

Enhancing human navigation ability using an active wearable exoskeleton



Scan for a video demo

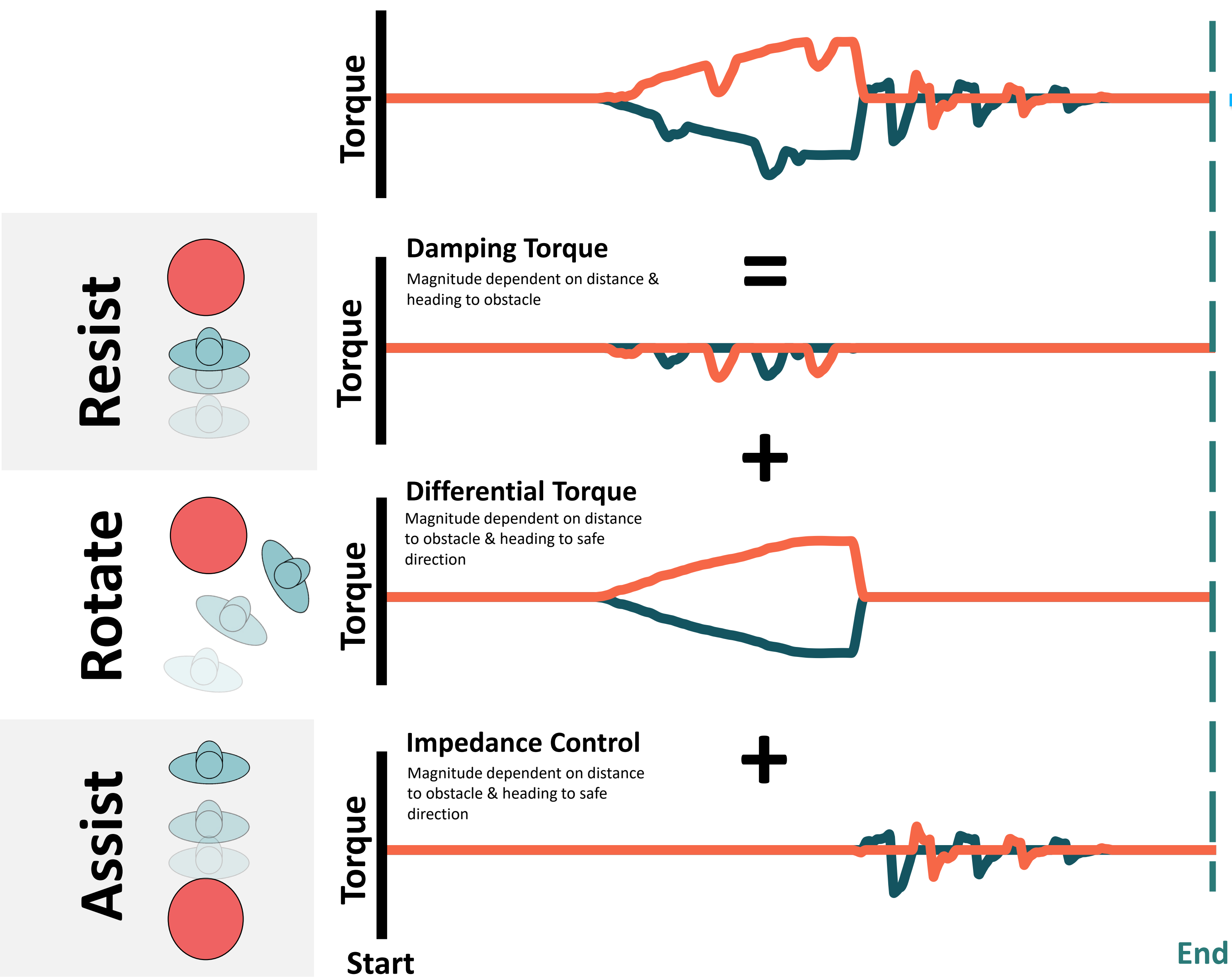
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Goal of This Project

How can we help people **navigate safely** when environmental awareness is low?

How the Controller Works



Acts on hip joint
1-DOF Hip Exo [1]

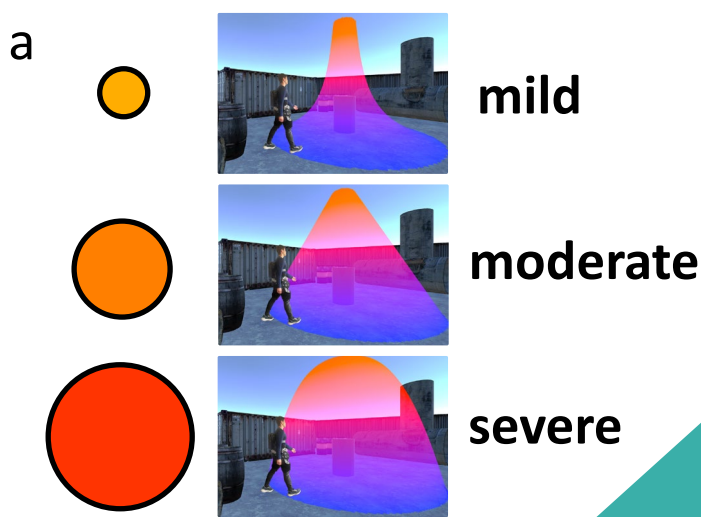
Repulsive Potential

Goal

Experiment

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

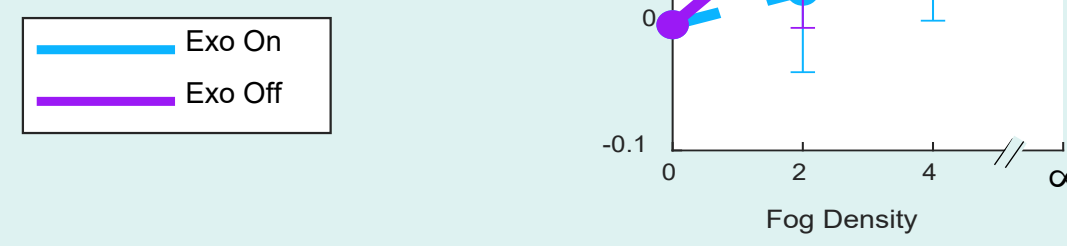
Conditions (Exo, Visibility)
Exo On, Clear
Exo On, Impaired
Exo On, Heavily Impaired
Exo On, Blind
Exo Off, Clear
Exo Off, Impaired
Exo Off, Heavily Impaired



Results

Collisions

Average # of collisions per level was significantly reduced with exo in all visibilities except clear.

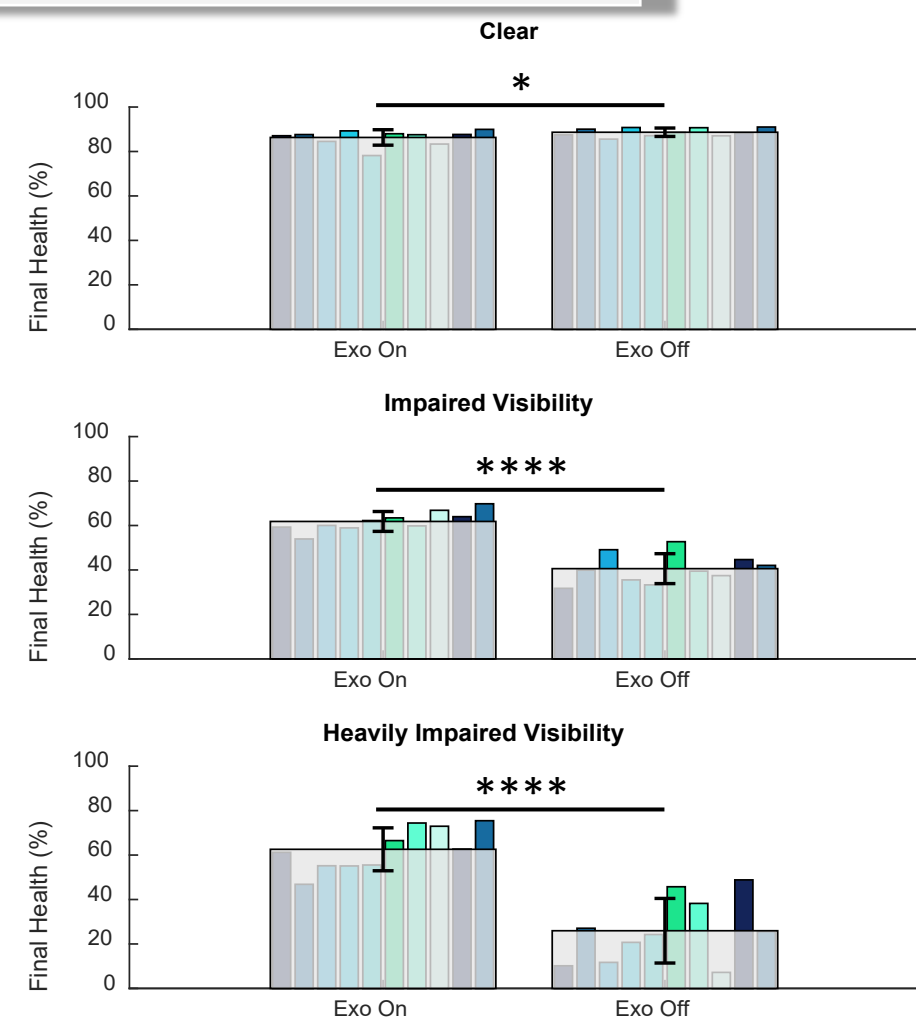


Health Metric

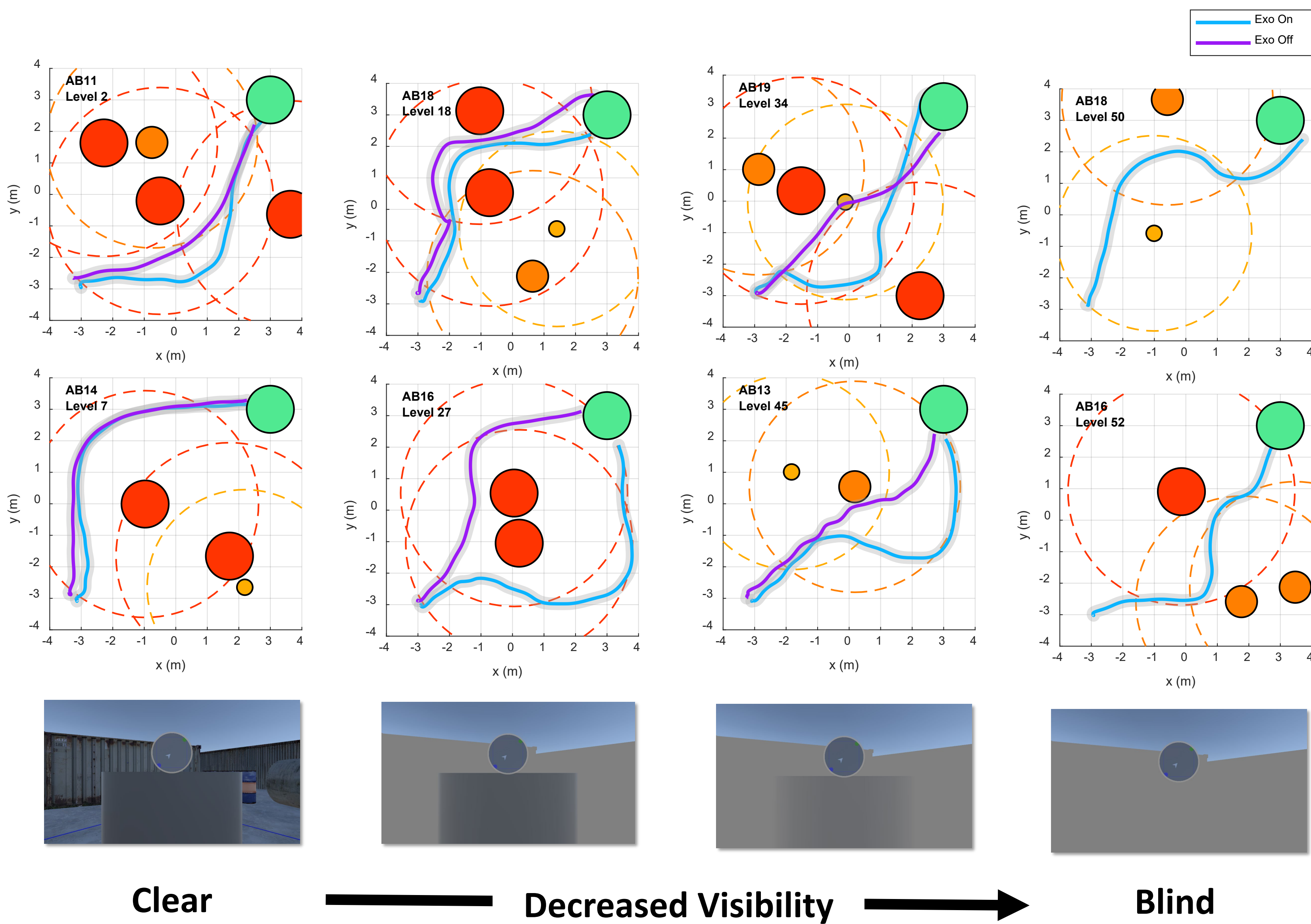
Performance with exo on was significantly better in all visibilities except clear.

$$h_0 = 100$$
$$h_{i+1} = h_i - G \sum_{k=1}^{\text{\#obstacles}} d_k \frac{1}{r_k^2}$$

damage gain G damage taken at t_i
 d_k distance to obstacle k
 r_k^2 radius/danger level of obstacle k



Sample Trials



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.

