Enhancing human navigation ability using an active wearable exoskeleton

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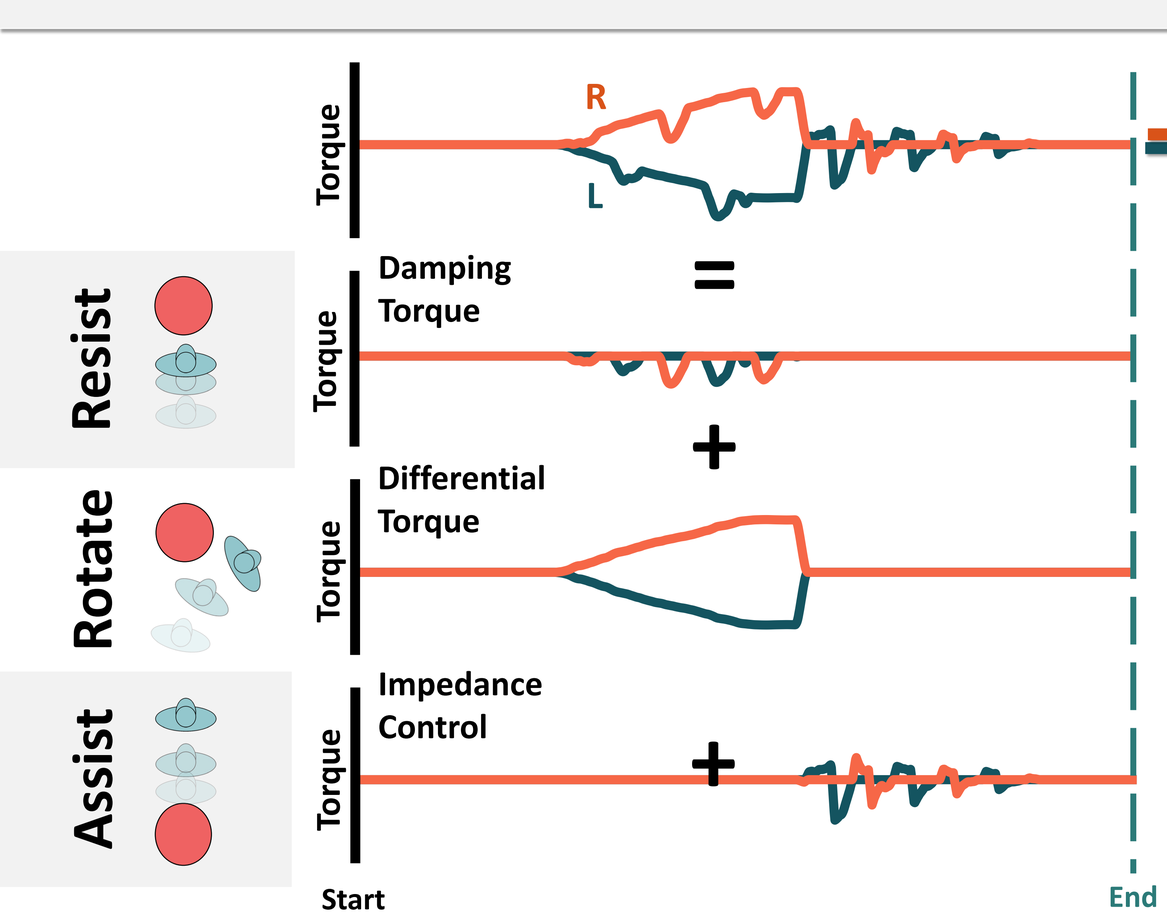
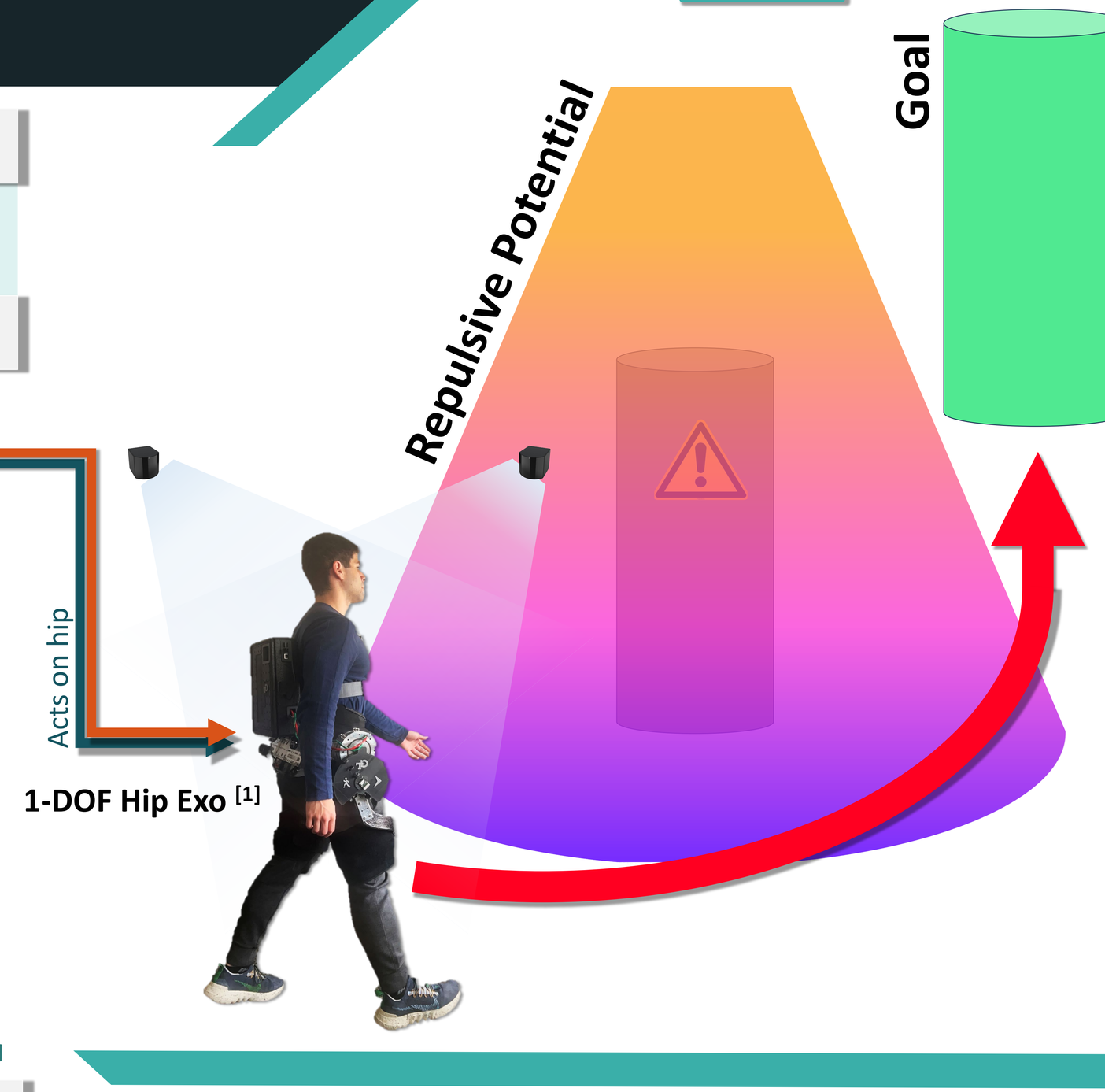
Scan for a video demo

Goal of This Project

How can we assist people in **navigate safely** when visibility is low?

How the Controller Works

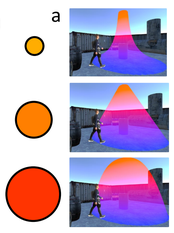


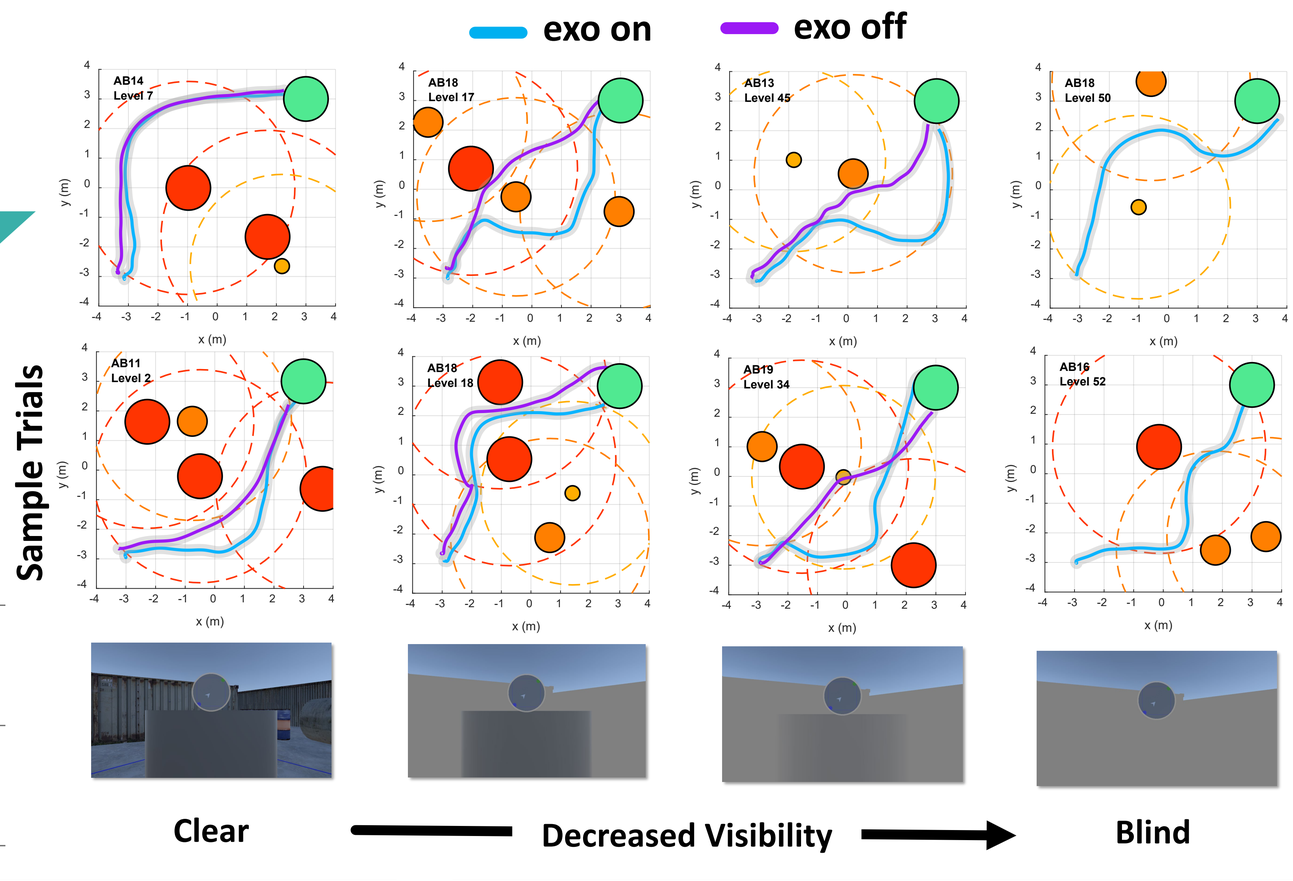


Experiment

- N=10
- 3h training day
- 7 conditions, 16 levels per condition
- 3 obstacle danger levels, d^a
  (visually represented by radius)

Conditions (Exo, Visibilty)
Exo On, Clear
Exo On, Impaired
Exo On, Heavily Impaired
Exo On, Blind
Exo Off, Clear
Exo Off, Impaired
Exo Off, Heavily Impaired



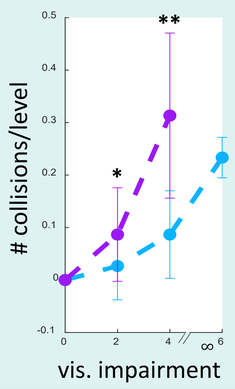


Results

Collisions

Collisions were significantly reduced with exo in all visibilities except clear.

exo on
exo off



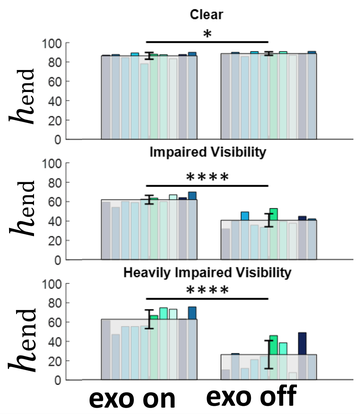
Health Metric

Performance with exo on was significantly better in all visibilities except clear.

$$h_0 = 100$$

$$h_{i+1} = h_i - G \sum_{k=1}^{\#\text{obstacles}} d_k \frac{1}{r_k^2}$$

damage taken at t_i
damage gain
radius/danger level of obstacle k
distance to obstacle k



References & Acknowledgements

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[1] A. Bajpai *et al.*, "Design and Validation of a Versatile High Torque Quasi-Direct Drive Hip Exoskeleton," 2023.