User-Adaptive Variable Impedance Control of a Wearable Upper-Extremity Exoskeleton Robot with Safety Guarantees

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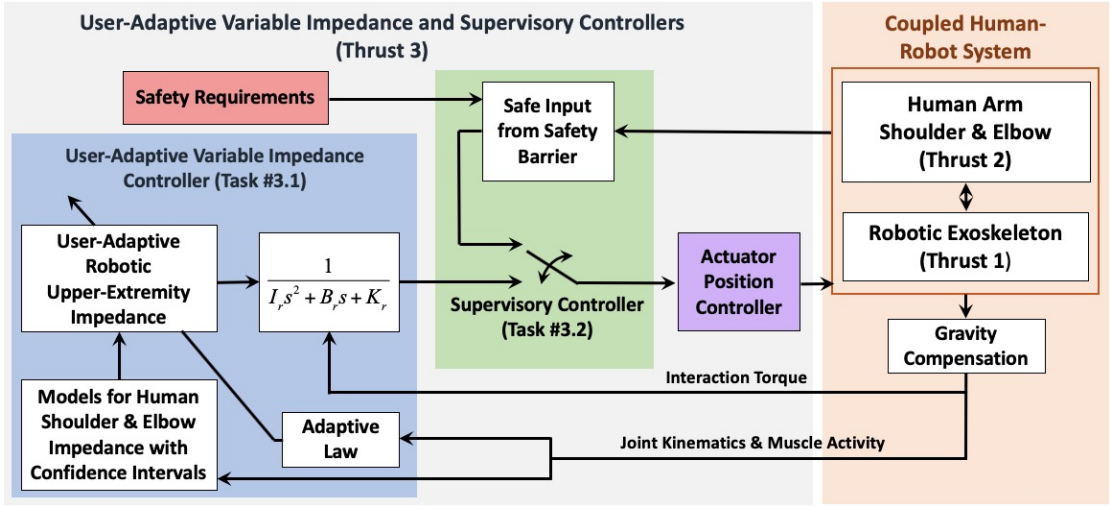
Challenge

- Reducing/preventing work-related musculoskeletal disorders (MSDs) via active and safe robotic assistance.
- Current research in physical-robot interaction (pHRI) focuses less on transparency and agility.

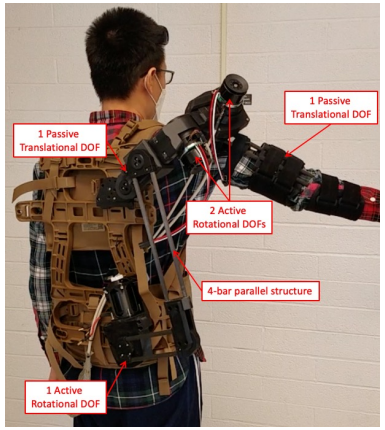


Scientific Impact

- Improved trade-off between agility /transparency and stability of the human-robot systems in pHRI.
- Controller-centric approaches to ensure safety in pHRI to complement safety considerations through mechanical designs.

Solution

- **User-adaptive variable impedance controller**
  : Incorporates user intent & biomechanics
- **High-level supervisory controller**
  : Synthesizes robust controlled invariant safety sets to avoid unsafe or awkward motions



Broader Impact

- Potential to reduce work related MSDs, which account for 33% of worker injury and illness cases, incurring a loss of more than $200 billion annually.
- Mentoring of underrepresented students, outreach to K-12 studies and new graduate-level course.