Optimizing Exoskeleton Assistance to Improve Walking Speed and Energy Economy for Older Adults

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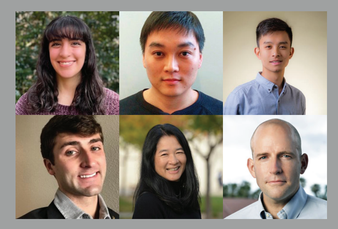


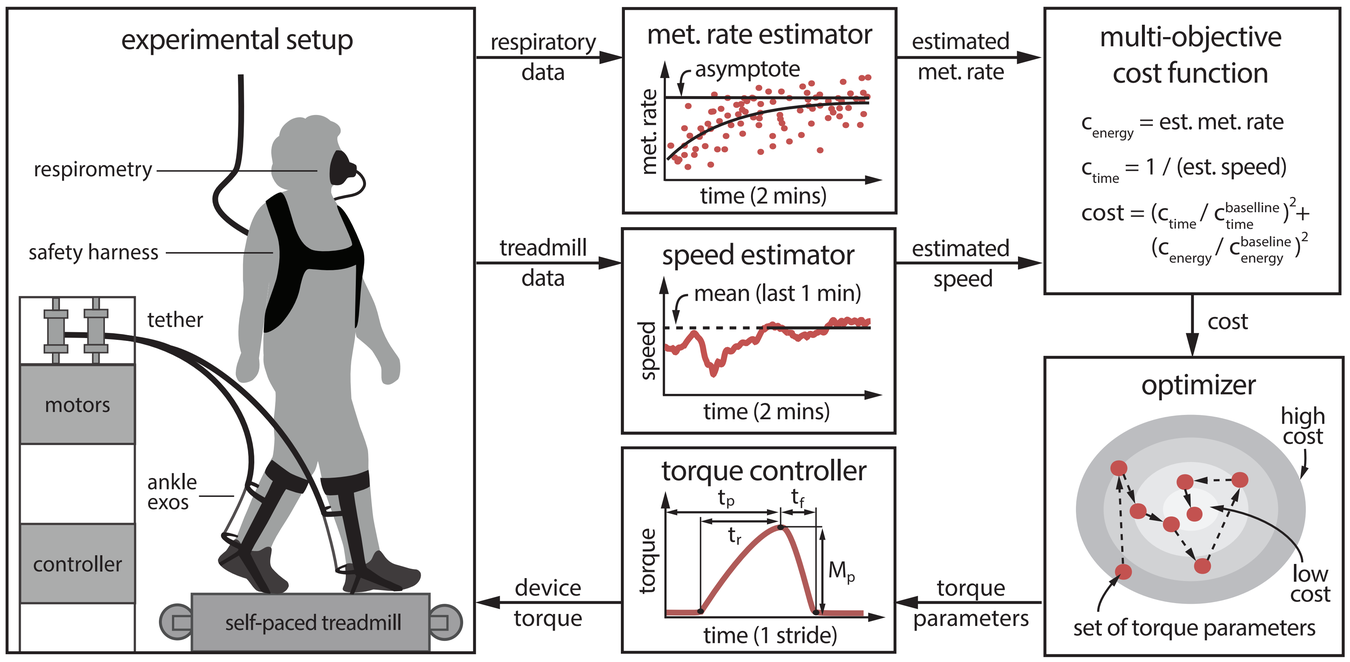
Background

Walking speed and energy economy tend to decline with age. Exoskeletons can improve either measure, but have yet to be optimized for older adults or optimized for speed and energy cost simultaneously.

Multi-objective human-in-the-loop optimization

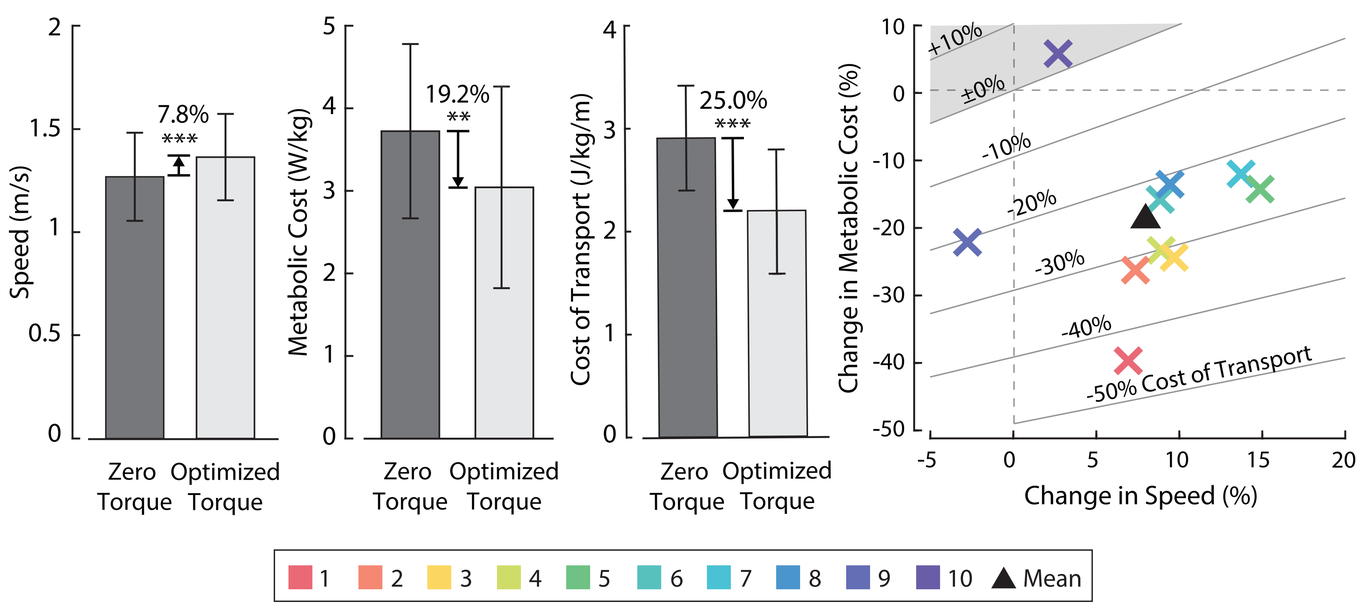
Participants: n = 10, 5 female, age: 72 ± 3 yrs, body mass: 77.3 ± 18.9 kg, height: 1.71 ± 0.08 m

Sessions: one familiarization, four optimization, one validation

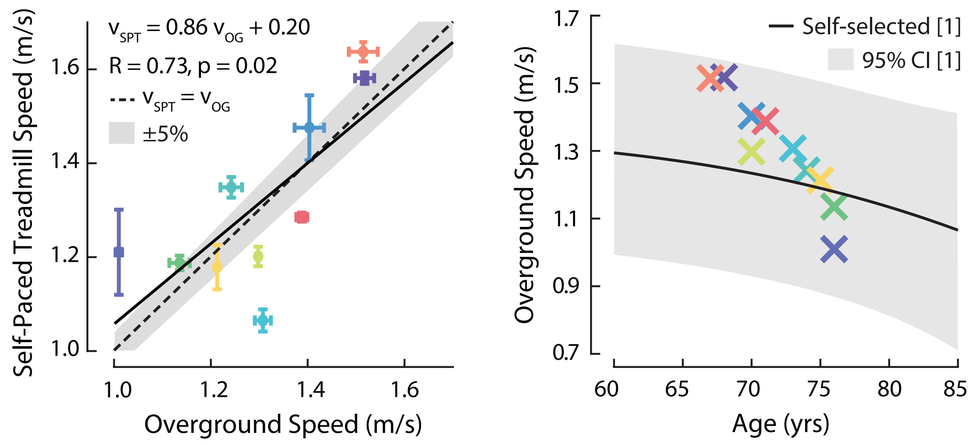


Results

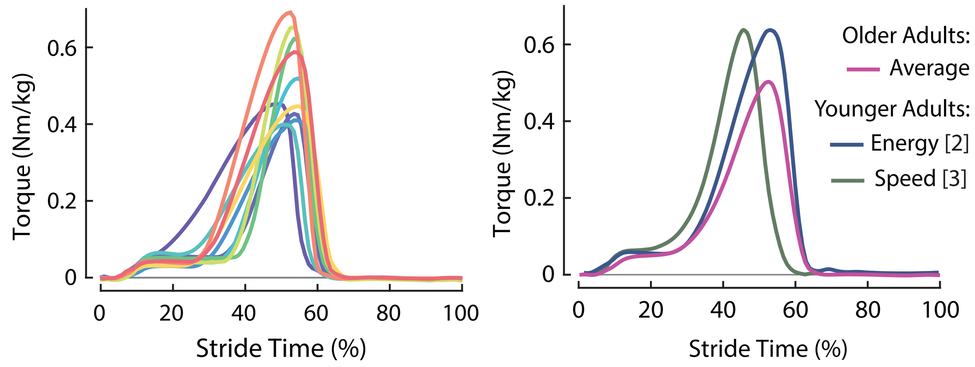
Self-selected walking speed and energy economy simultaneously improved with optimized assistance.



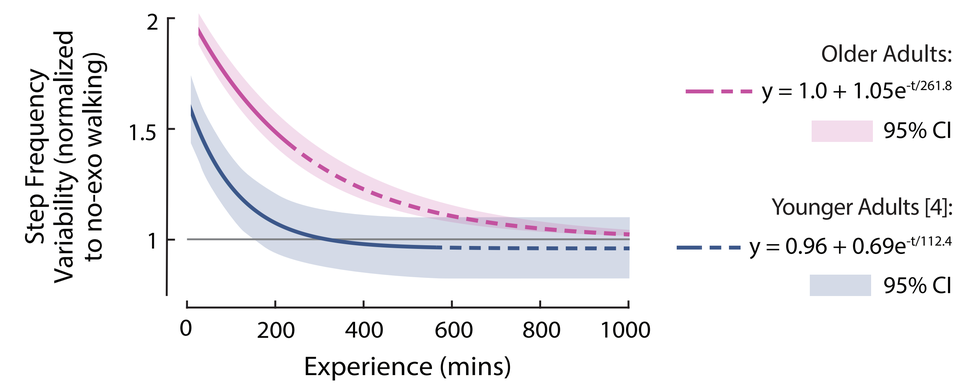
Speeds on the self-paced treadmill were significantly correlated to those overground. Participant speeds spanned a meaningful range for their age group.



Optimal torque parameters varied among participants. Optimal parameters differed between older adults and younger adults in prior studies.



Older adults adapted to exoskeleton use more slowly than younger adults in prior work, likely due to age and difficulty of self-paced treadmill use.



Conclusions

1. Exoskeletons can provide clinically meaningful [6,7] gait improvements for older adults.
2. Multiple objectives can be simultaneously addressed with human-in-the-loop optimization.
3. Self-paced treadmills are effective tools to study older adults' gait.
4. Smaller, lighter-weight exos may be more appropriate for older adults.
5. Personalization matters for older exoskeleton users.

Future Directions

1. Extend human-in-the-loop optimization to other relevant objectives
2. Develop personalized familiarization and training protocols
3. Explore the effects of aging, and age-related mobility decline, on responses to exoskeletons

References

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Acknowledgments

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