The Hip Exoskellie

MCG 4322 - Computer Aided Design

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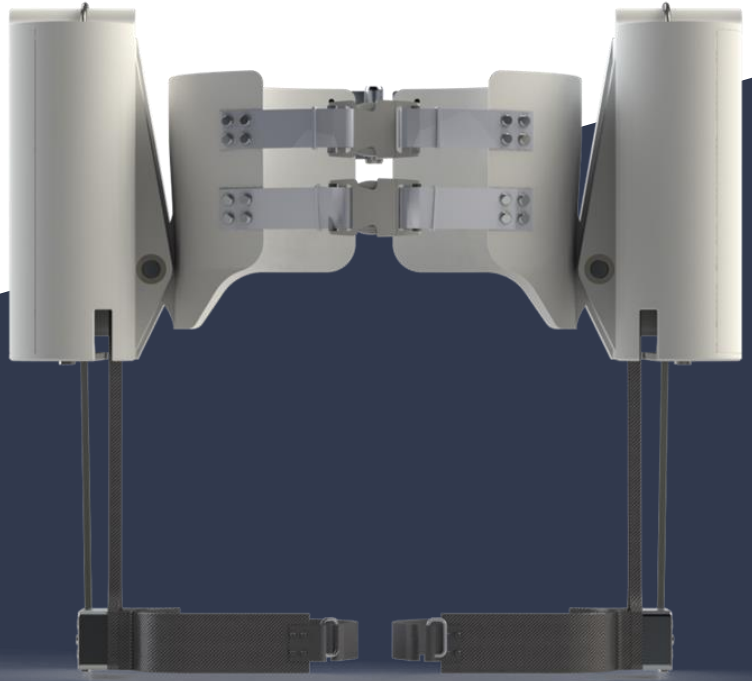
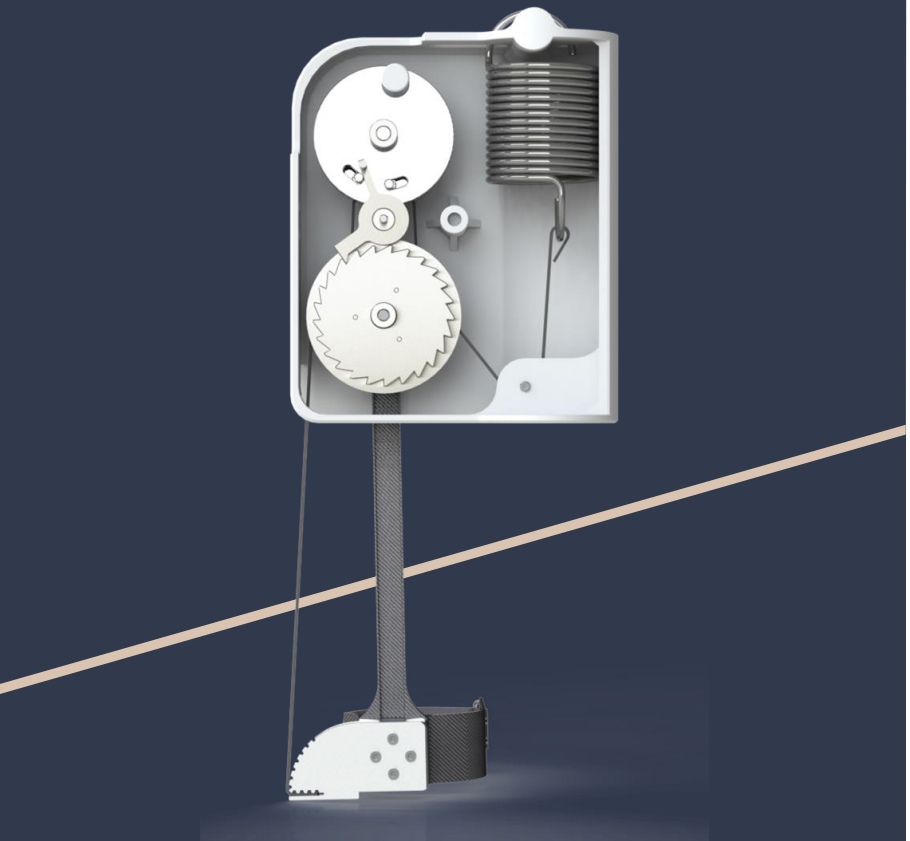


Agenda

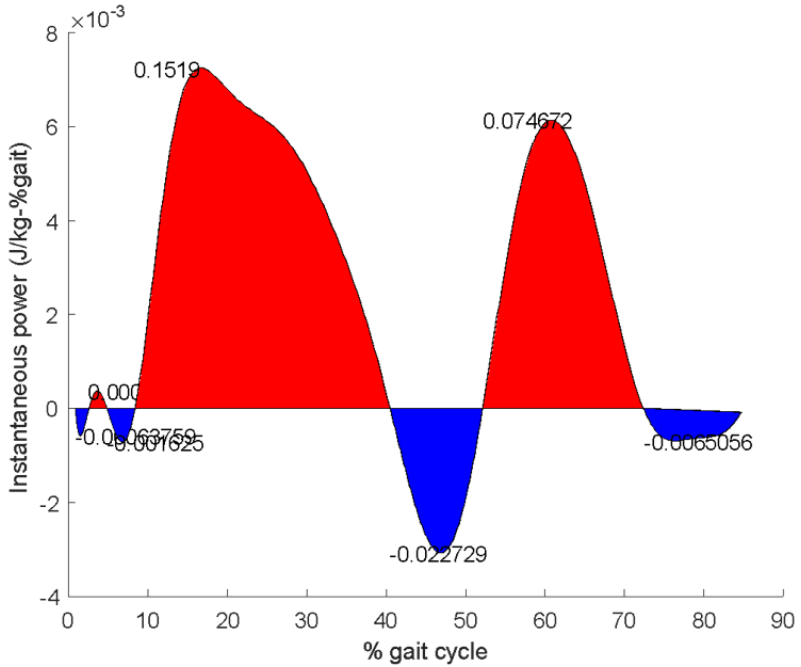


- Introduction
- Gait assist strategies
- Full Design
- Sub Assemblies: Main, Timing, Thigh, Hip and Waist
- Simulation and Validation
- Parametrization: GUI
- Conclusion

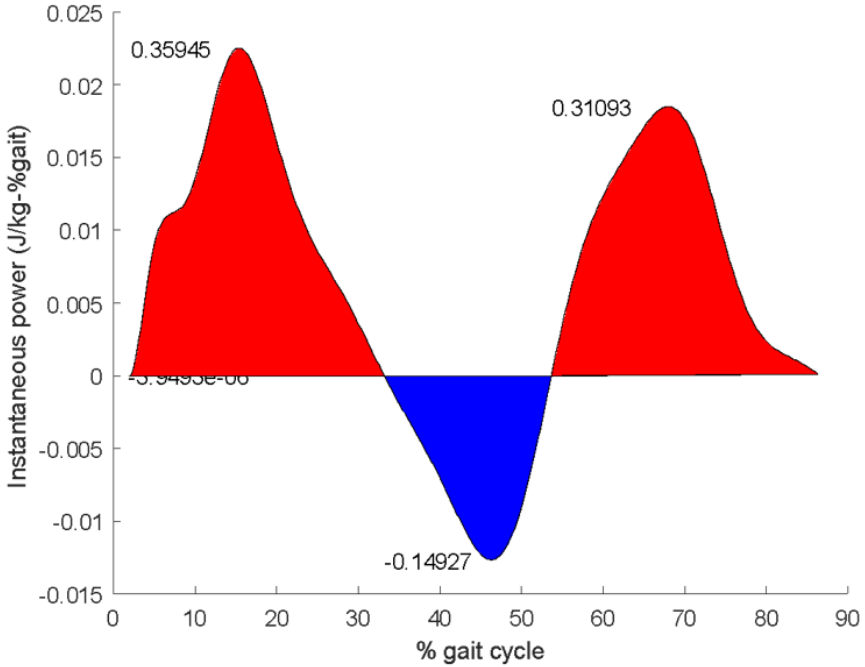
Introduction

- Target user - seniors over 65 without significant lower limb joint diseases.
- Target action:
  - Provide up to 8% stance phase energy assistance in sagittal plane.
  - Stabilize hip joint to a safe range of motion.
- Adaptable design - level, incline, and stair gait assistance.

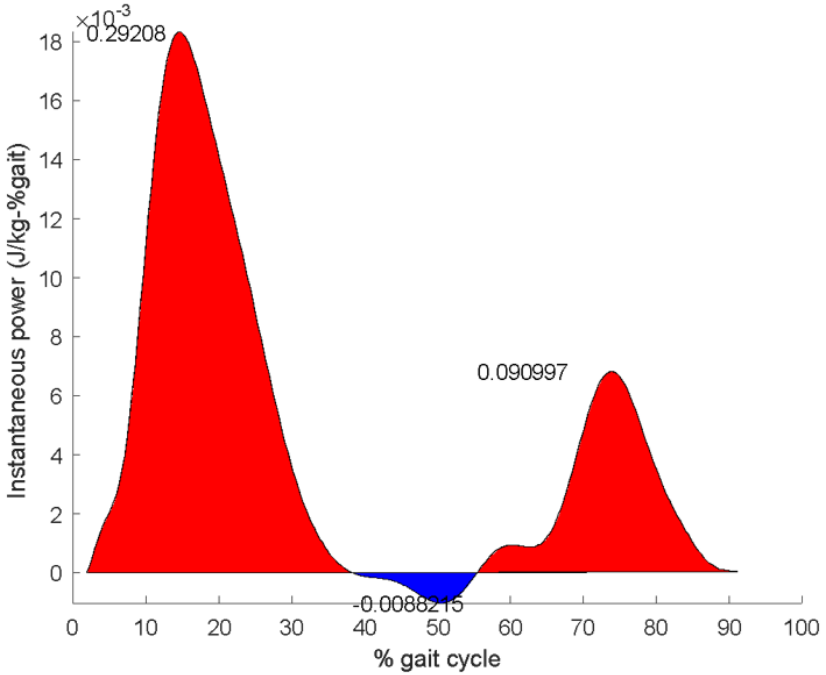
Sagittal Gait Strategy: Level Ground



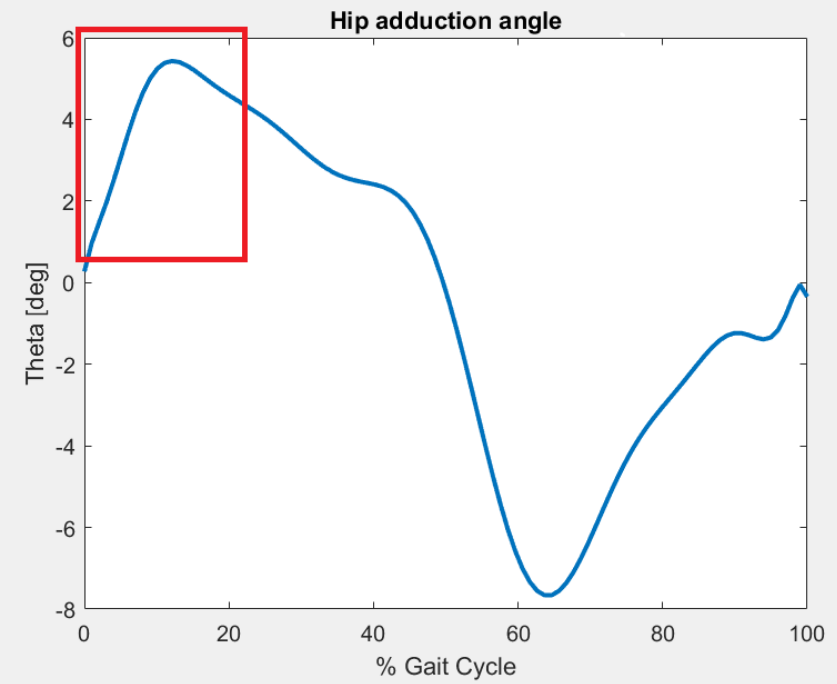
Sagittal Gait Strategy: Incline Ascent

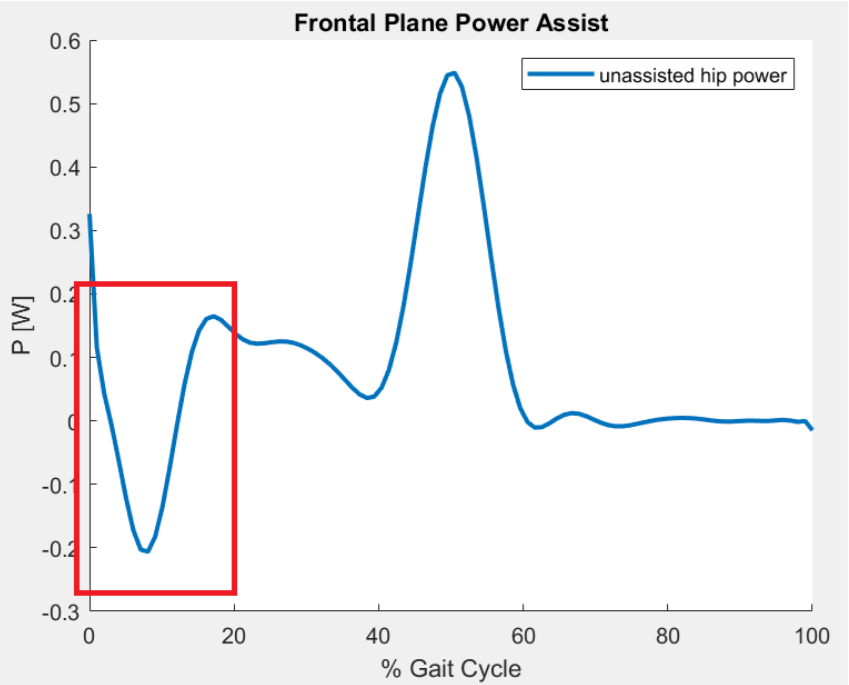


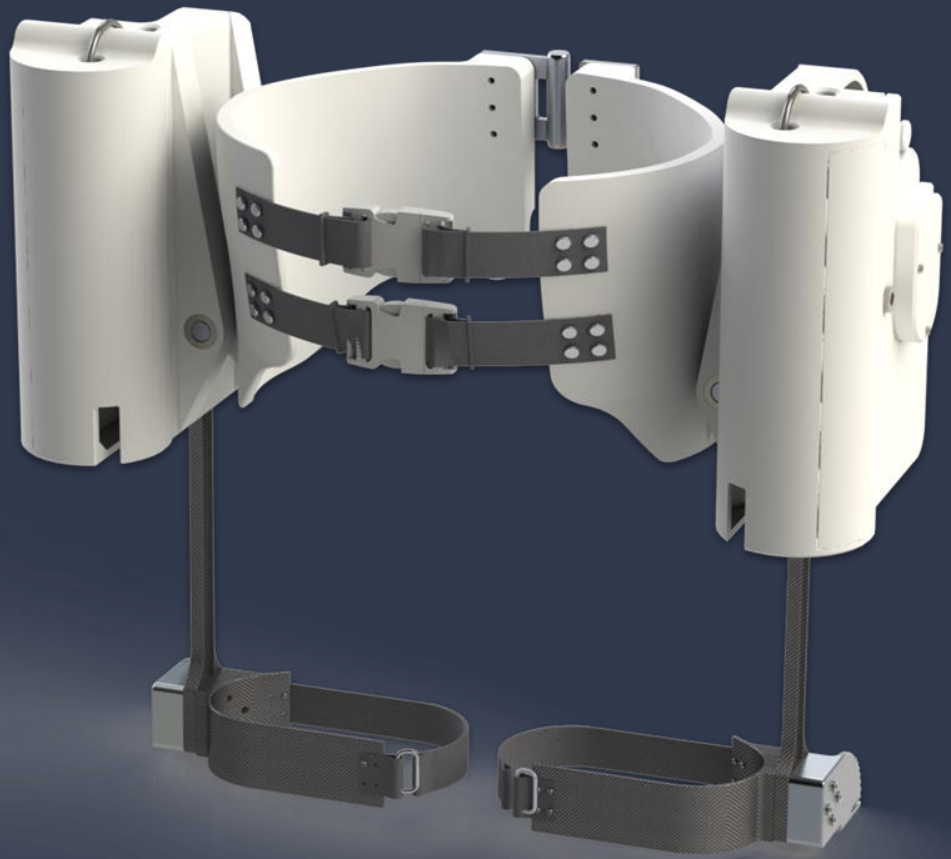
Sagittal Gait Strategy: Stair Ascent

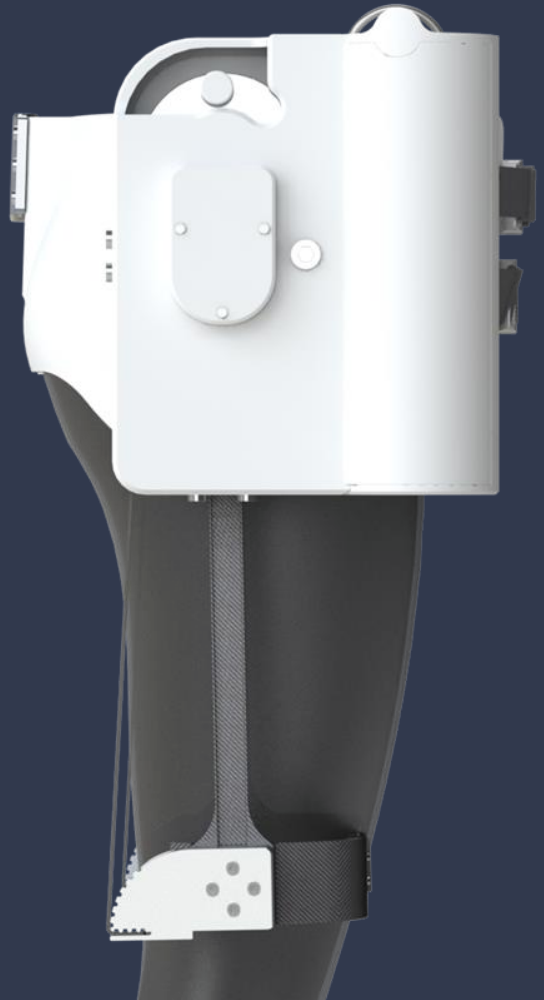


Frontal Gait Strategy: Level

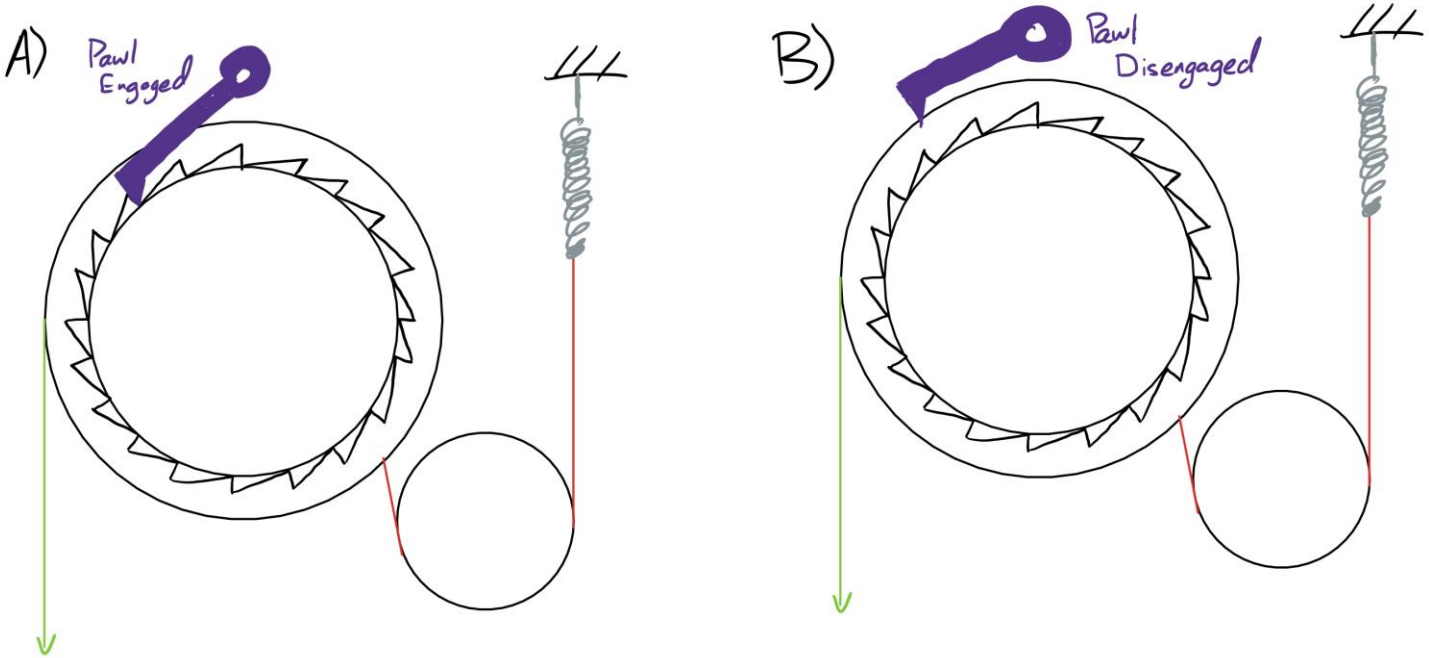




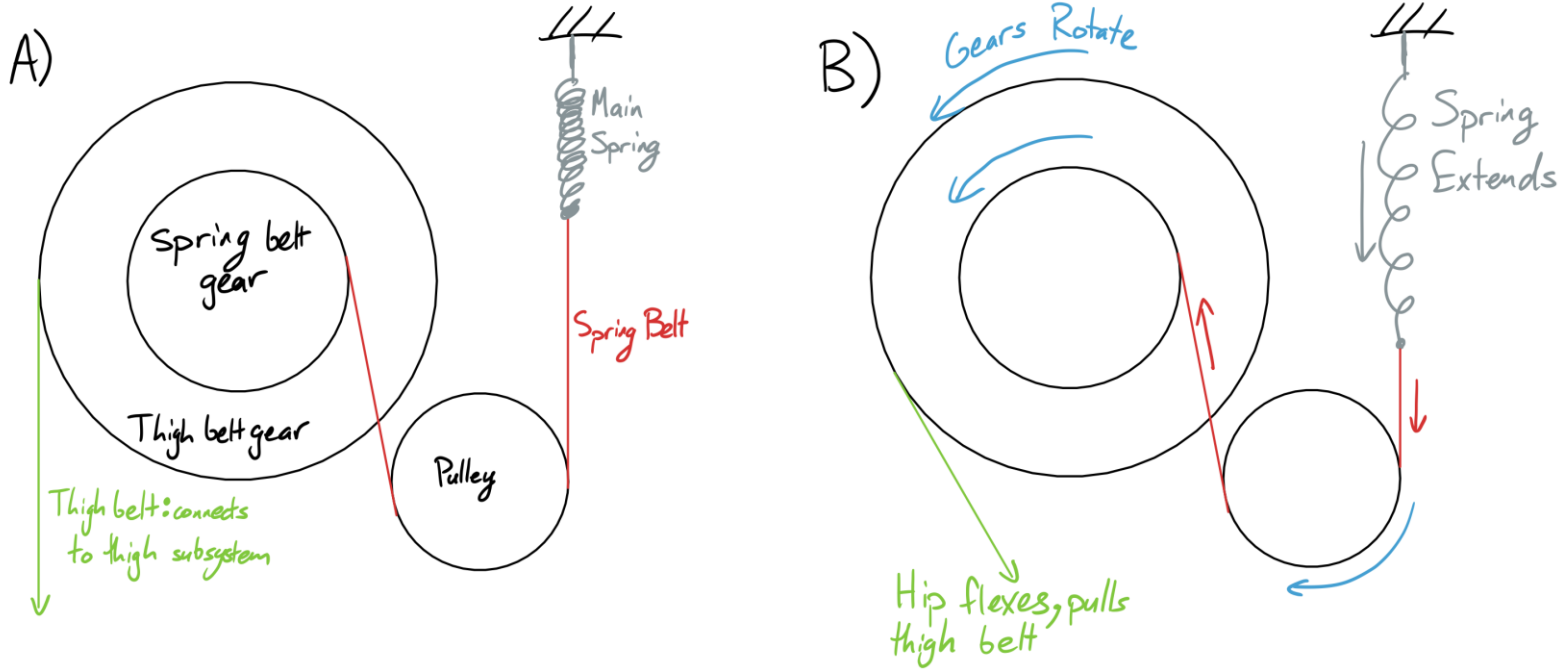


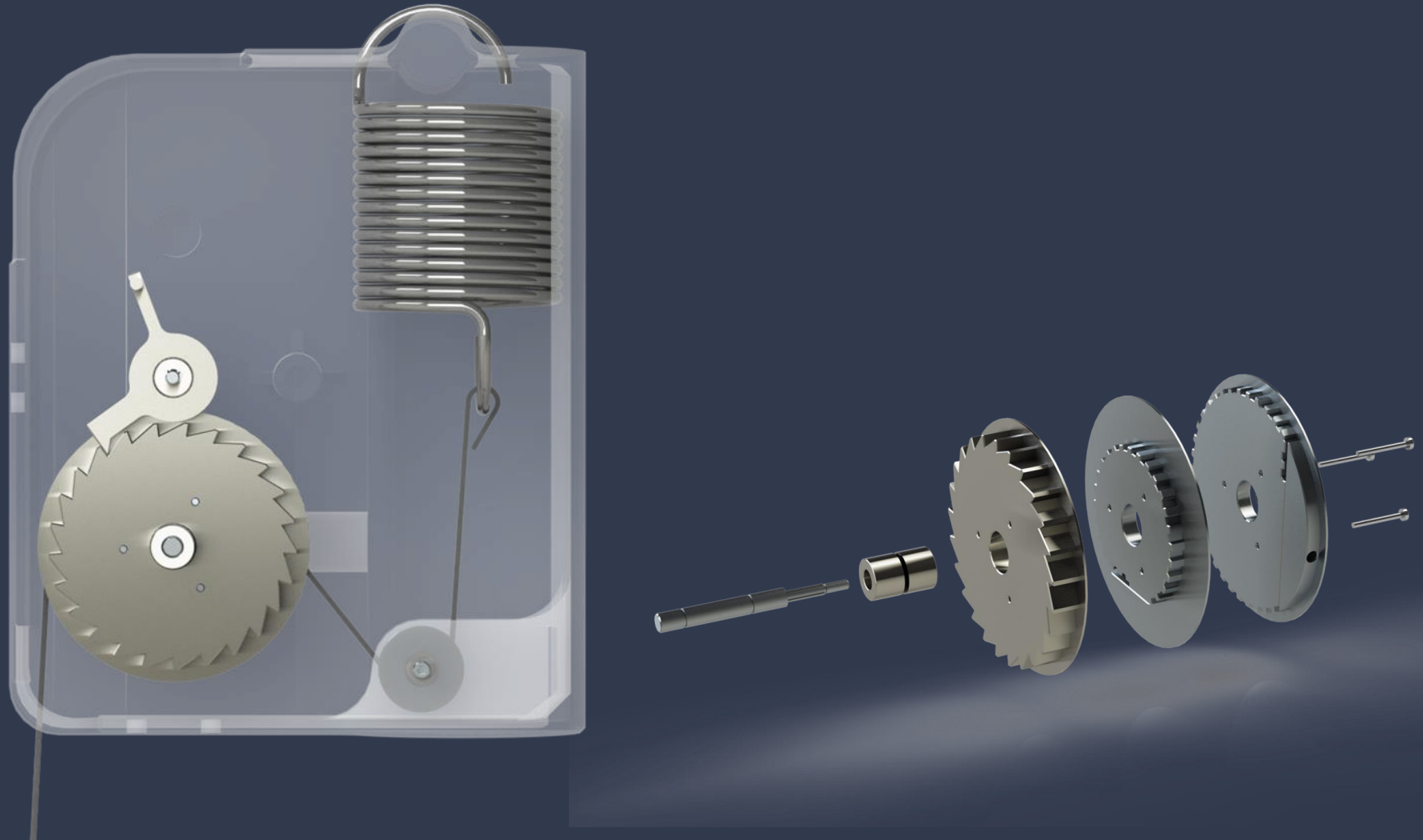


Main Energy Subsystem



Main Energy Subsystem



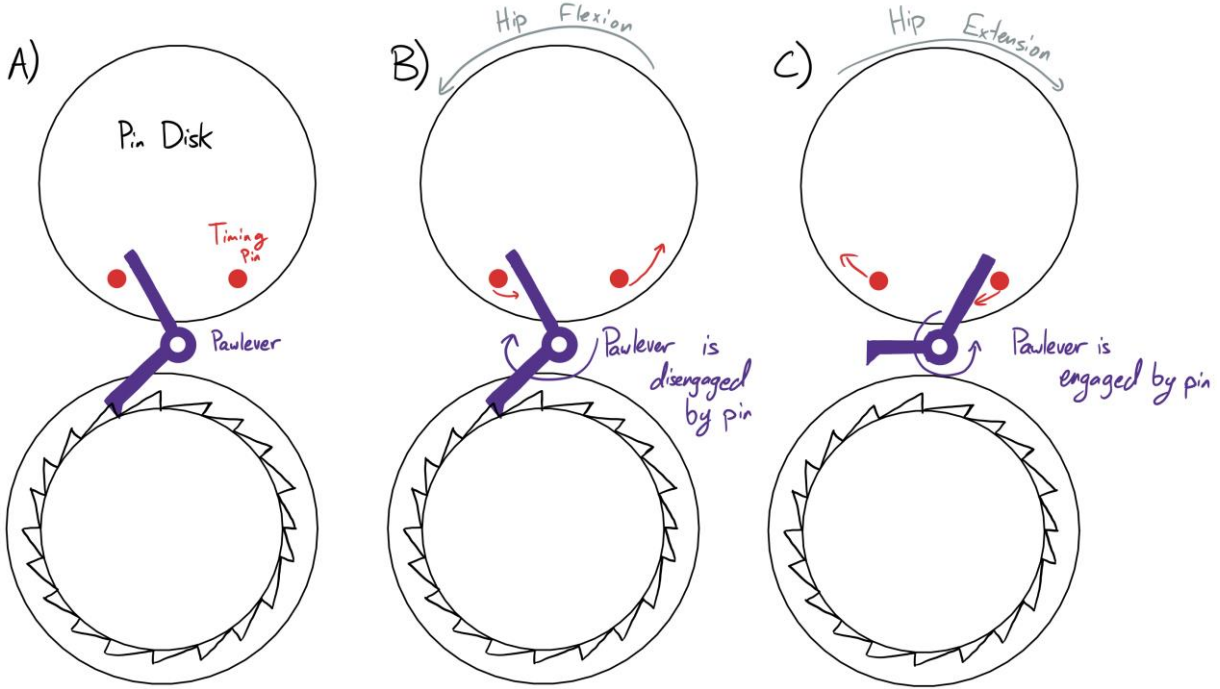


Timing Subsystem

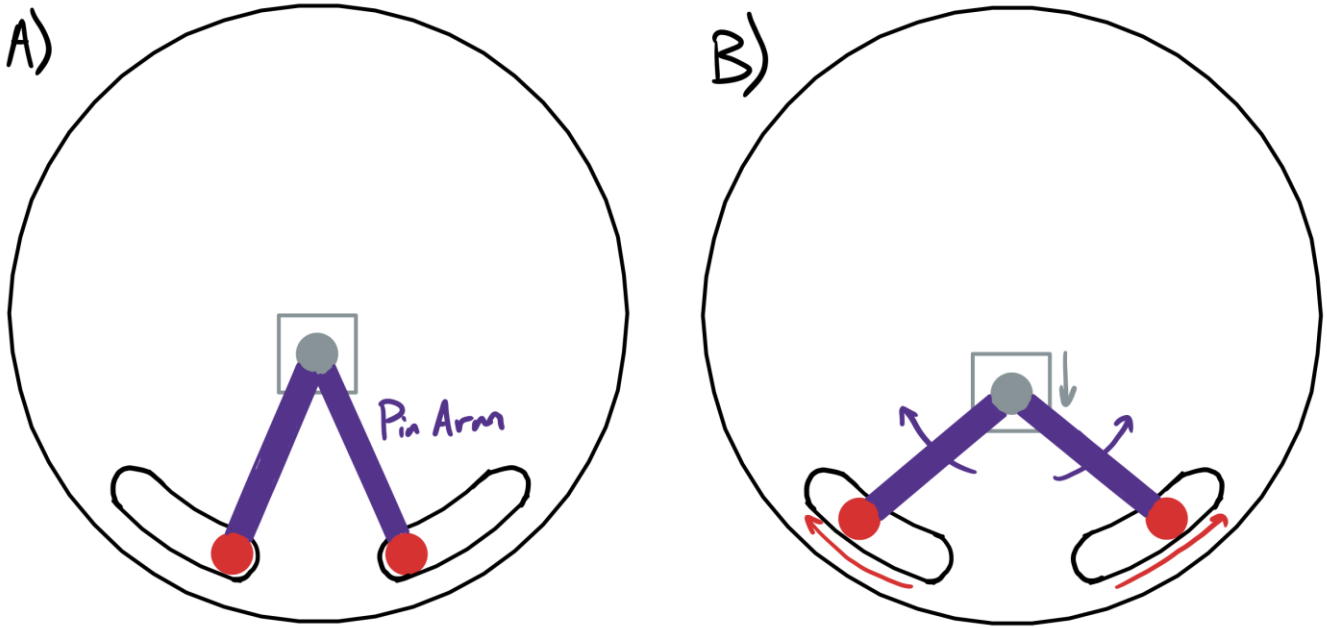
Functions:

- Control the pawl, engaging it and disengaging it depending on phase of gait
- Change gait modes (level, incline, stairs)

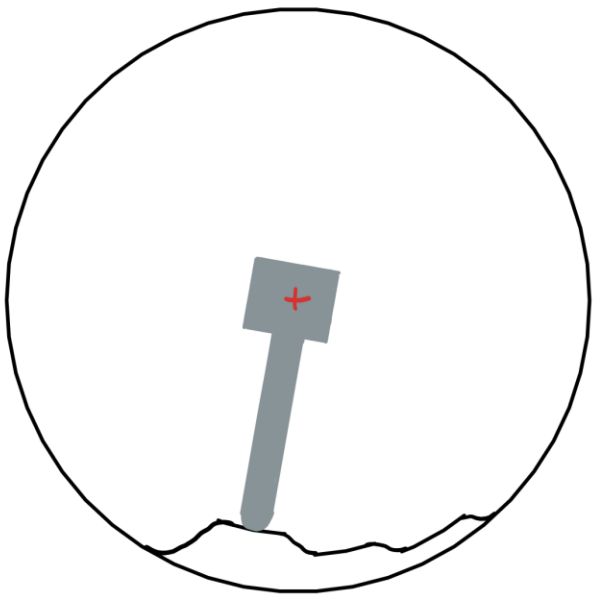
Timing Subsystem

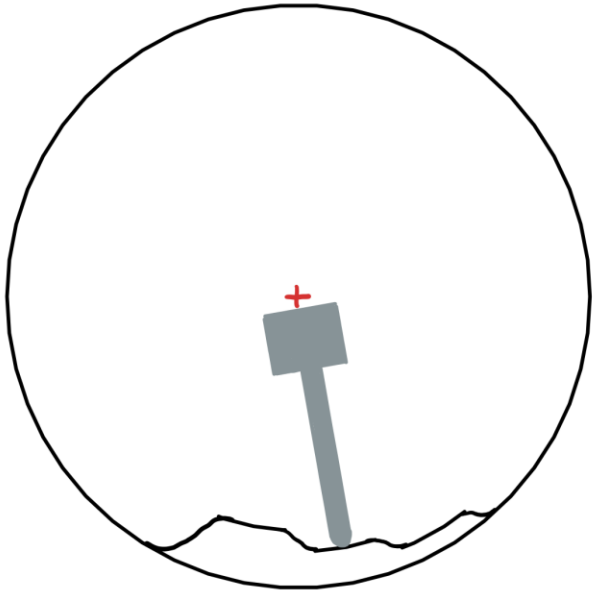


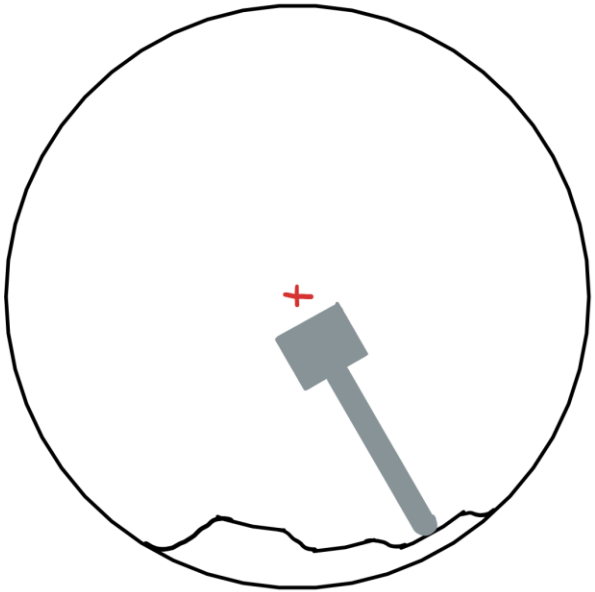
Timing Subsystem



Timing Subsystem





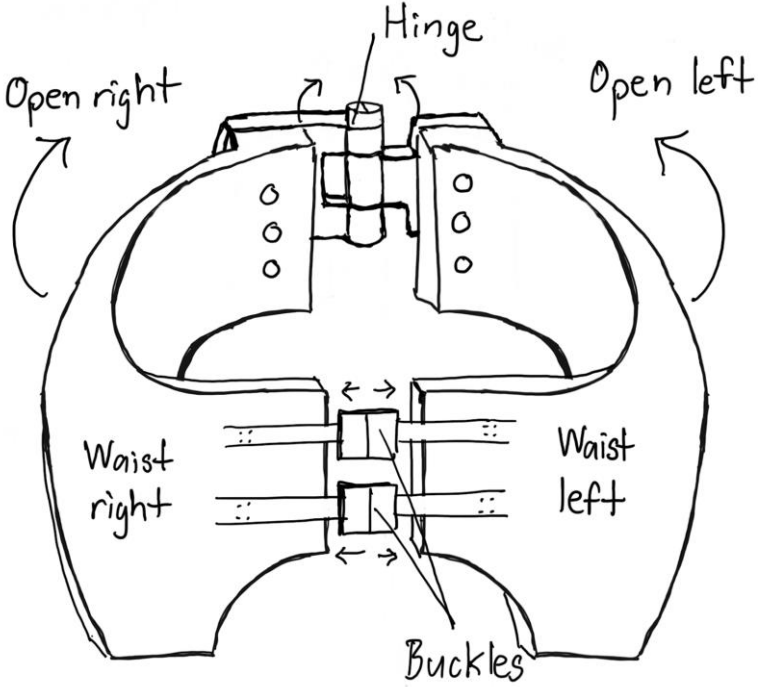


Thigh Subsystem

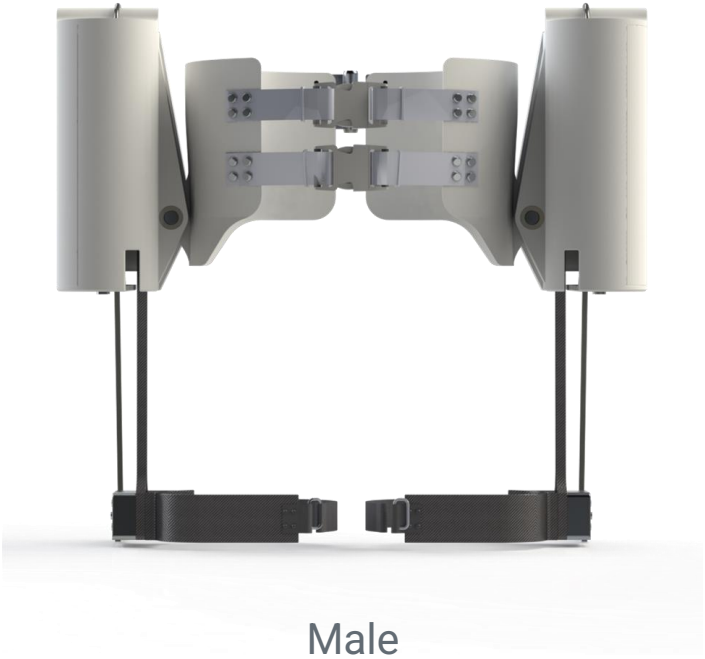
Functions:

- Connect to the thigh belt to transfer energy to and from the main spring
- Connect to the timing system to rotate timing disks

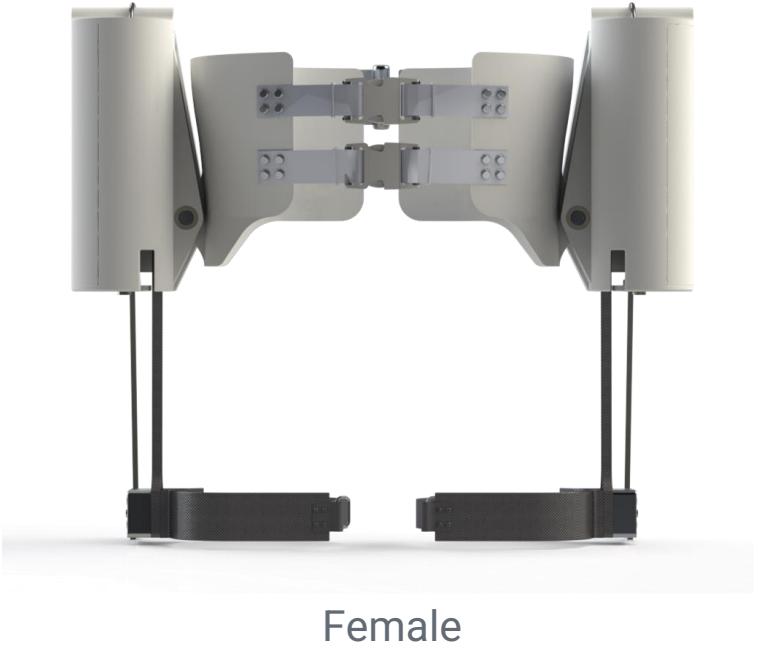
Waist Subsystem



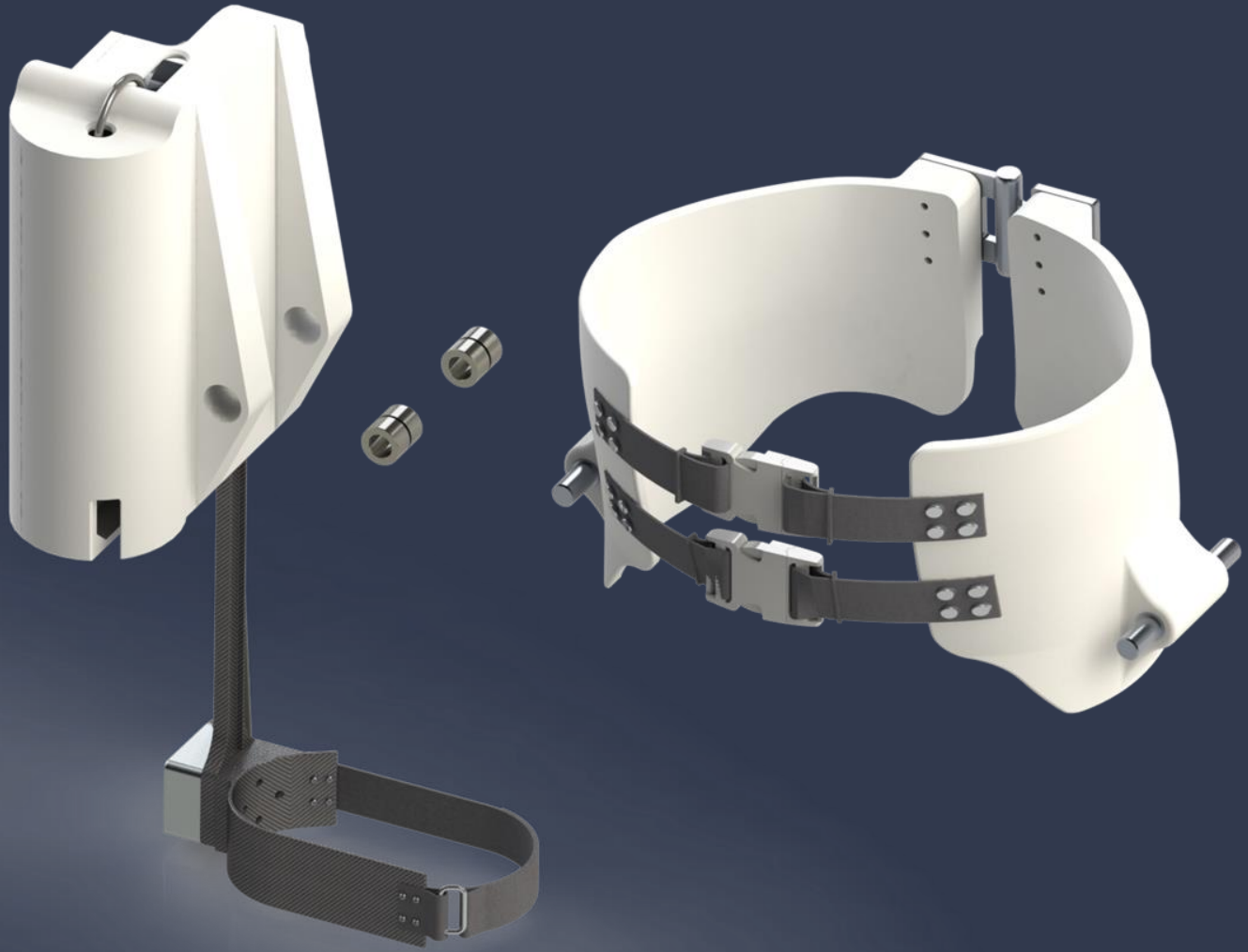
Waist Subsystem



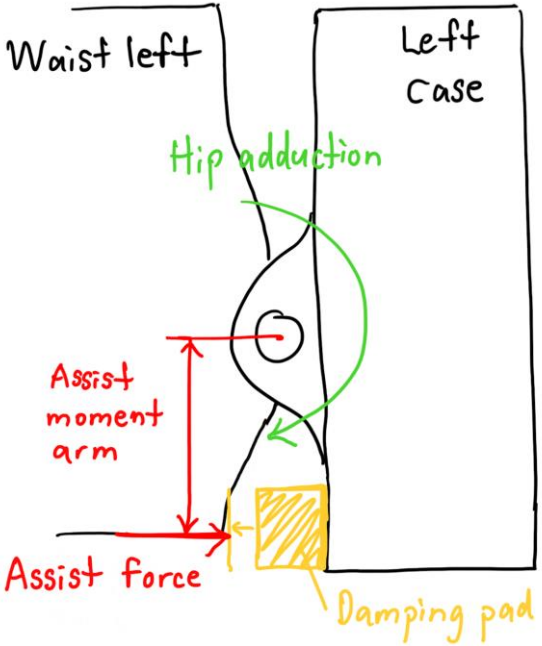
Male

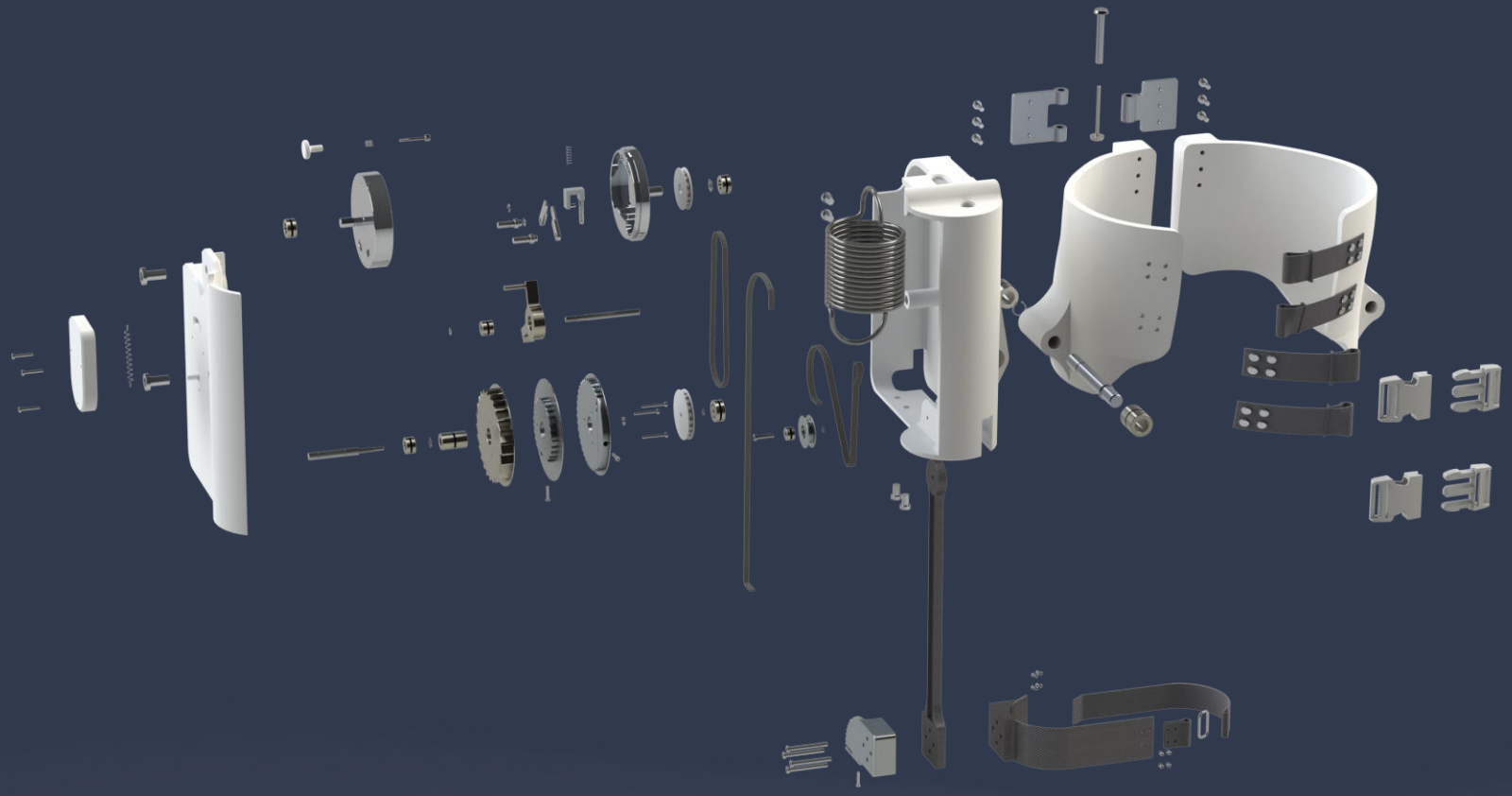


Female



Waist Subsystem





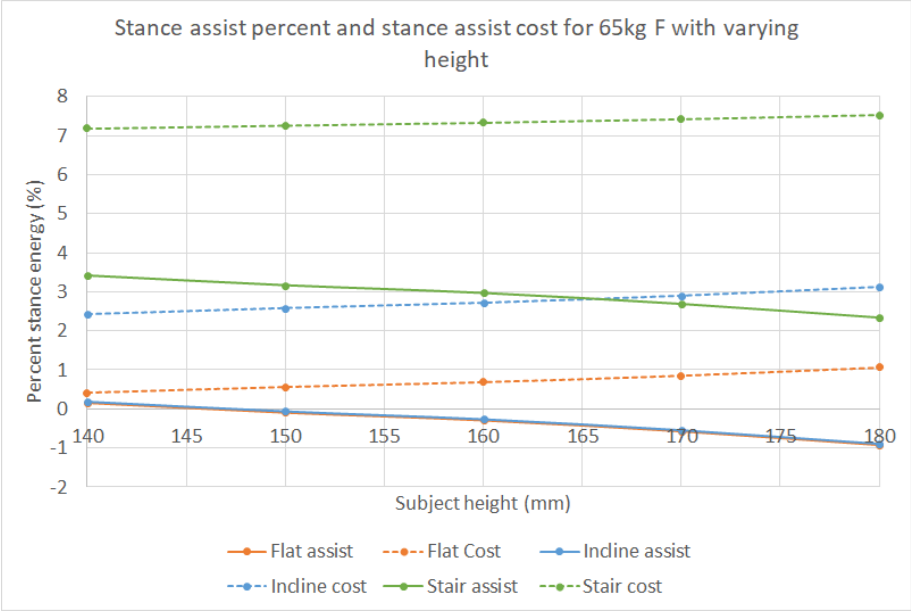
Simulation and Validation

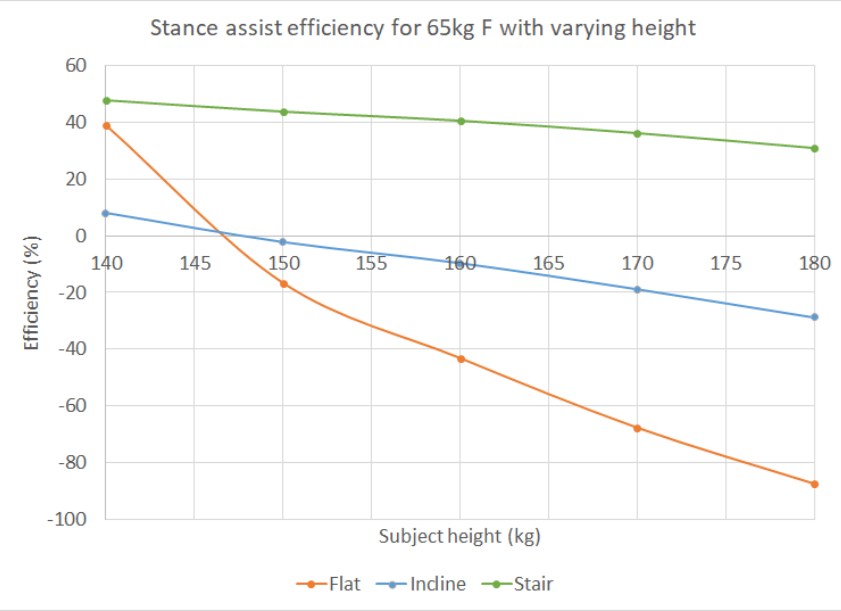
- Three elderly gait data sets:
  - Law (2013) stair ascent
  - Vickers (2008) incline gait
  - Winter (1990) flat gait

- MATLAB simulation and optimization
  - Kinematics
  - Dynamics
  - Stresses

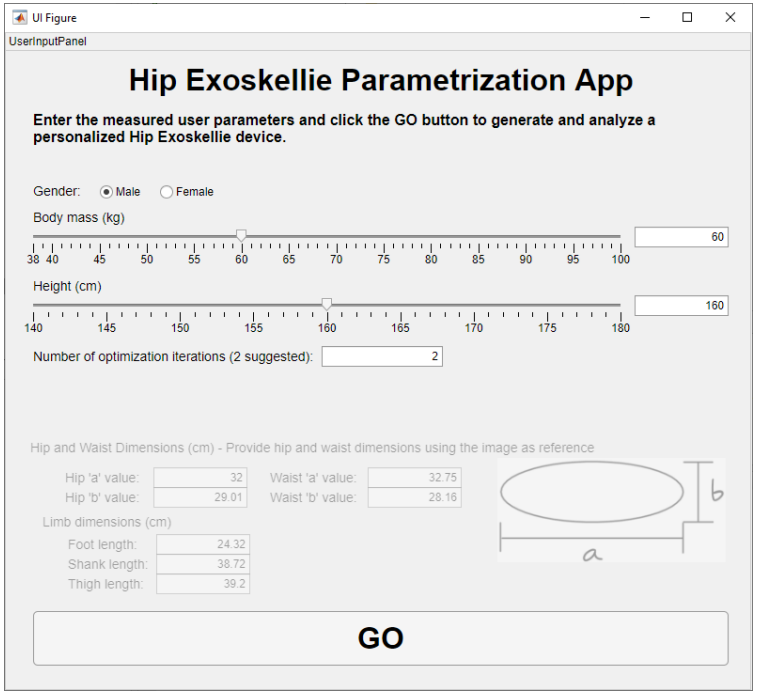
- SolidWorks FEA

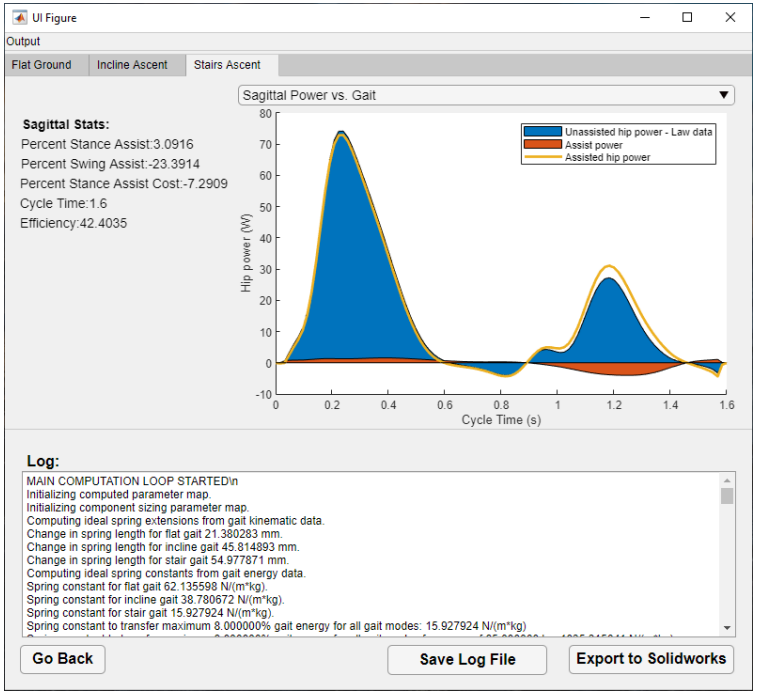
Simulation and Validation - Device assist





Parametrization: GUI





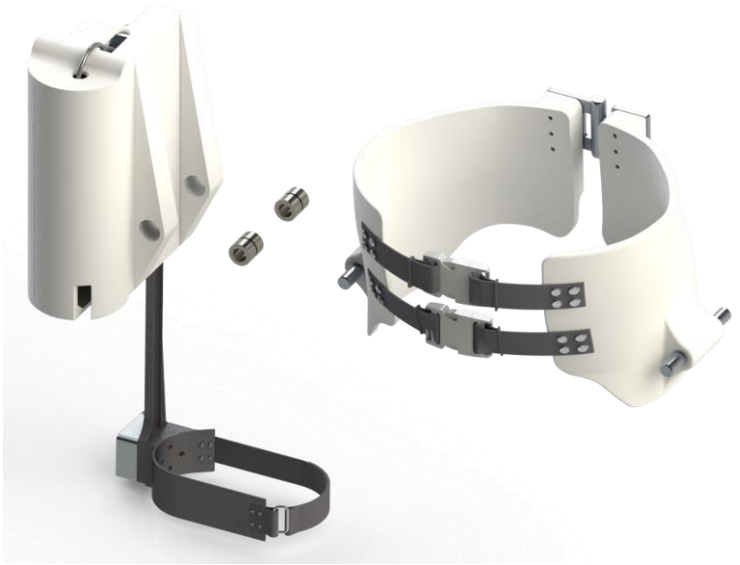
Conclusion

Takeaway:

- Works for stairs, sometimes works for incline and flat

Future work:

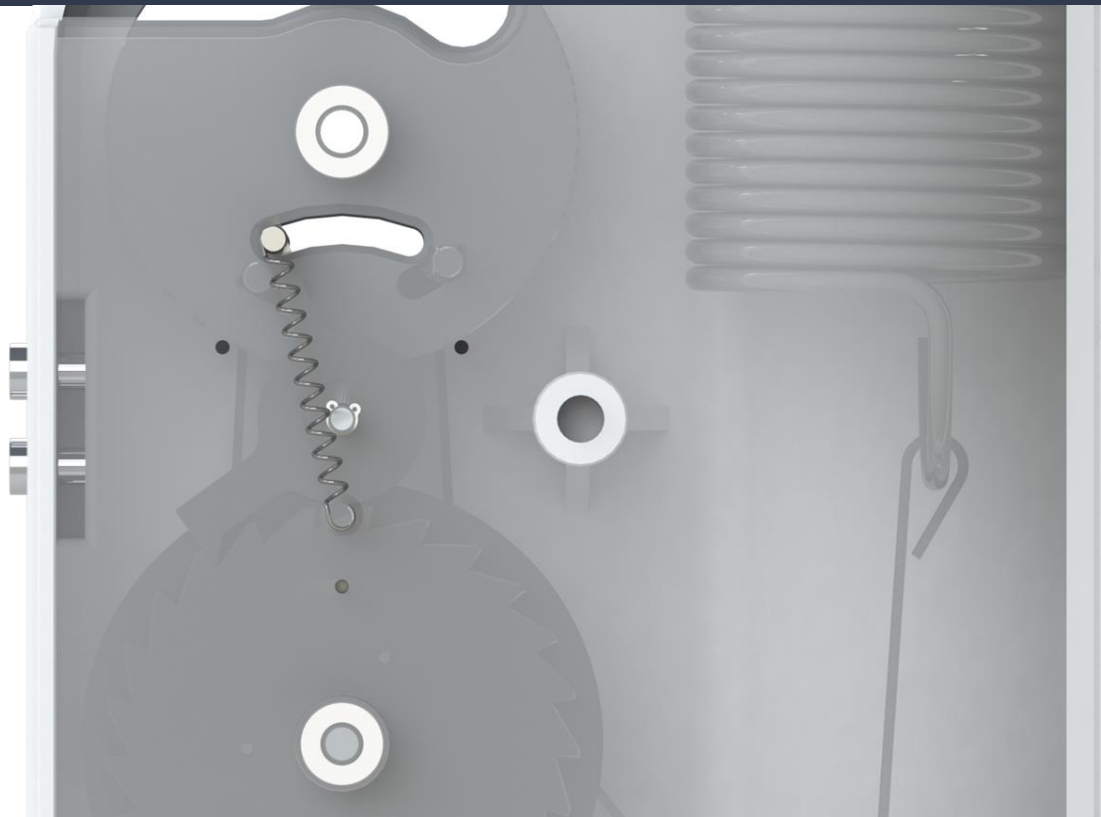
- Further optimization of device mass and size
- Improve power transfer system efficiency

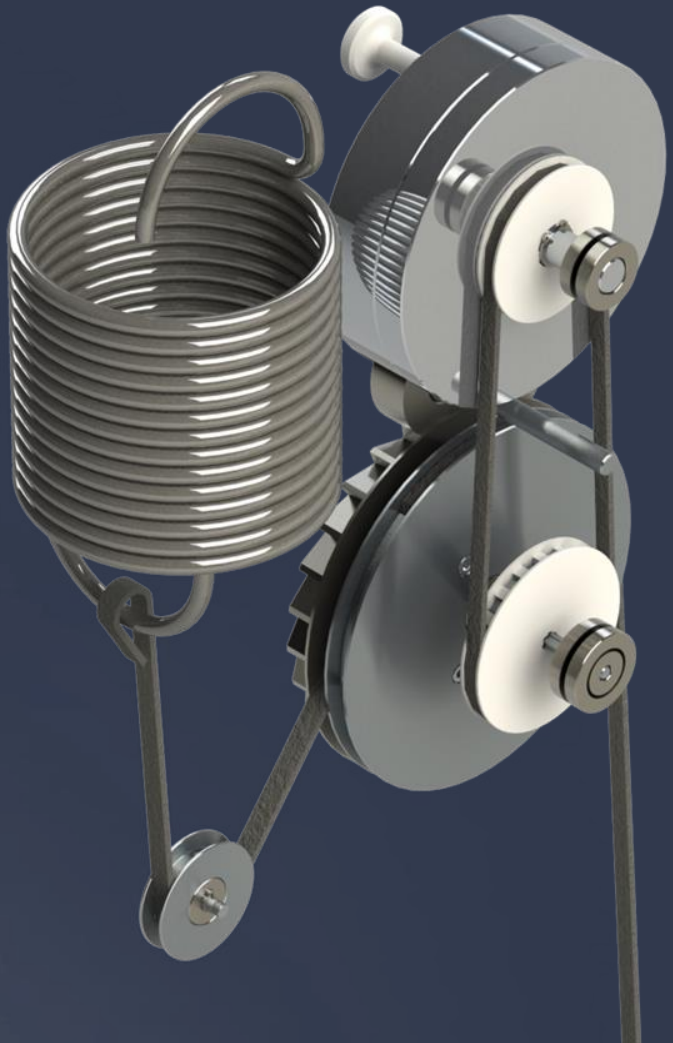


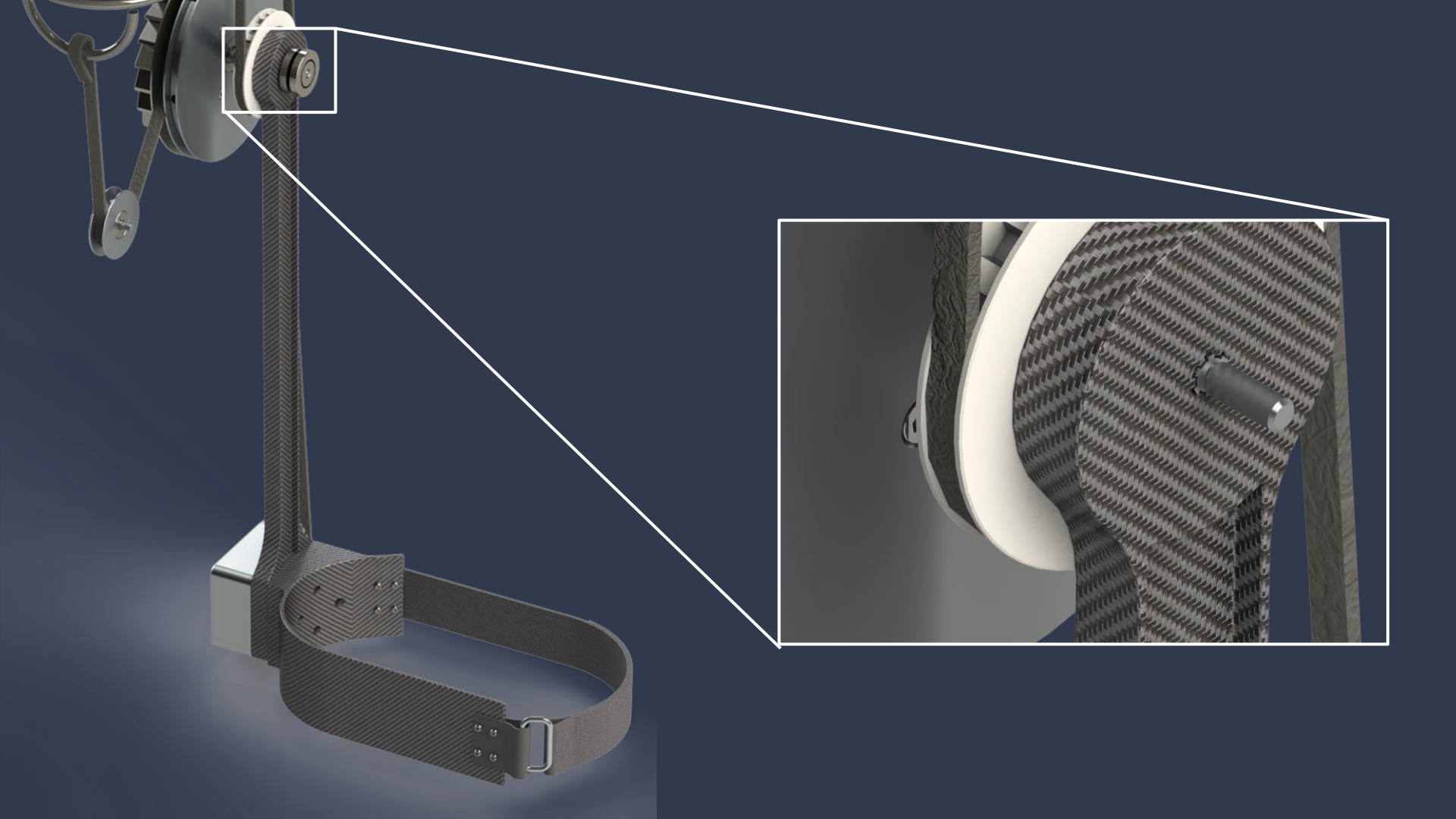
Questions

Question? Comments?

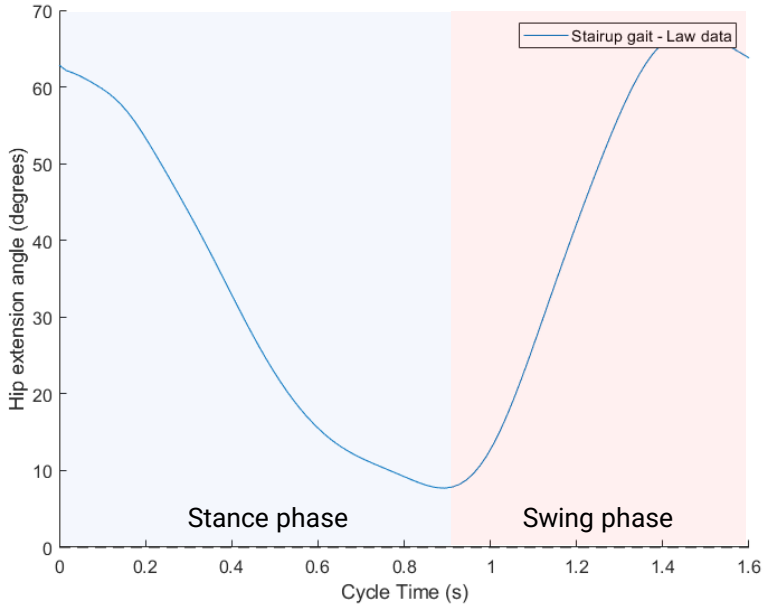
Timing Subsystem

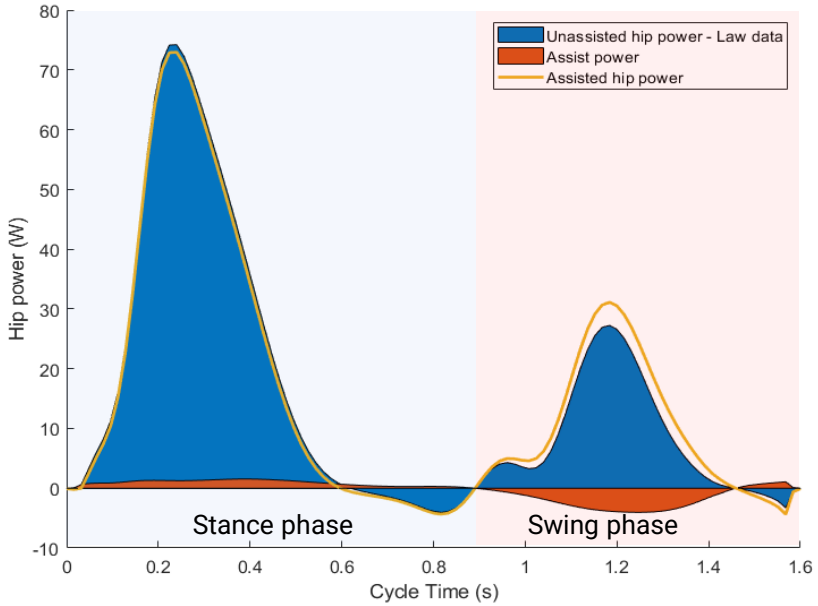






Simulation and Validation - Data Example





Simulation and Validation - Device assist