CHANGING WHAT'S POSSIBLE

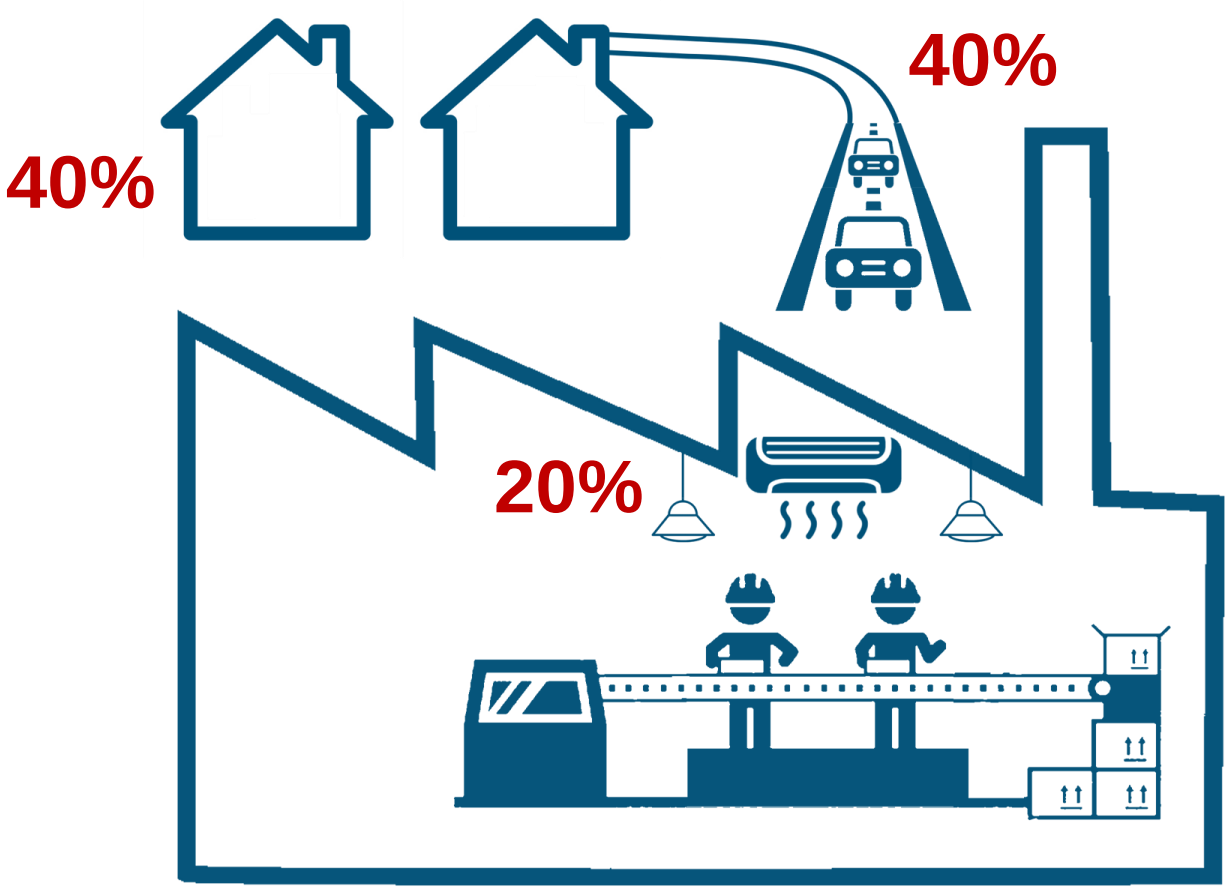
Reaching for Energy Savings

Challenging opportunities for tele-robotics

Mike Kane Fellow

How much energy do workers consume?

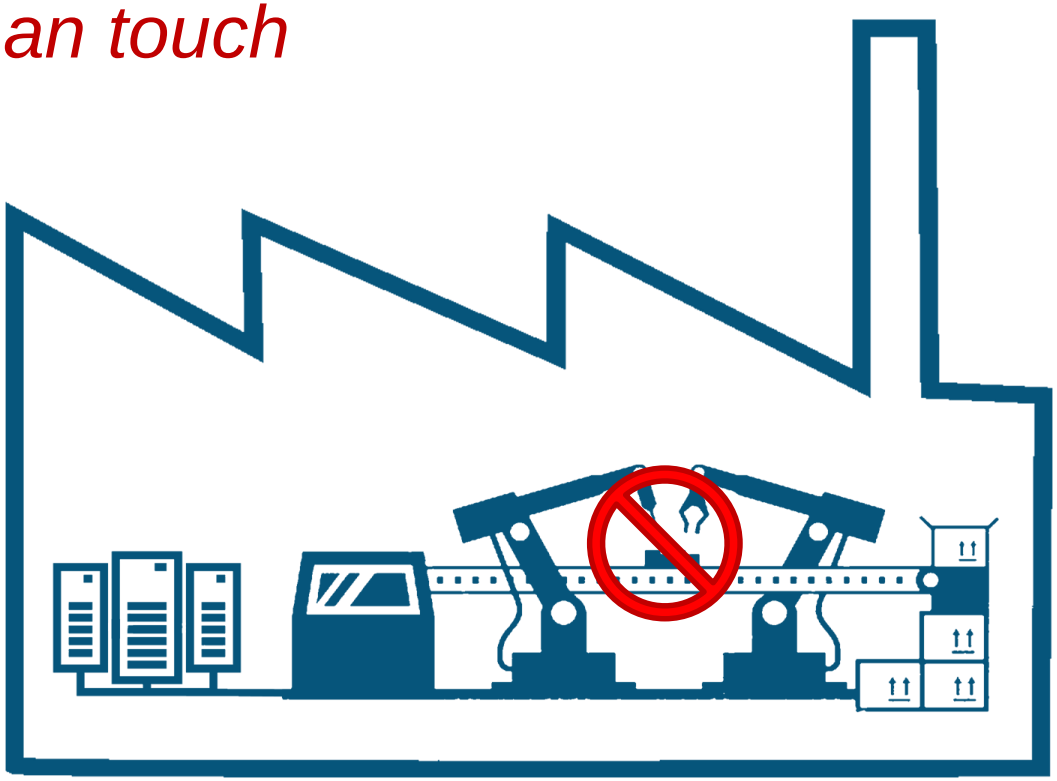
5% of all US energy consumption



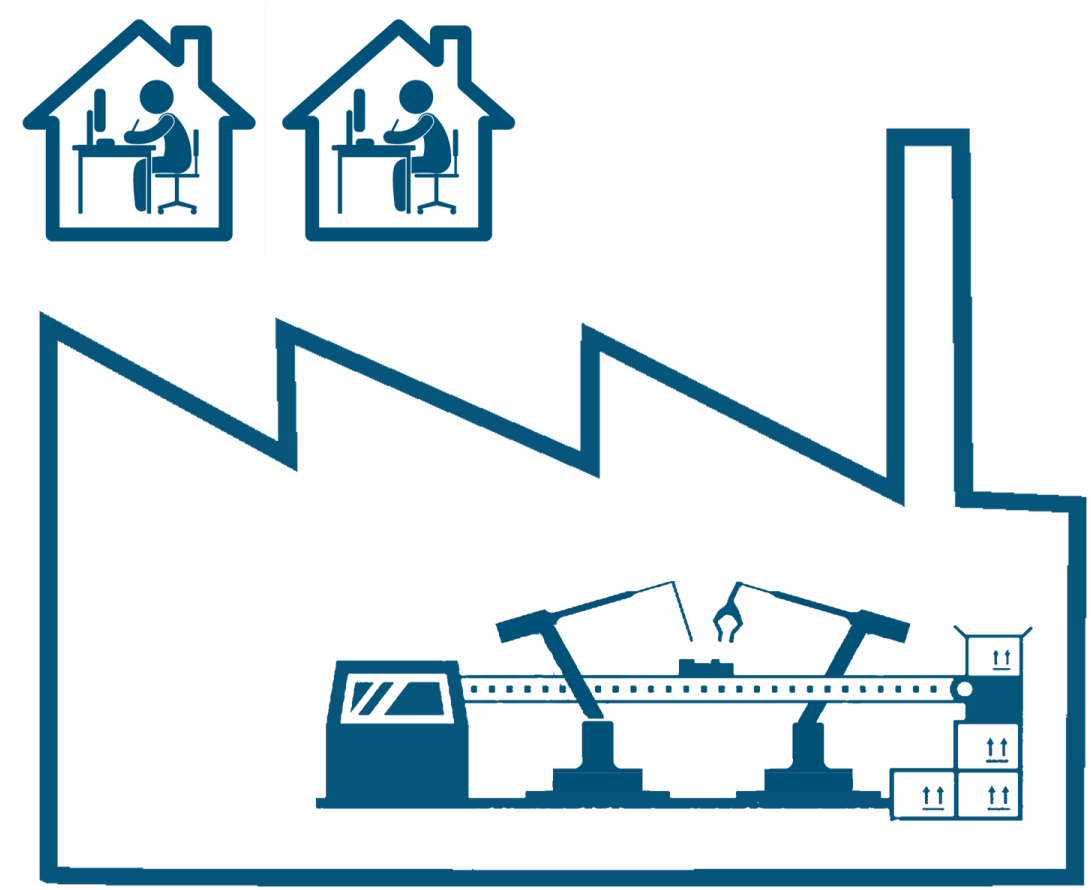
Automation to the rescue?

Serious limitations

- Perception
- Decision making
- The *human touch*



Efficient and effective tele-operations



Ripe for transformation

Remote Service Calls

Tele-operated existing services

- Skilled experts assist novices
- More productive use of experts time
- **Presence, mobility, cost**

Expert-in-Residence

New on-site regular services

- Affordable, timely hired help
- Dangerous and difficult tasks
- **High presence, dexterity, cost**

Remote Duty Station

'Remote desktop' for factory workers

- Tele-op fill in automation gaps
- Improved throughput and quality
- **Presence & shared autonomy**

Personal Shopper

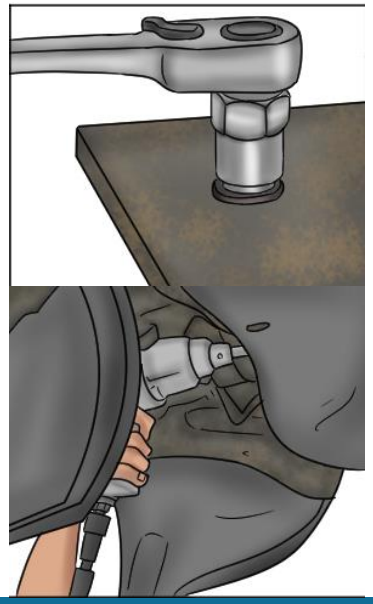
Online shopping with touch

- Expand online shopping markets
- Reduce return shipping
- **Fine sensing and feedback**

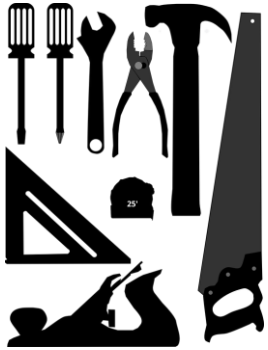
Barriers to Overcome

Ease of Use & Performance

Corner Cases



Tools and Tool Handling



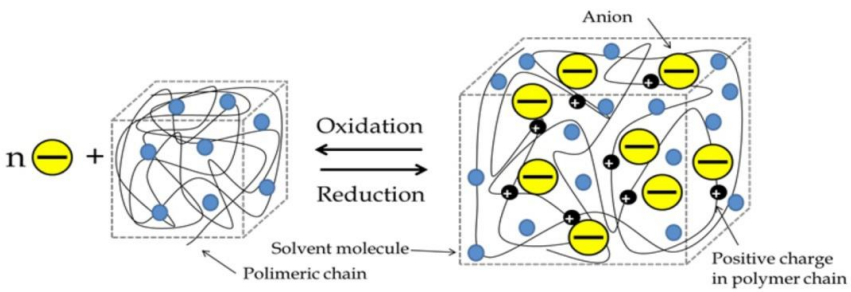
Today's Industrial Robotics

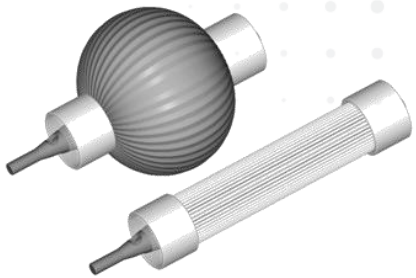
State of the Art Industrial Robotics

Target Price Point

Research opportunities: low-cost actuation

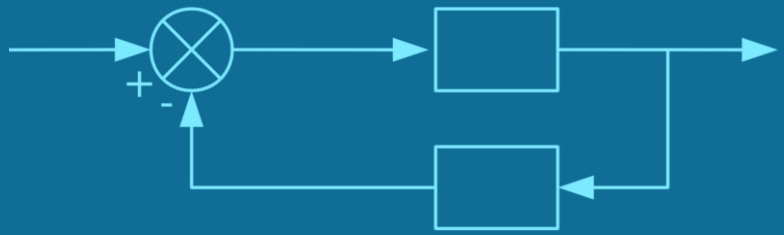
Novel mechanisms, designed for manufacturing at scale





Images: Gonzalez @ RIT, Walsh @ Harvard, Daerden @ Vrije

Feedback control around inexpensive parts

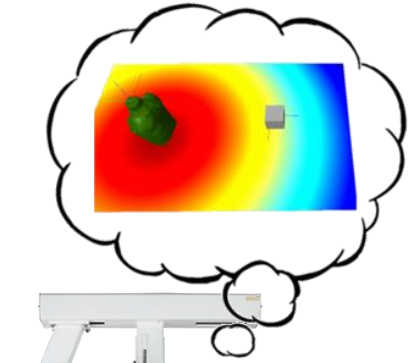


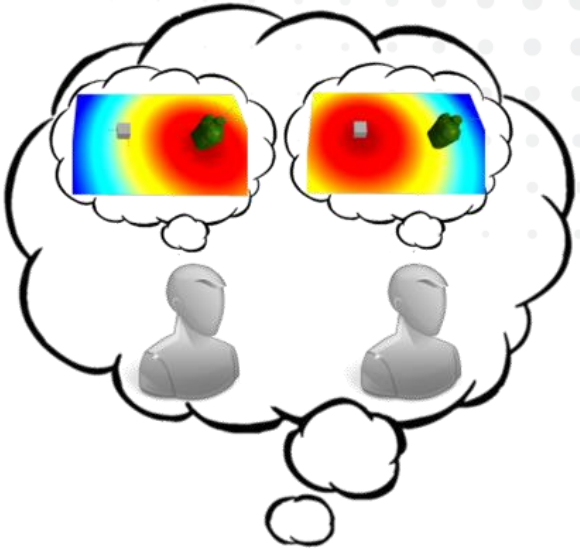
Novel manufacturing

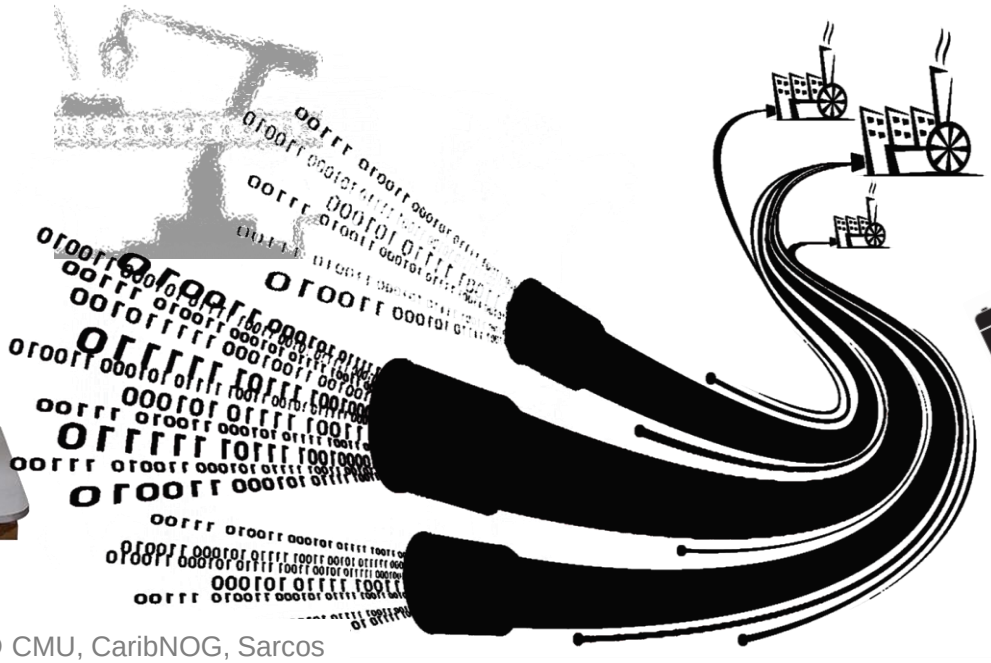
Casting	**Molding**
Forming	**Machining**
Joining	**Growing**
Bio	**…**

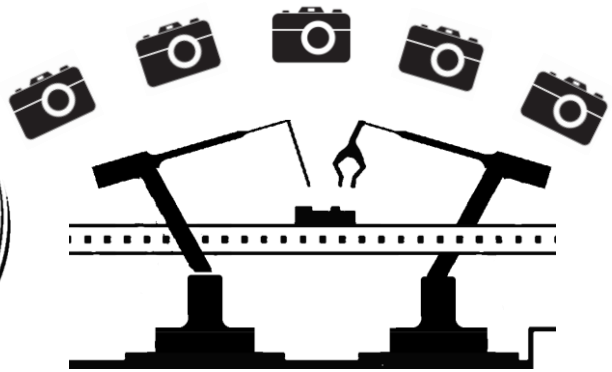
Research opportunities: Controls & UI/UX

- Nav. and manipulation sensing
- Autonomy buffers latency
- Low-cost intention capture
- Achieve user embodiment









Images: Javdani @ CMU, CaribNOG, Sarcos