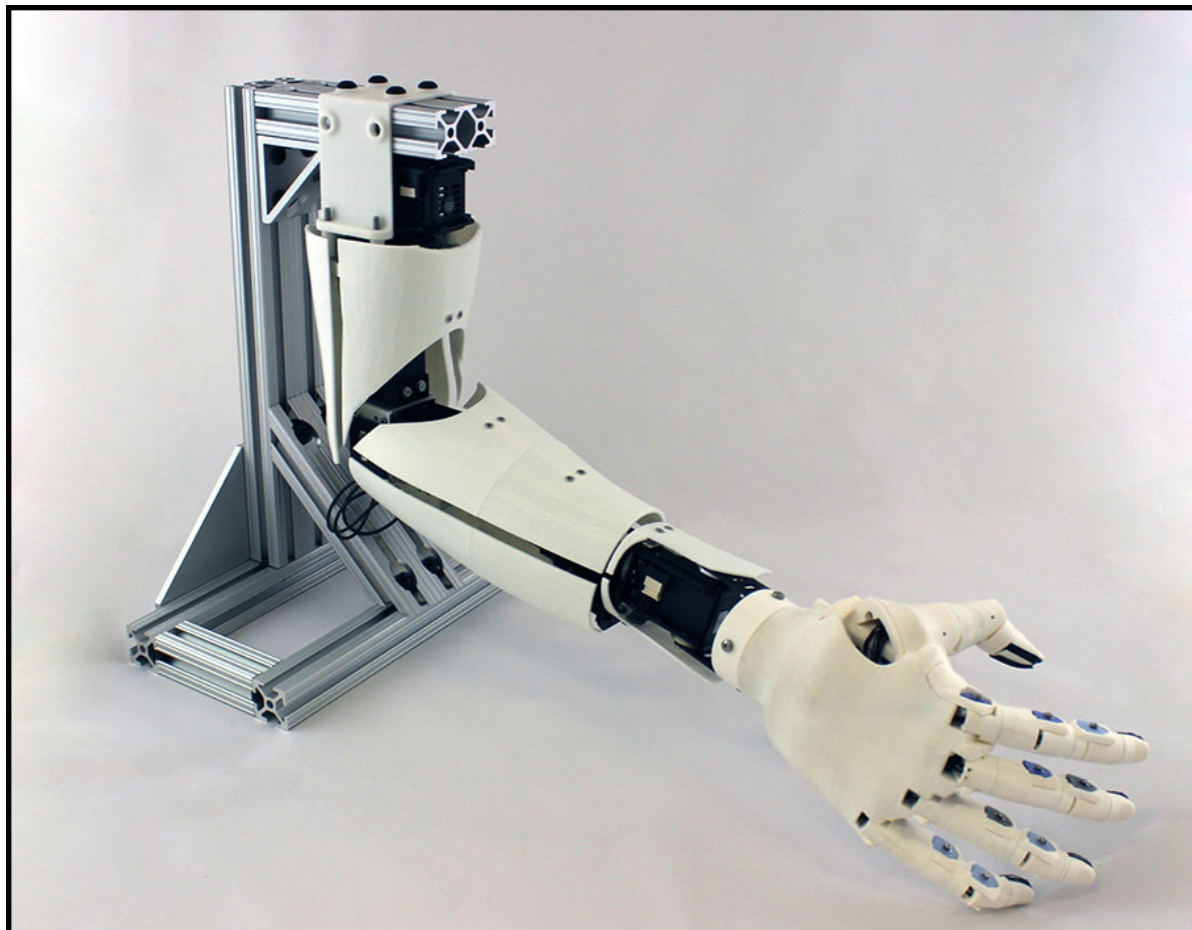
(from cables-and-hooks to bionic bodies)

Functional Use in Daily Life

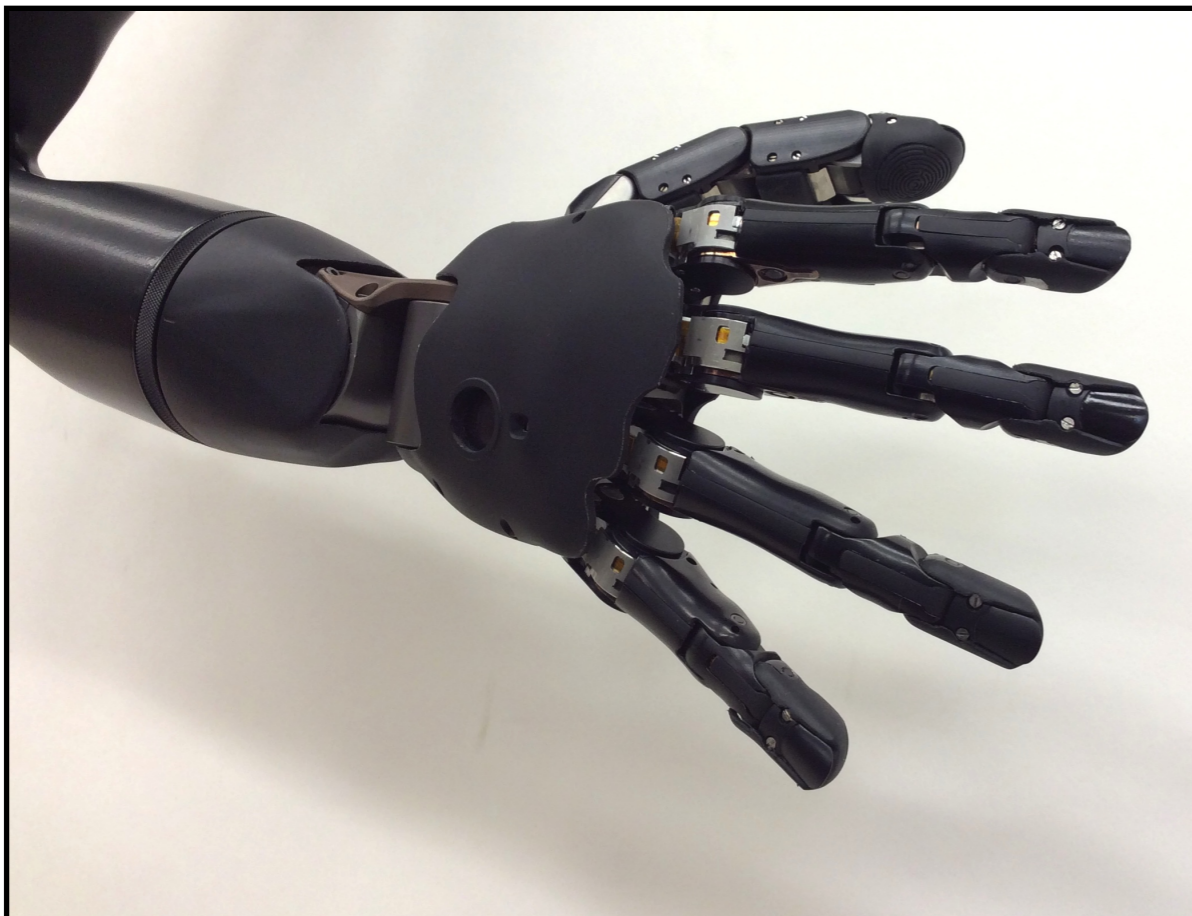


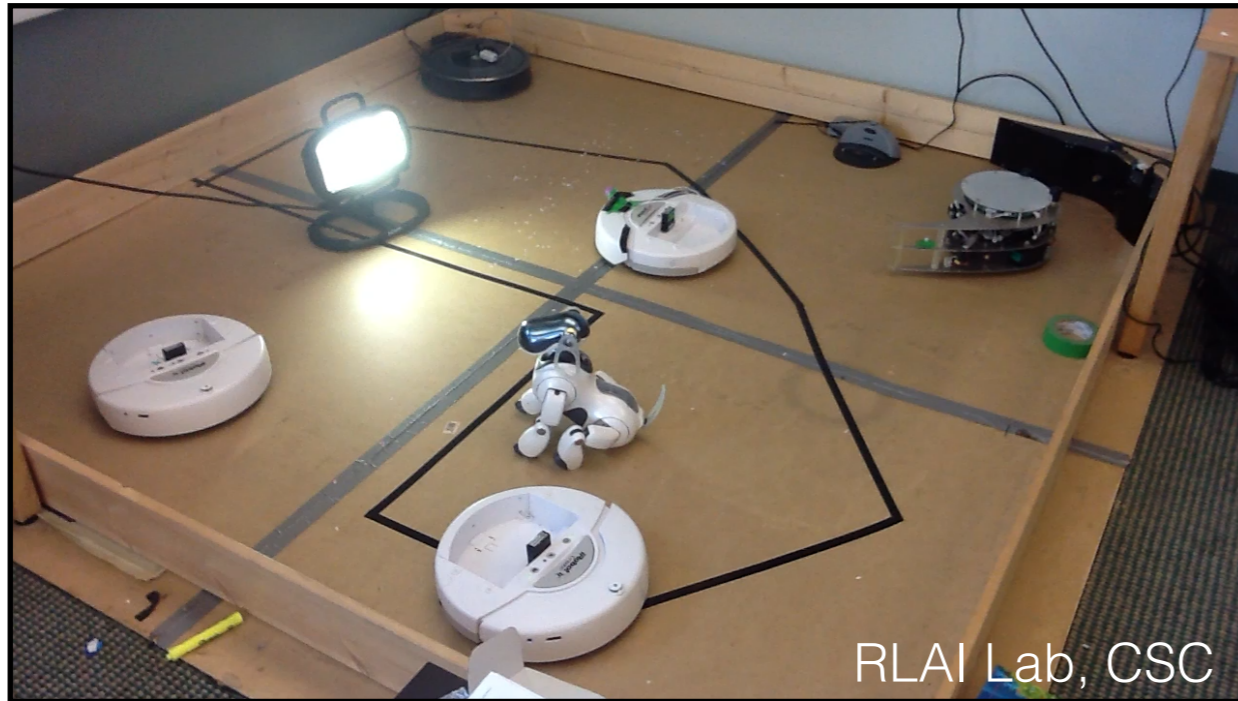


Courtesy of DEKA Research & Development and
The Rehabilitation Institute of Chicago



Advanced
Bionic
Technology
is here today*

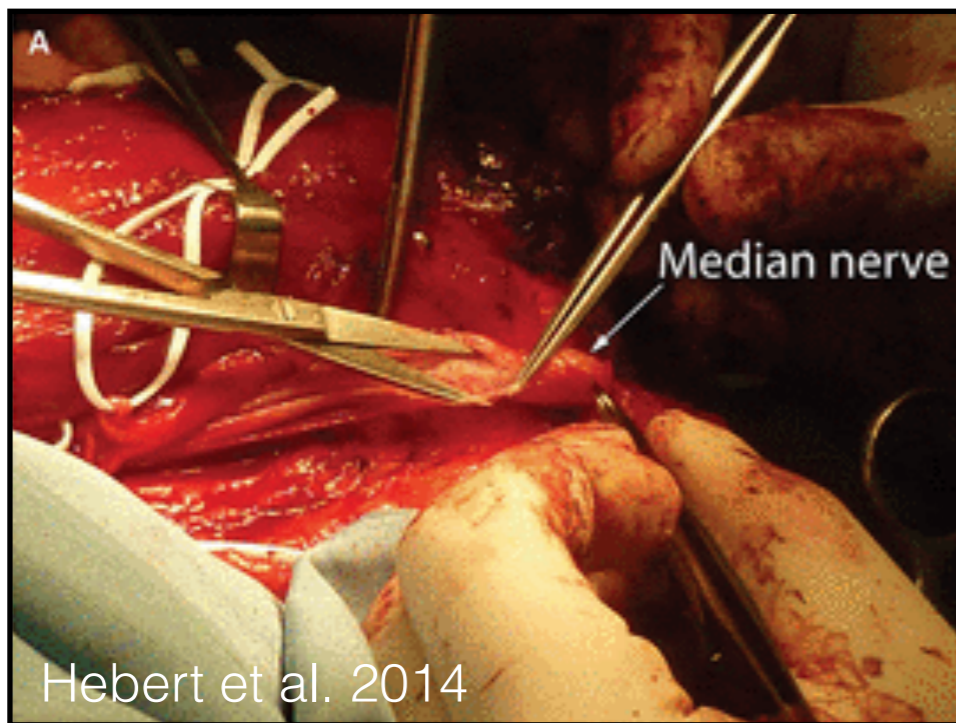




RLAI Lab, CSC



Pilarski et al. 2013



Hebert et al. 2014



Glenrose Rehabilitation Hospital

Interdisciplinary Capacity in Edmonton

Our Perspective

1. Real-time machine learning (**RL**).
2. Thinking of enhancing devices / interfaces as intelligent goal-seeking **agents**.
3. Effecting a fruitful **progression** in terms of human-device interaction.
4. **Prediction** forms a strong basis for progressive assistance and augmentation.

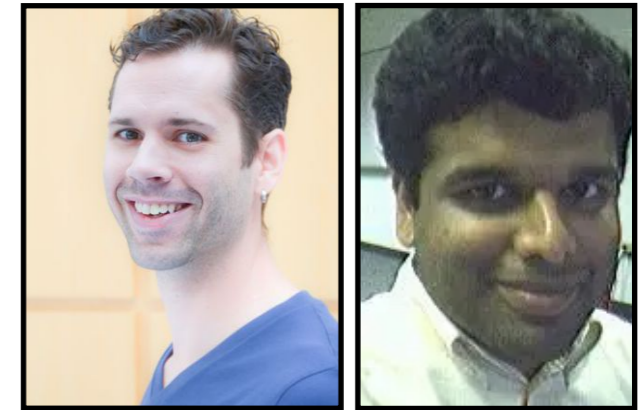
(Knowledge, intent, context, or, being on the same page.)



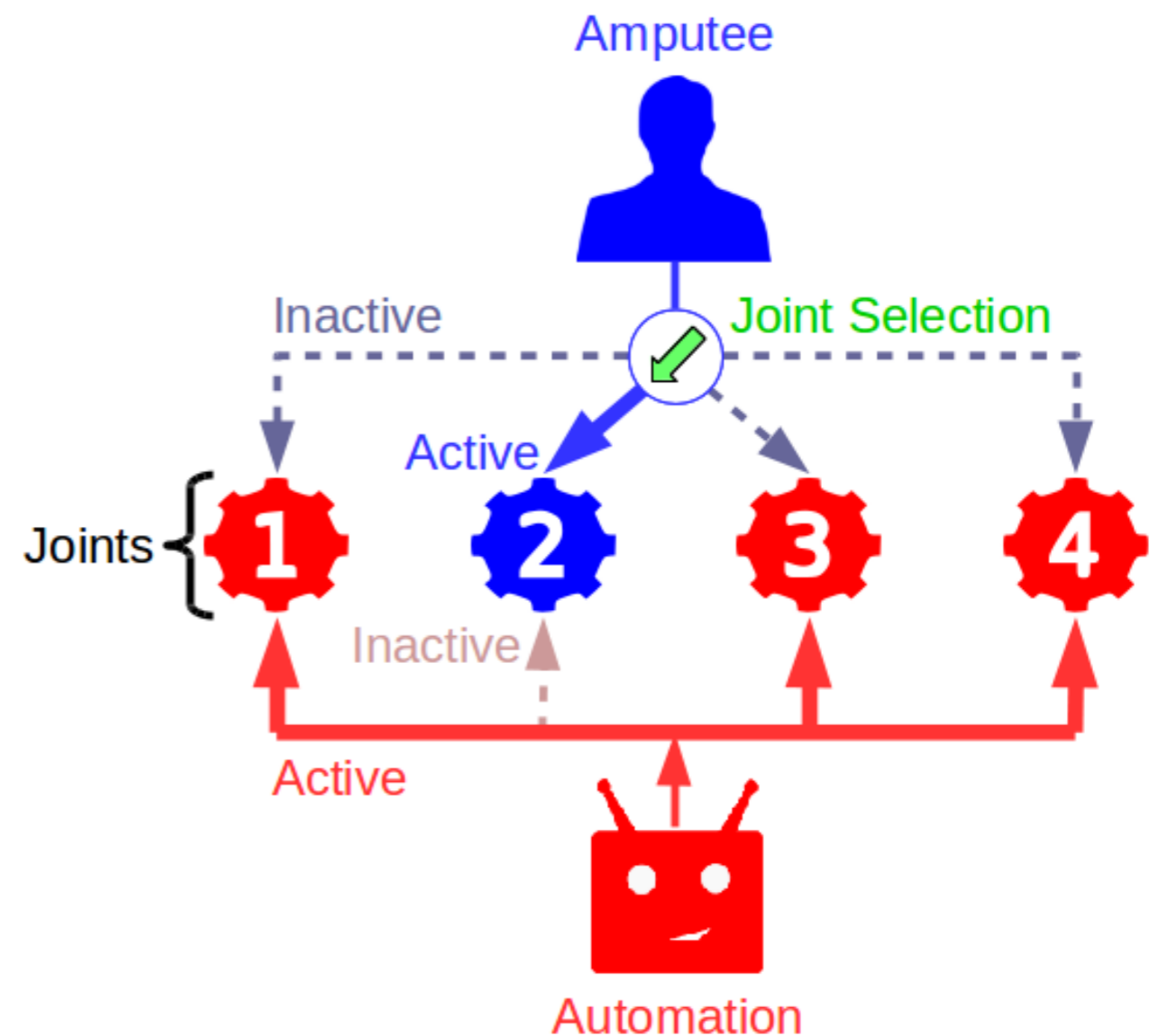
Opportunity: Improve Switching



Direct Predictive Collaborative Control



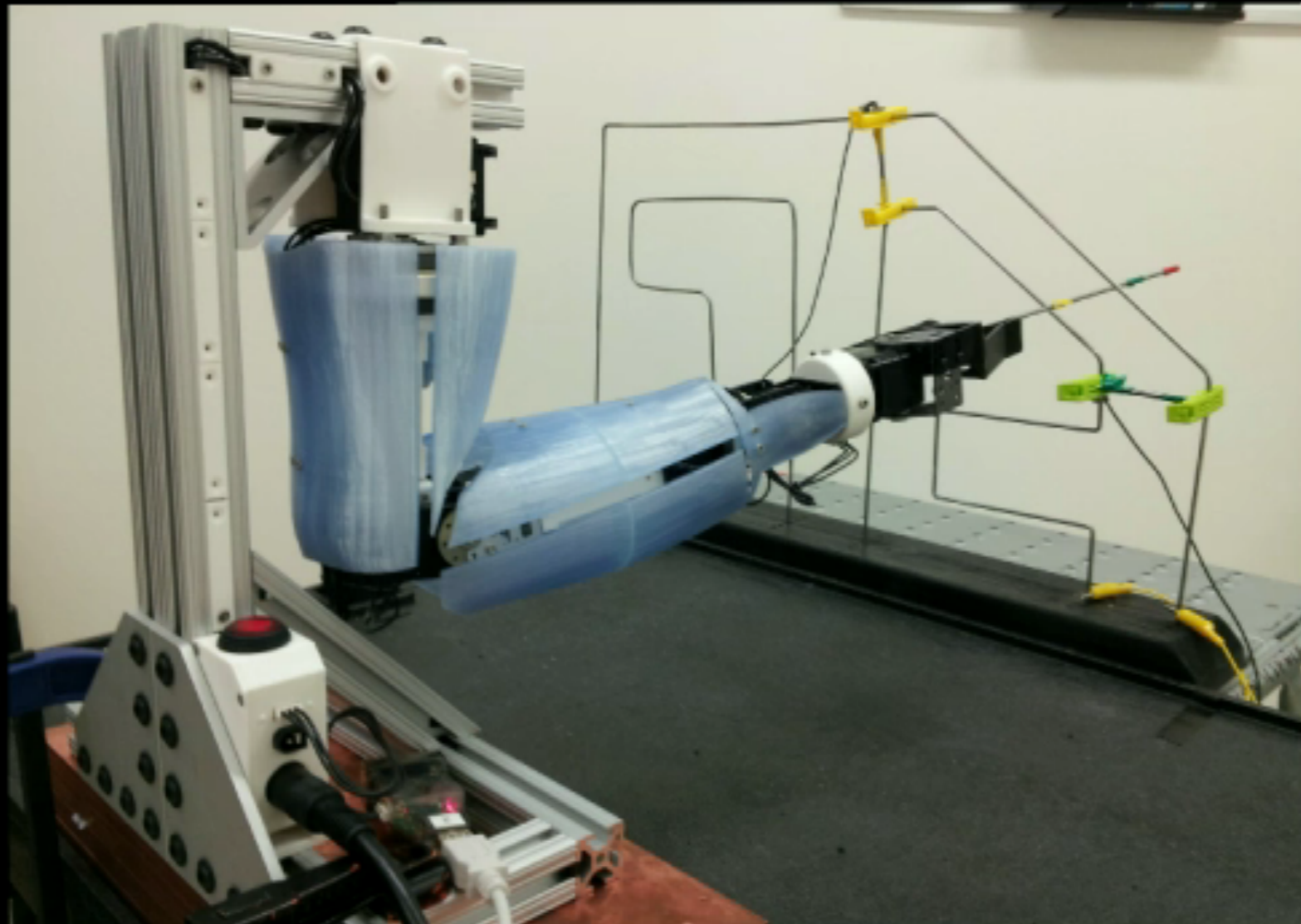
- User begins by sequentially controlling single joints. (**manual control**)
- **Predictions** made about future motions, become control actions.
- In **collaborative control**, user still has single DOC; arm uses learned synergies to coordinate motion.



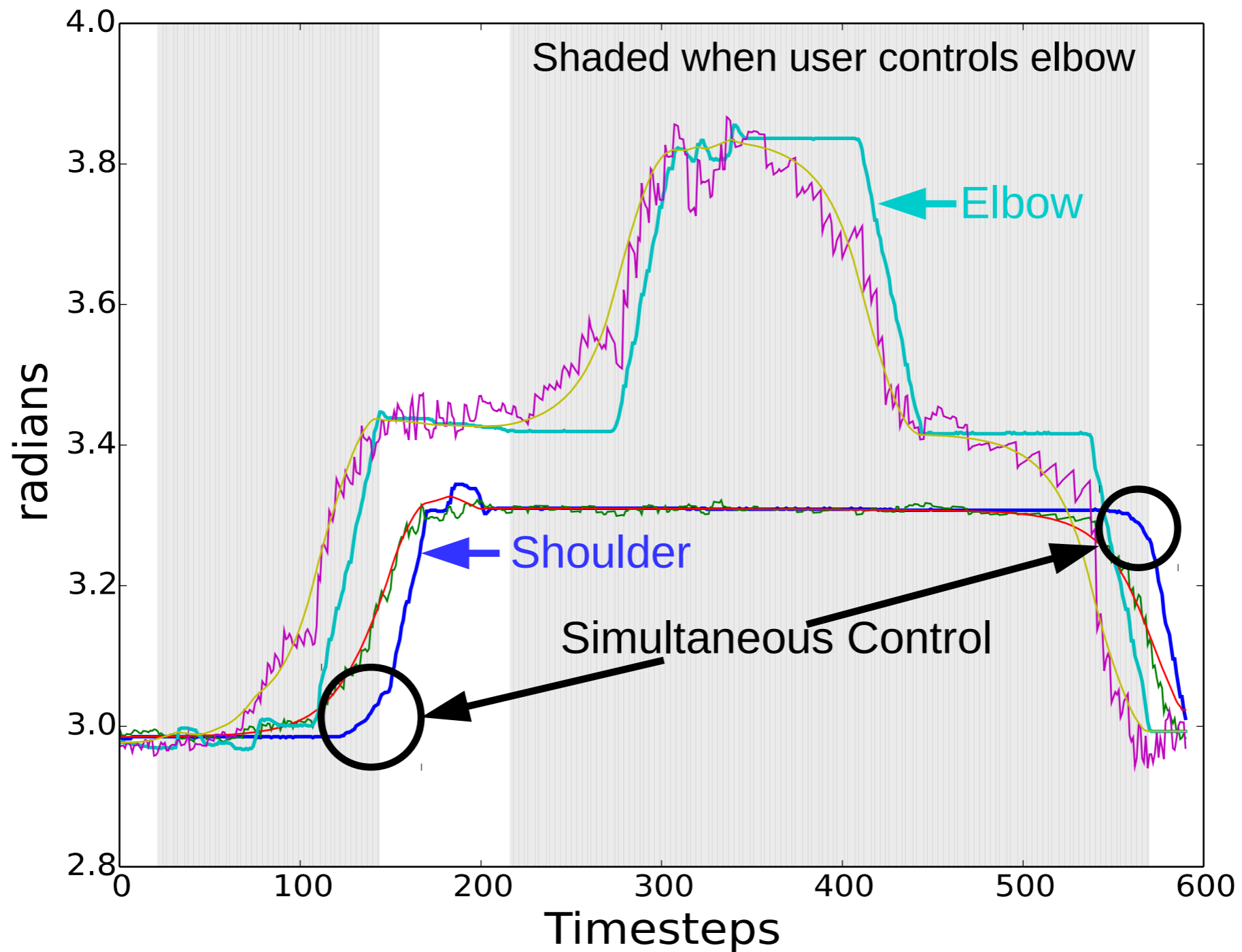
Successful Collaboration

Goal:

Move from green to yellow, hold for 5 s, then back to green



... based on predictions.



Closing Thoughts

- Towards **continual, day-to-day improvement** of communication, control, and decision making abilities of human-machine team.
- Exciting thing here with DPCC: **no cost for training**, in channel learning, use itself is reinforcement.
- Fruitful avenues to integrate **other channels**: notably, **reward**. Resonates with many other lines of thought here.
- Enhance human physical, sensory, and cognitive capacity through truly **knowledgeable assistive technologies**.

Funders and Collaborators



Questions

Please see Craig at his poster (T24)

... and thank you very much
for your attention.

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