2021 NSF CYBER-PHYSICAL SYSTEMS PRINCIPAL INVESTIGATORS' MEETING

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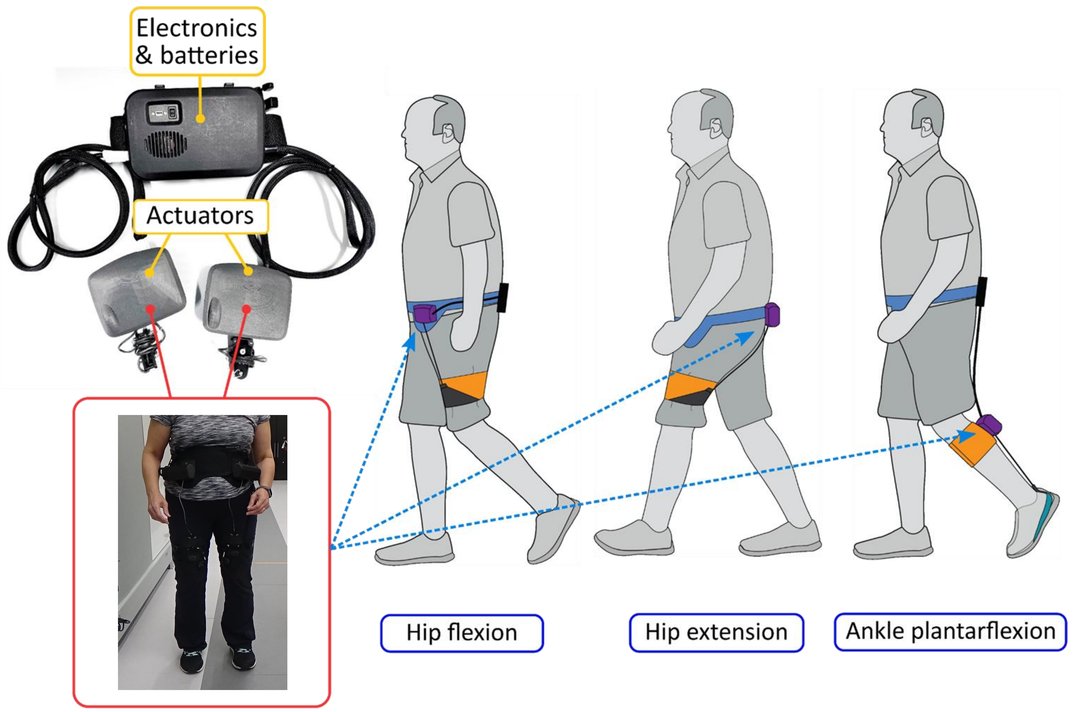
CPS: TTP Option: Medium: Robotic Apparel to Enable Low Force Haptic Cueing for Improving Parkinson's Gait

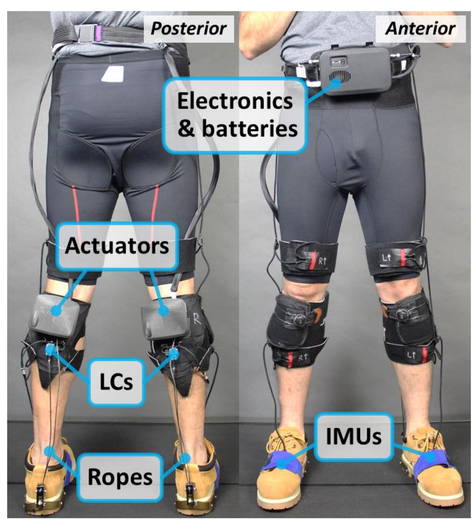
Modular hip and ankle system



- **Modular actuator design** allows to place the actuators at different target joints depending on the purpose and the user population
- New **small and lightweight actuator** using a miniature rope winch

Integrated prototypes with actuators and sensors

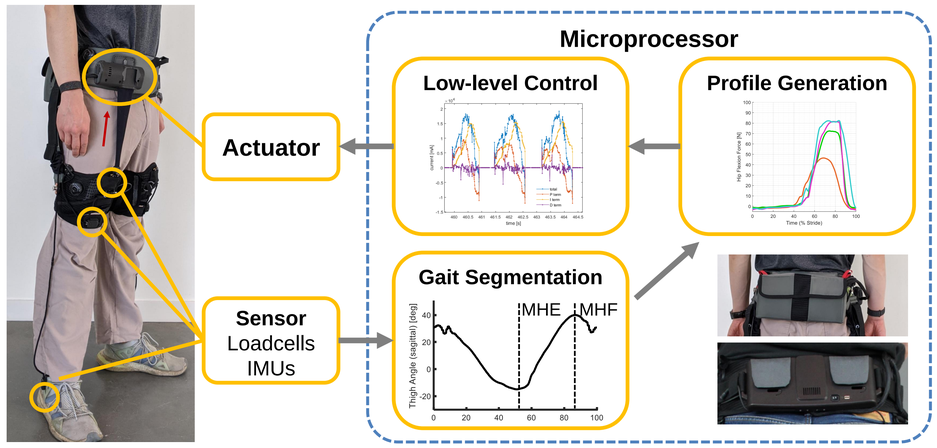
- **Inertial measurement units (IMUs)** placed on different body segments to detect walking and running
- **Load cells** used to monitor the assistive force delivered to the user



Control Approach

Bio-inspired assistance profile design

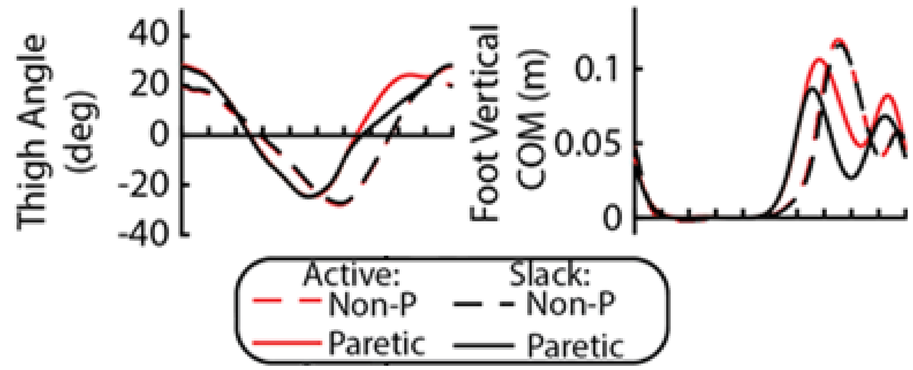
- Task- and subject-specific assistance profile design considering specific gait deficits and muscle-tendon dynamics
- Adaptation to walking speed and stride length changes using sensor information



Evaluations

Unilateral hip flexion device: PT-friendly portable system for in-clinic rehabilitation for patients post-stroke

- Optional actuation mode
  1) **Automatic mode**: gait segmentation based on heel strike detection
  2) **Manual mode**: PT-activated assistance for irregular/slow gait
- Smartphone App for parameter tuning
- Improved gait pattern



Bilateral hip flexion device: Stride length modulation in individuals with Parkinson's Disease (PD)

- Test modular actuator system on **different joints** in PD patients and find the **best joint motion** to **increase stride length**