

Hybrid Active-Passive Actuation For Human-Robot Collaboration and Rehabilitation



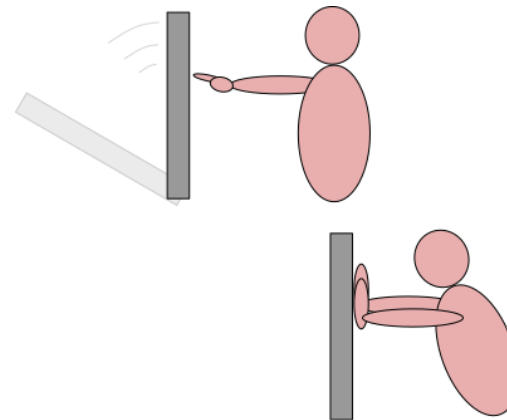
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CMMI-1830516 • NRI 2.0 2018



Safe Physically-Interactive Robots

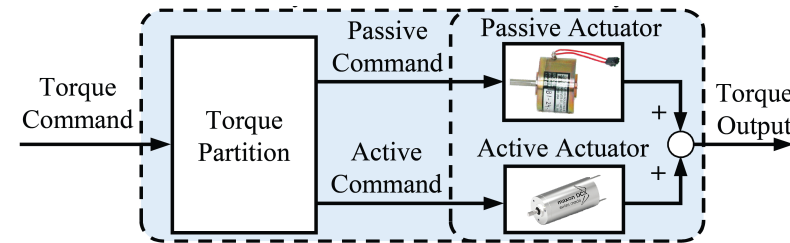
Goals:

- Support – but not Generate – human-scale forces
- Pushing a person: Low impedance
- “Being pushed”: High impedance



Solution

- Hybrid active-passive actuation
- Coordinate power-generating & power-absorbing components



Scientific Impact

- Active-Passive partitioning in design and control
- Better haptic rendering
- Safer co-manipulation

Broader Impact

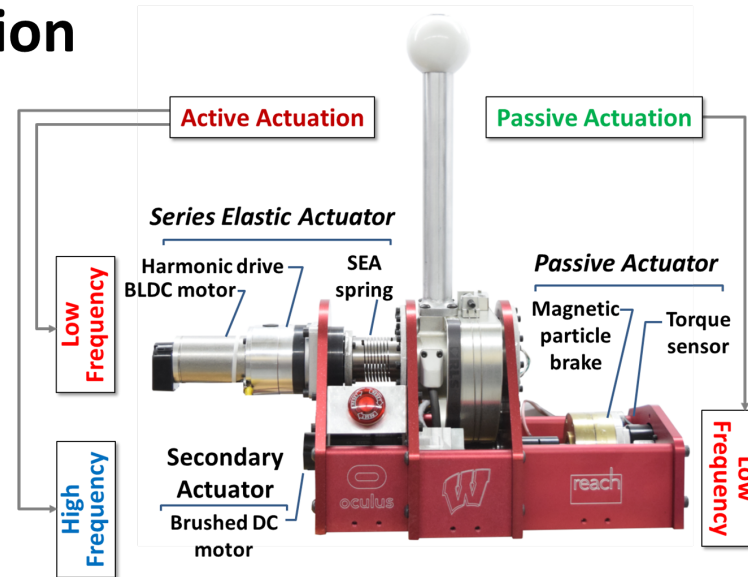
- Haptics
 - Motor Rehabilitation, Training
- Outreach: Education
 - How and why of Haptics
 - Handheld demo



Hybrid Active-Passive Actuation

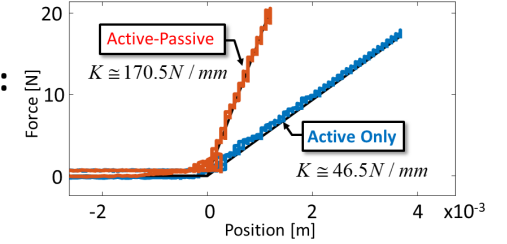
Actuator Architecture:

- SEA – Low Output Impedance
- Direct-Drive – High Bandwidth
- Brake – Stiffness, Dissipation

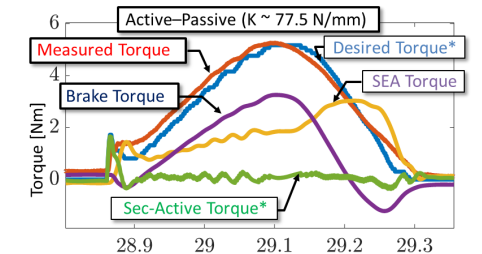


Accomplishments

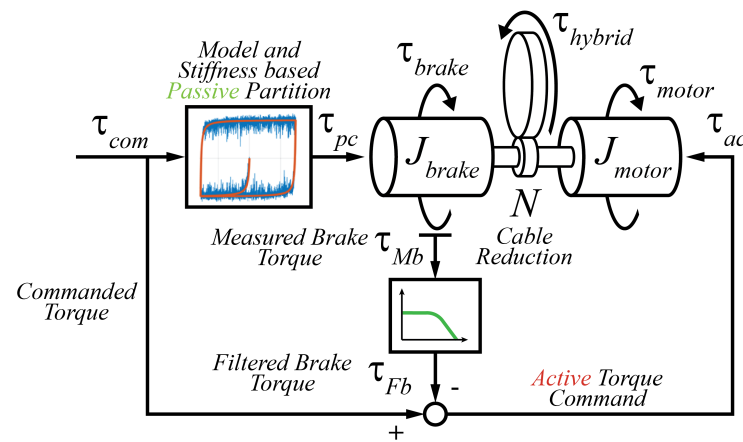
Stiffer Virtual Walls:



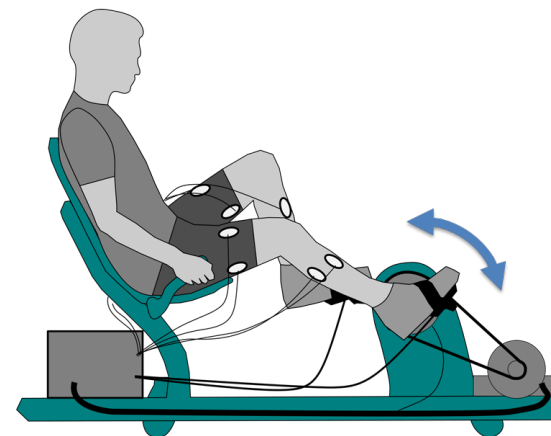
Torque Partitioning:



Control Partitioning Approaches



Lower-Limb Motor Control & Rehabilitation



Haptic Leg-Reaching with NOTTABIKE

Future: 2 DOF Haptic Leg Robot

