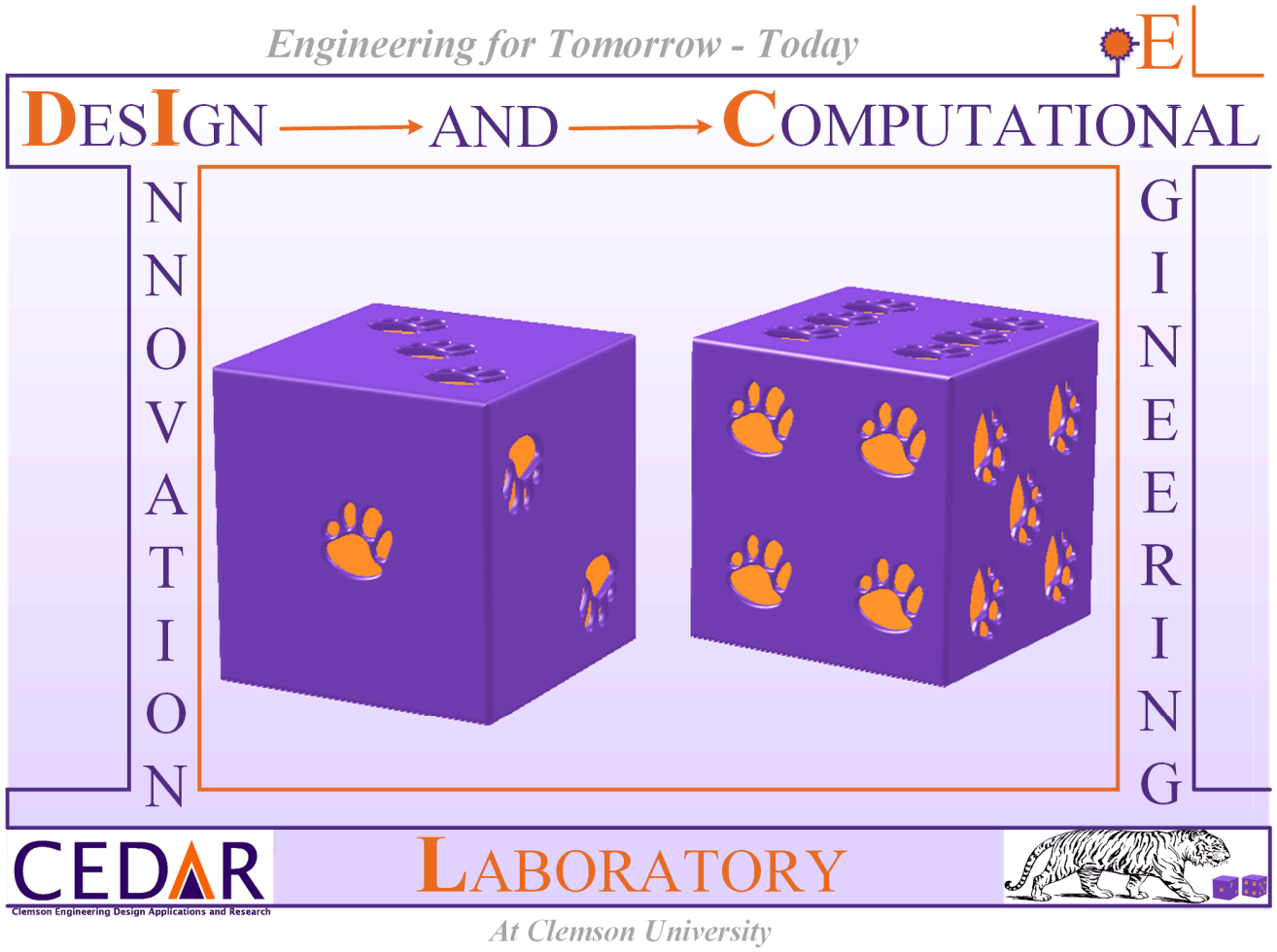
RAMR: Robotics & Mixed Reality Interface



Cameron J. Turner
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Mitch Pryor
UT-Austin

Veronica Santos
UCLA
with
SRNL and ANL

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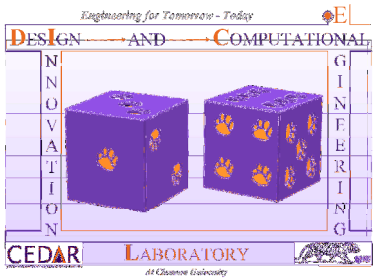
Nuclear Materials Gloveboxes

- Isolate the worker from High Consequence Material (HCM)
- Often inert atmospheres
- Low pressure
- Significant cause of ergonomic injuries

Glovebox Automation

- Automation Drivers
  - Environmental Hazards
    - Inert Gas
    - Particulates
    - Chemical
    - Radiation
  - Access Limitations
  - Ergonomics
  - Dose Reduction
  - Worker Availability

Task	%	Potential
Movement	49.5	High
Orientation	8.5	High
Process Control	19.0	Med
Sensing	7.3	Med
Inspection	2.7	Low
Other	13.0	N/A
TOTAL	100.0	-



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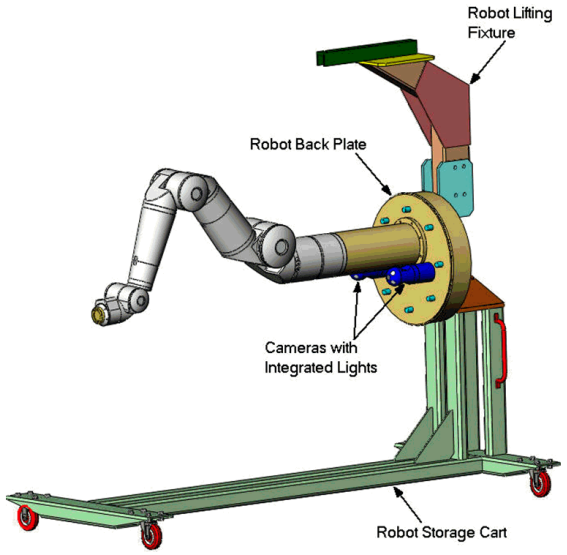
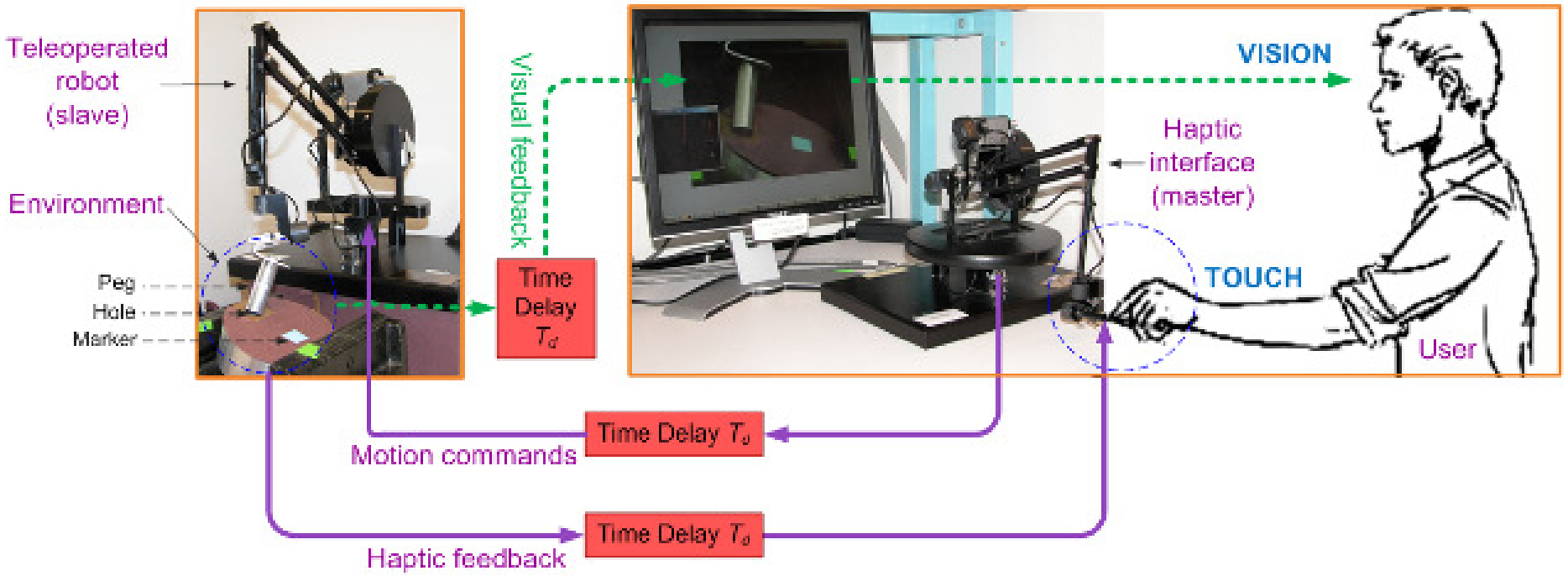
A Port Deployed Arm

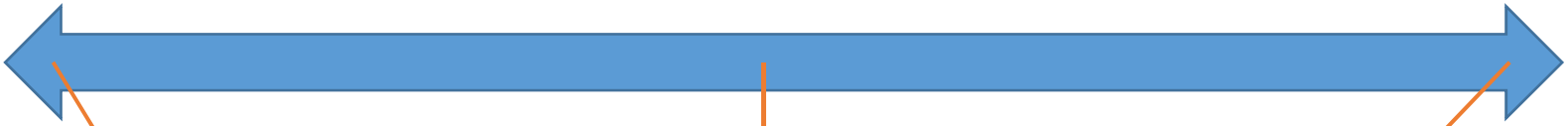
- 7 DOF slightly customized RRC system
- Port Deployed
- Used for Decontamination and Decommissioning (D&D) Tasks - contact
- Teleoperated
- Most complex single manipulator implementation



Unilateral vs. Bilateral Teleoperation



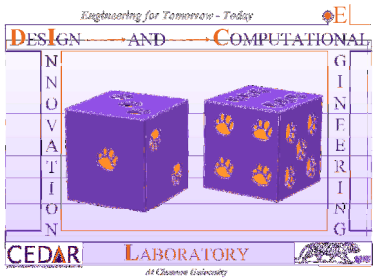
Finding a Middle Ground



Unilateral Operation
(Operator issues commands,
Robot handles feedback)

RAMR
Operator issues commands
and adjusts to predicted feedback
Robot executes operator intent
and handles actual feedback

Bilateral Operation
(Operator issues commands,
Robot communicates feedback,
Operator Adjusts)



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The Clemson Part – A Powerwall Glovebox

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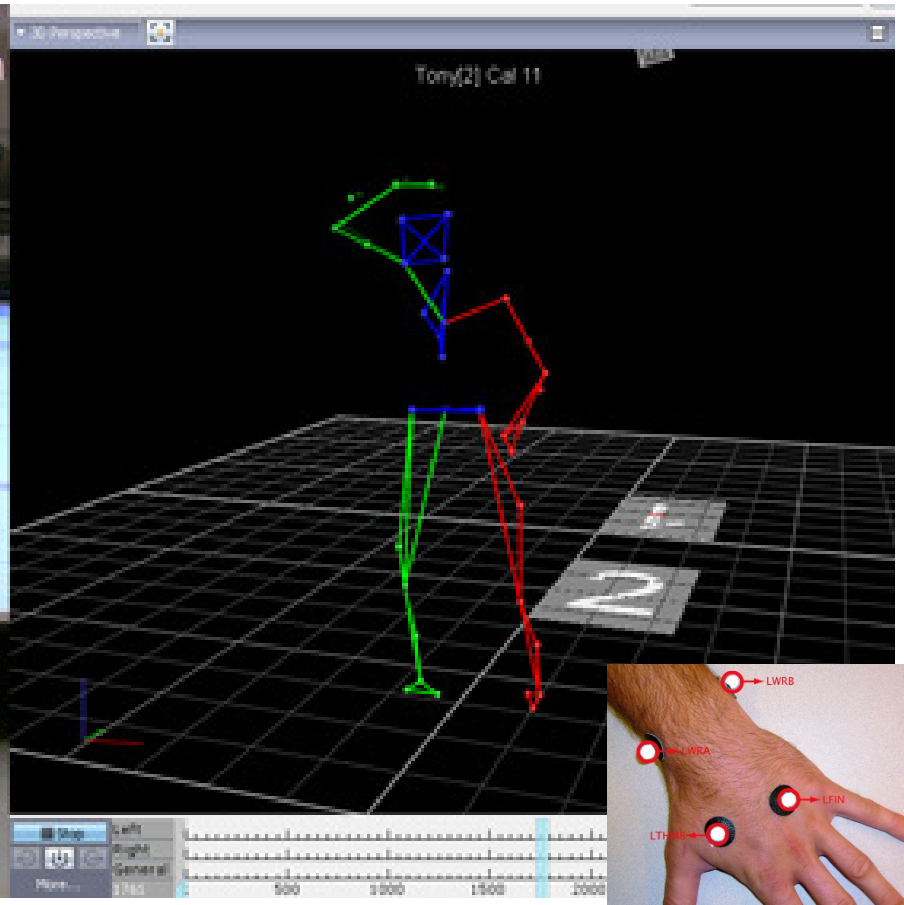
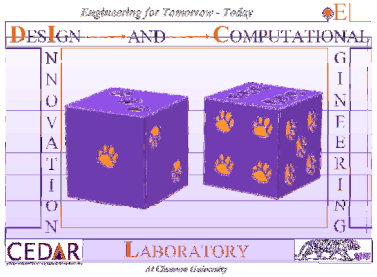
The Clemson Part – Motion Capture



KINECT



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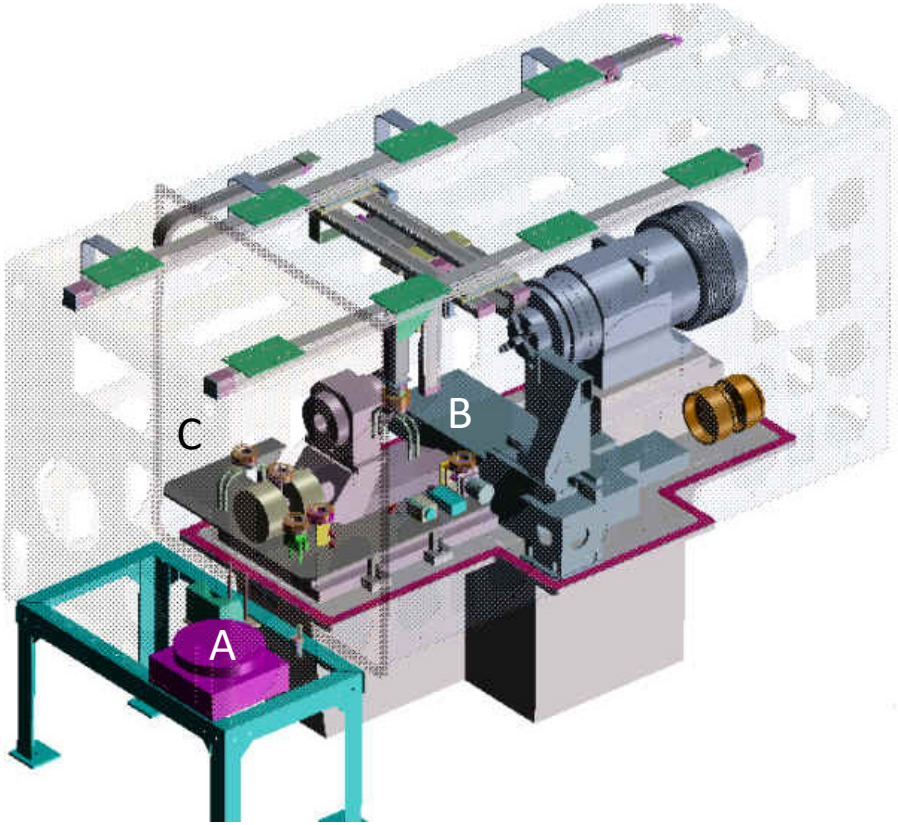
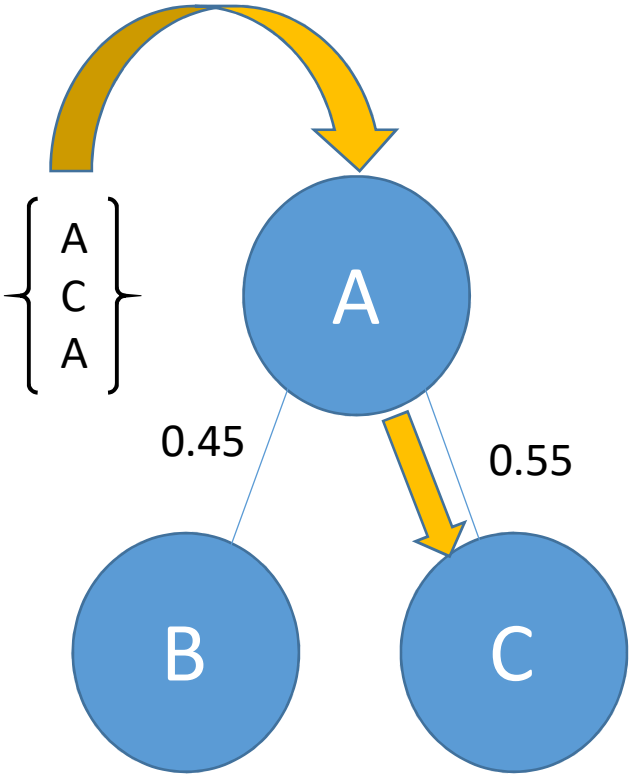
The Clemson Part – Operator Intent Models





The Clemson Part – Virtual Props

Our Collaborators

- UT-Austin
  - Robot Path Planning
  - Local Feedback Compensation
  - Environment Sensing/Modeling
- UCLA
  - User Haptic Interfaces
  - Robotic Haptic Sensors
  - Grippers/Tooling
- SRNL
  - Advisory on Glovebox Operations
- ANL (Argonne)
  - Demo Application
  - Radionuclide Handling

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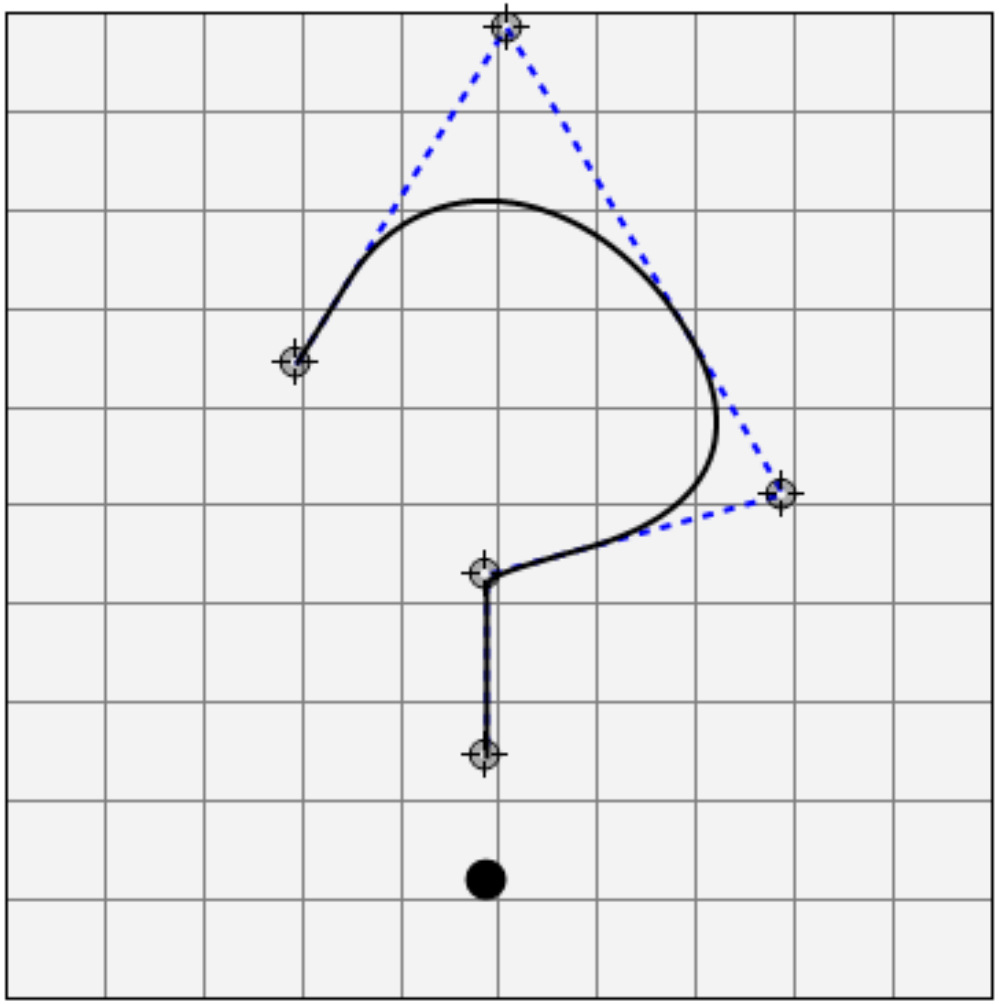
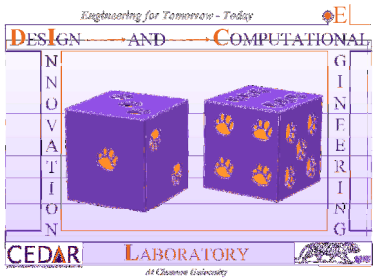
Questions or Comments?





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