Novel Compliant Orthosis *Reduces Kinematic Misalignment* and Measures Distributed Interaction Force.

Enhancing Comfort and Repeatability of Human-Robot Attachment Systems: Comparison of a Compliant Orthosis for BLUE SABINO

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Motivation

Rehabilitative exoskeletons are shared devices; thus Human Robot Attachment systems (HRA) must fit a wide population of users. Size adjustment and misalignment between joints have been accommodated in ways which limit the controllability and accuracy of recorded data and usually requiring assistance.

BLUE SABINO Background

BLUE SABINO (BiLateral Upper-extremity Exoskeleton for Simultaneous Assessment of Biomechanical and Neuromuscular Output) is rehabilitative exoskeleton currently being developed at the University of Idaho. This explores an alternate HRA system for devices like BLUE SABINO.

Device Objectives:

- Adjustable
- Self-centering
- Independently Usable
- Discrete Control/Repeatable
- Comfortable

Solution

A compliant orthosis has been developed leveraging compliant and rigid materials achieve necessary rigidity for data collection and control while adjusting to fit the widest range of users

Validation

A laser setup was used to measure and compare kinematic misalignment on both orthoses. An armband was fabricated with an array of piezoelectric resistors to measure and map force levels around the user's arm.

Results

Preliminary results conclude that the compliant orthosis reduced joint misalignment by up to 11.5 mm, while being able to fully accommodate 5th to 95th percentile users.

Discussion

Future work will focus on:

- improving functionality of the orthosis design and armband
- mounting the compliant orthosis to BLUE SABINO for further testing
- investigating interaction between the user and exoskeleton and how the force distribution may change during usage



Fig. 1: BLUE SABINO Exoskeleton, HRA attachments labelled

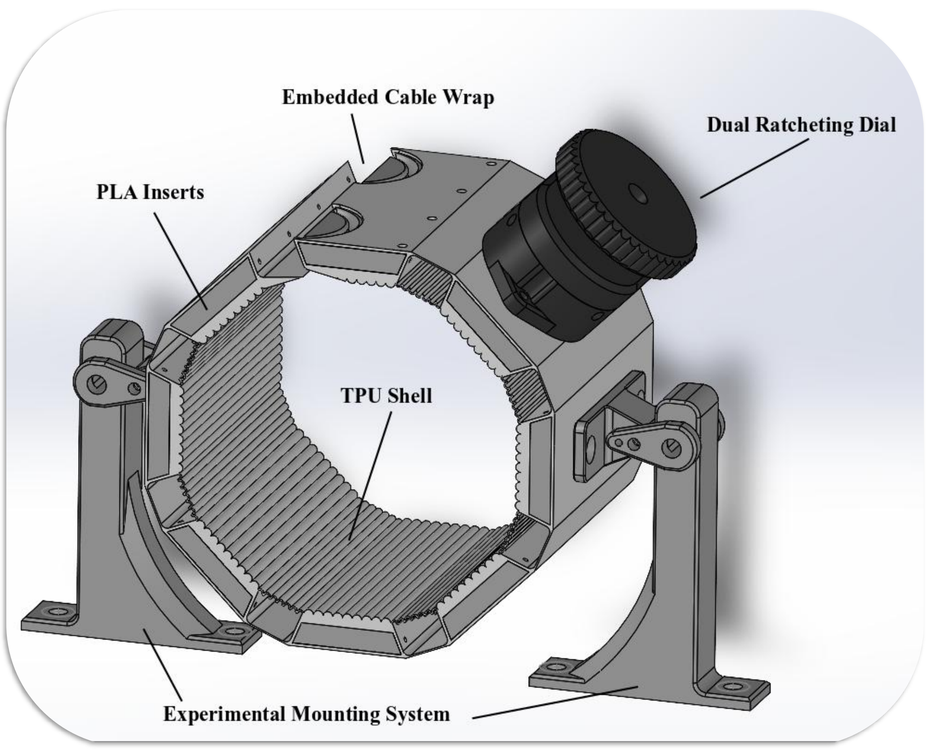


Fig. 3: CAD rendering of Novel Orthosis

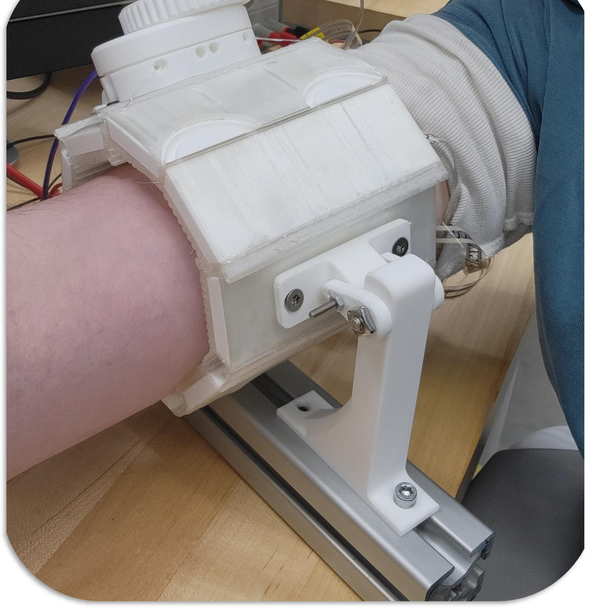


Fig. 2: Participant wearing Compliant Orthosis

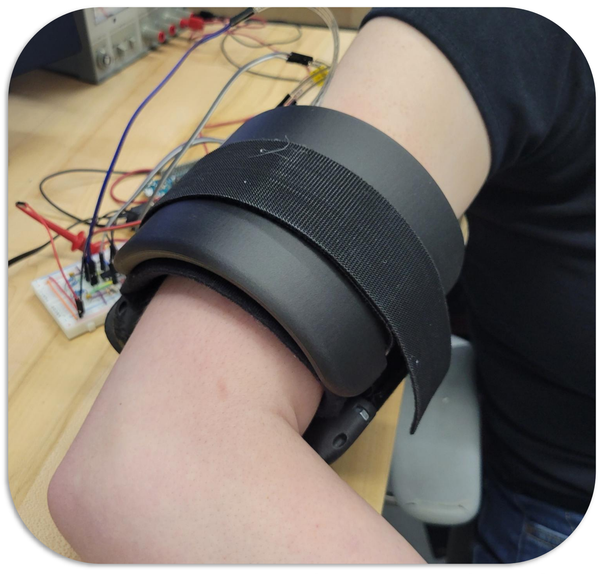


Fig. 4: Participant wearing Current BLUE SABINO Orthosis

Force Distribution:

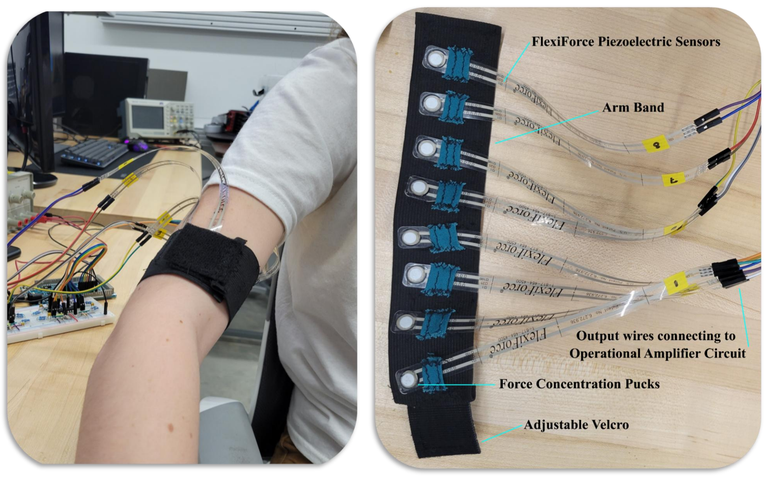


Fig. 8: Force Distribution worn by participant (left), and displayed

Results:

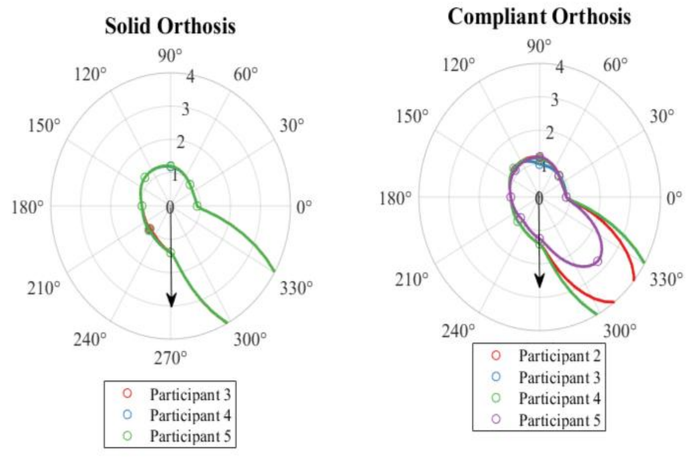


Fig. 9: Plots displaying forces measured while using each orthosis

Kinematic Alignment:

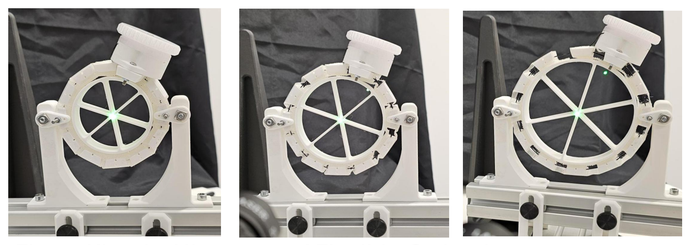


Fig. 5: Kinetic Alignment of Flexible Orthosis



Fig. 6: Kinetic Alignment of Solid Orthosis

Device	Misalignment 5th % (mm)	Misalignment 50th % (mm)	Misalignment 95th % (mm)	Average (mm)
Compliant Orthosis	0.0	0.0	0.0	0.0
Current Orthosis	11.5	2.7	10.3	8.2

Fig. 7: Table displaying measured misalignment from orthoses

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