

# Enhancing human navigation ability using an active wearable exoskeleton



Scan for a video demo



<sup>1,2</sup>Carlos Carrasquillo, <sup>1,2</sup>Aakash Bajpai, <sup>1</sup>Divya Iyengar, <sup>1</sup>Killian Collins, <sup>1,2</sup>Anirban Mazumdar, <sup>1,2</sup>Aaron Young

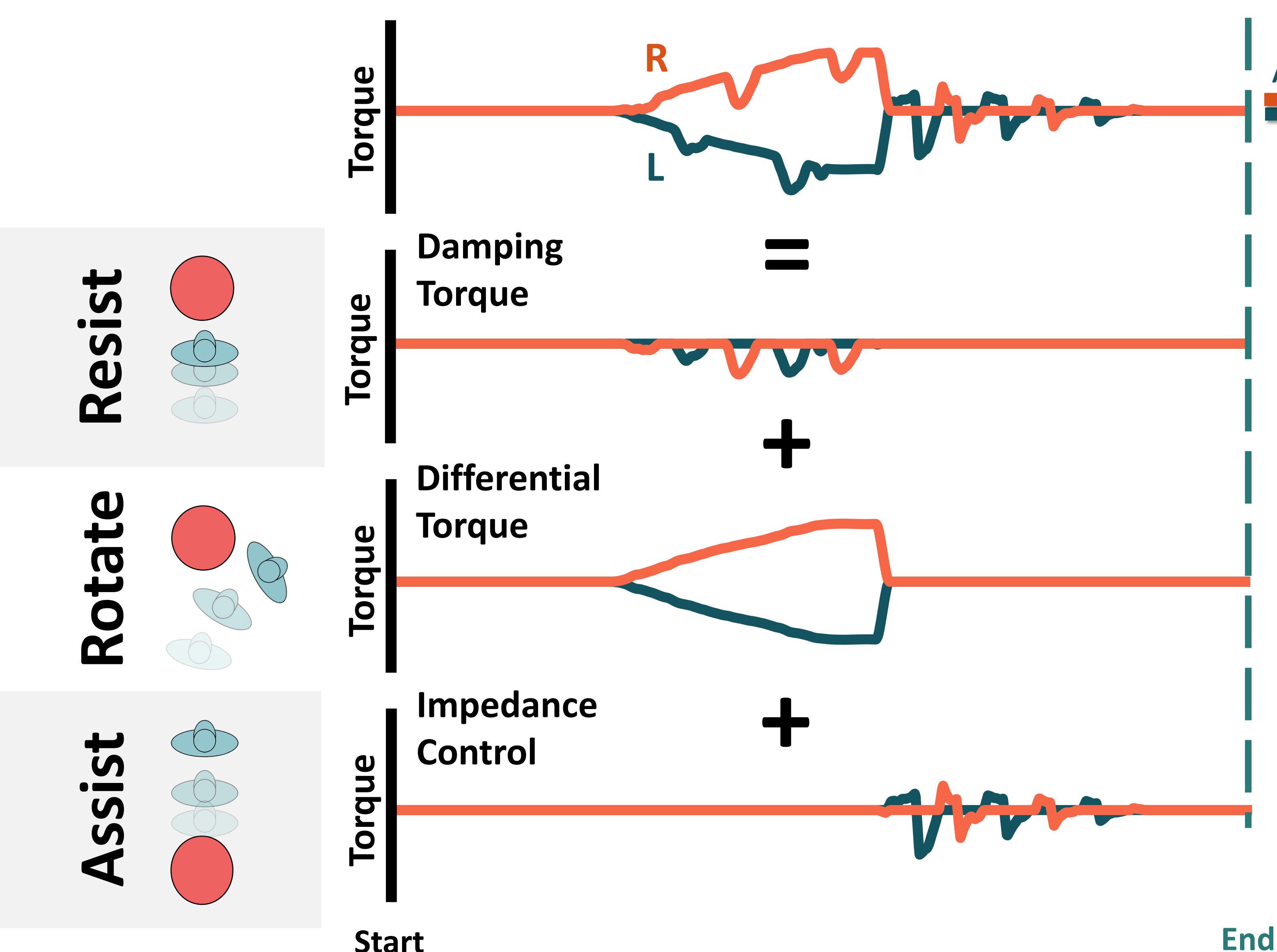
<sup>1</sup>George W. Woodruff School of Mechanical Engineering

<sup>2</sup>Institute for Robotics and Intelligent Machines

## Goal of This Project

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

## How the Controller Works



## Experiment

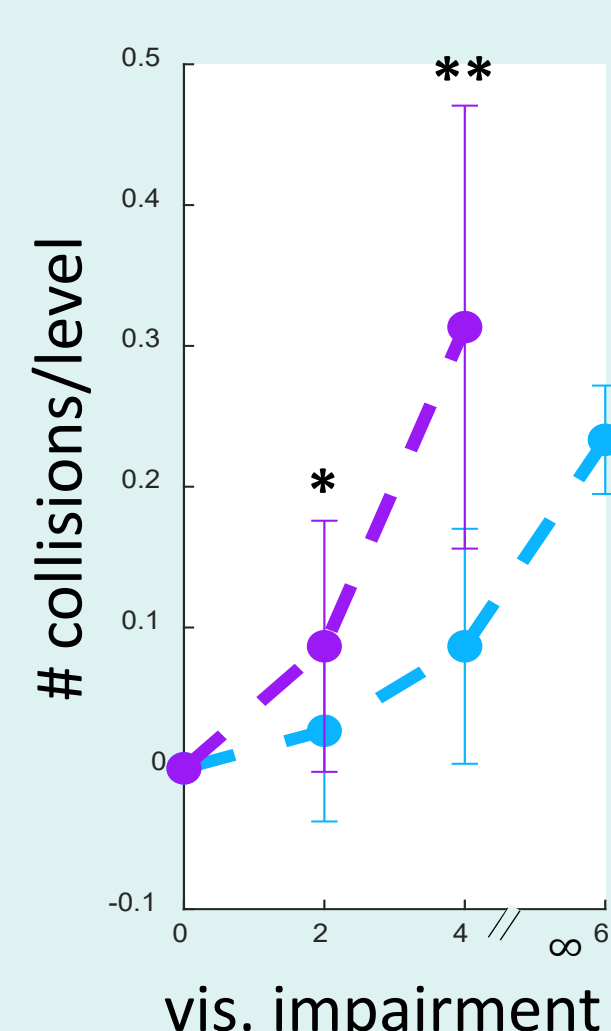
- N=10
  - 3h training day
  - 7 conditions, 16 levels per condition
  - 3 obstacle danger levels,  $d$  (visually represented by radius)
- Conditions (Exo, Visiblity)
- Exo On, Clear
  - Exo On, Impaired
  - Exo On, Heavily Impaired
  - Exo On, Blind
  - Exo Off, Clear
  - Exo Off, Impaired
  - Exo Off, Heavily Impaired

## Results

### Collisions

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

— exo on  
— exo off

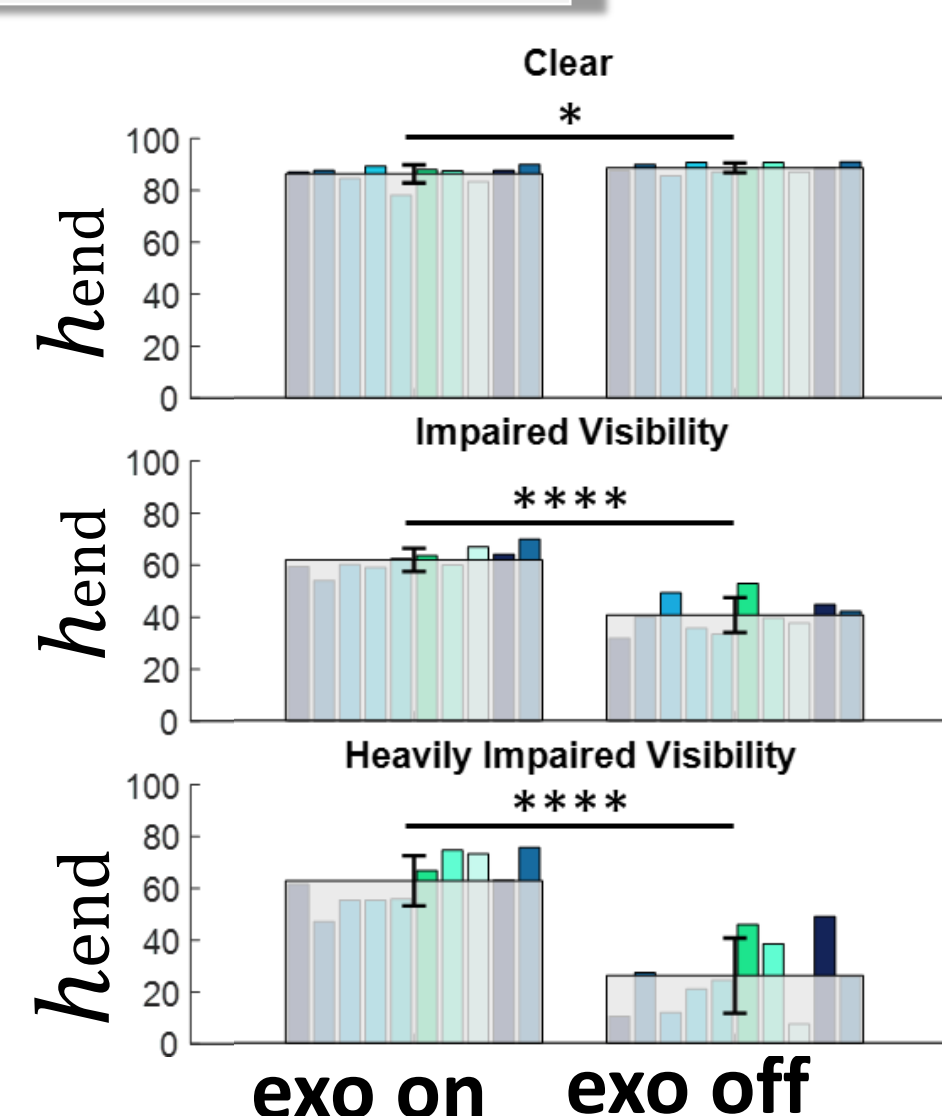


### Health Metric

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

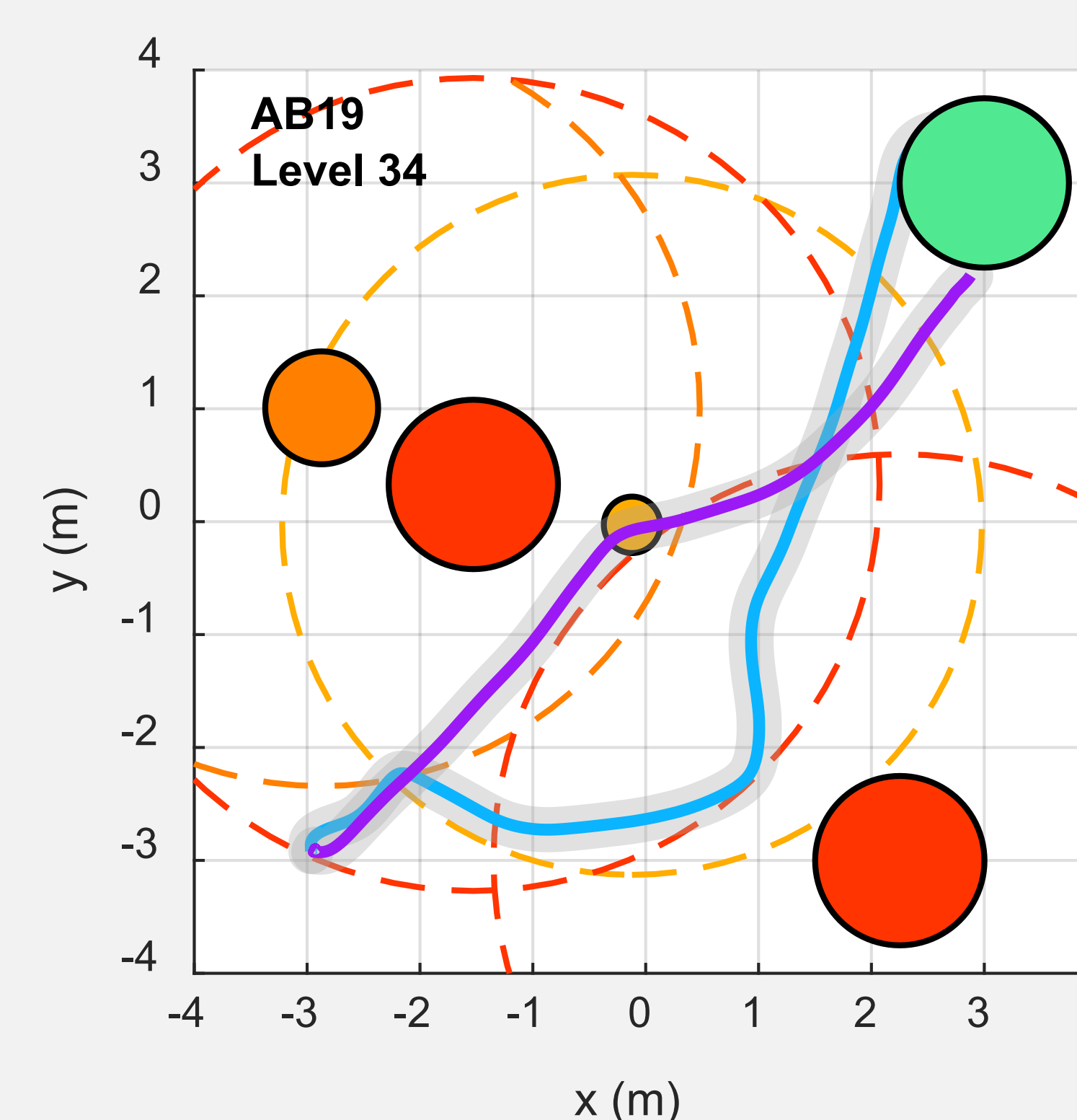
$$h_0 = 100$$
$$h_{i+1} = h_i - G \sum_{k=1}^{\# \text{obstacles}} d_k \frac{1}{r_k^2}$$

damage gain  
radius/danger level of obstacle  $k$   
distance to obstacle  $k$

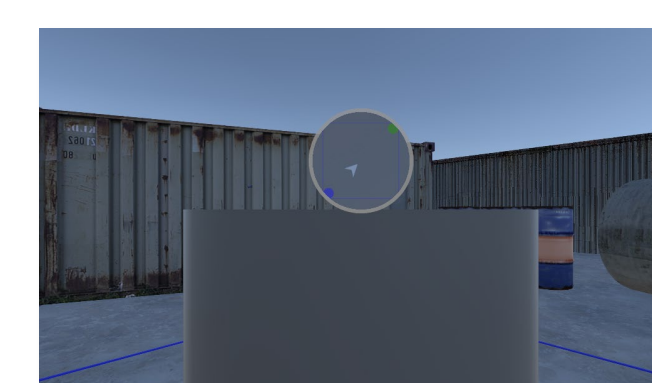
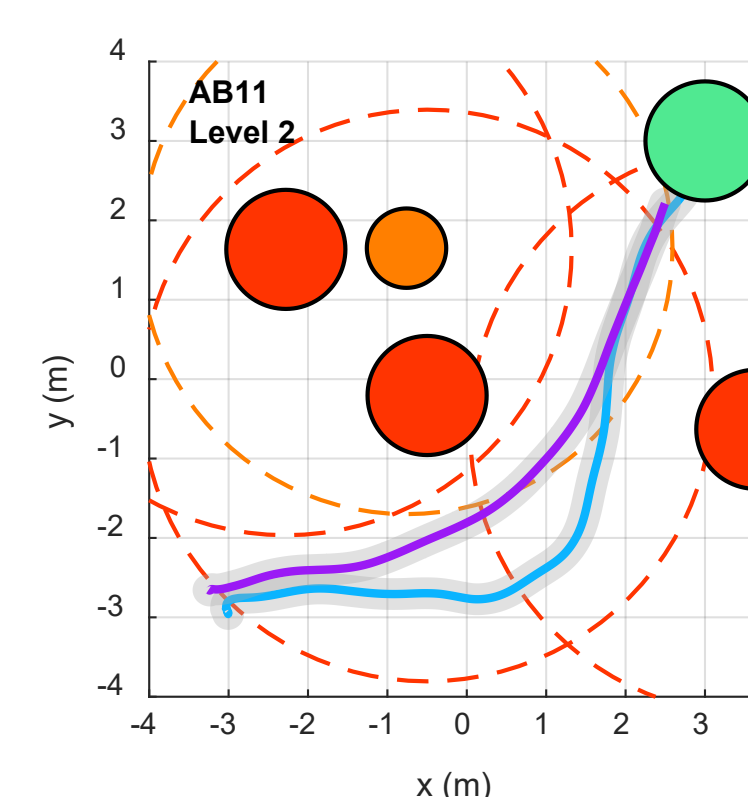
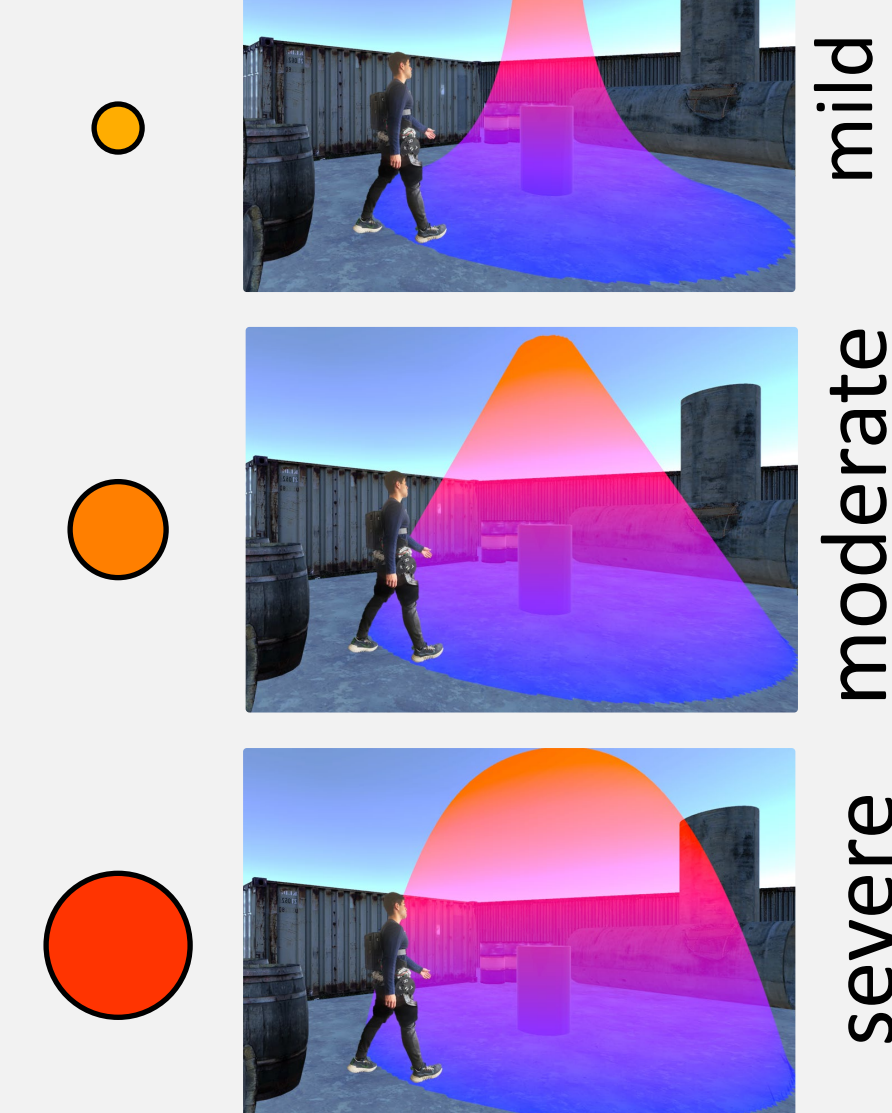


## Sample Trials

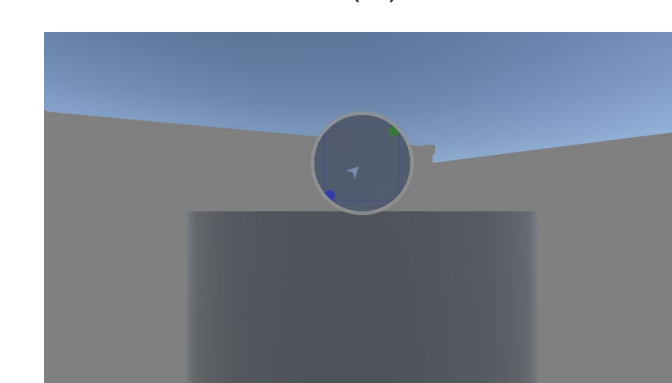
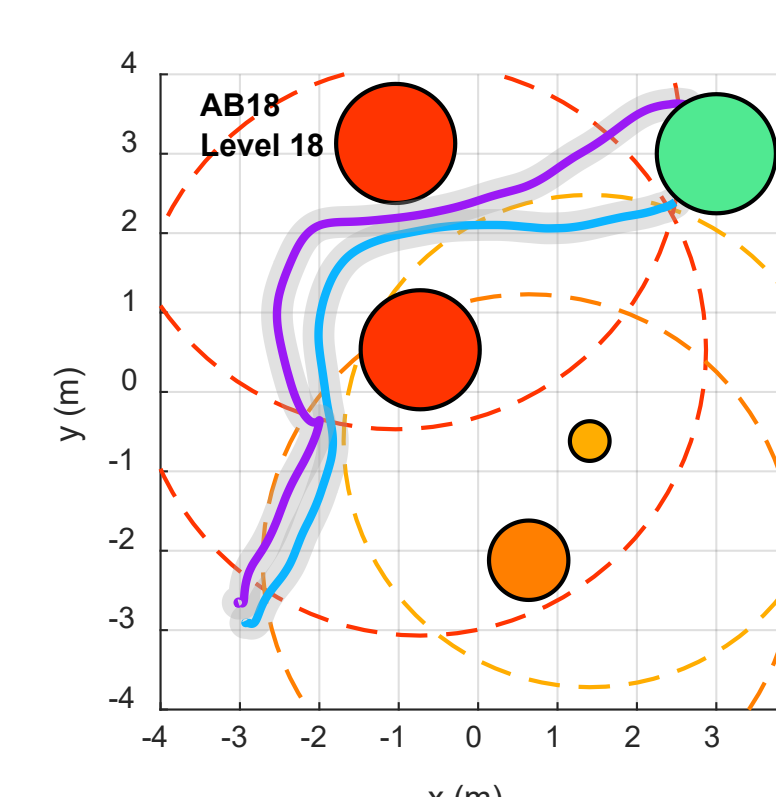
— exo on  
— exo off



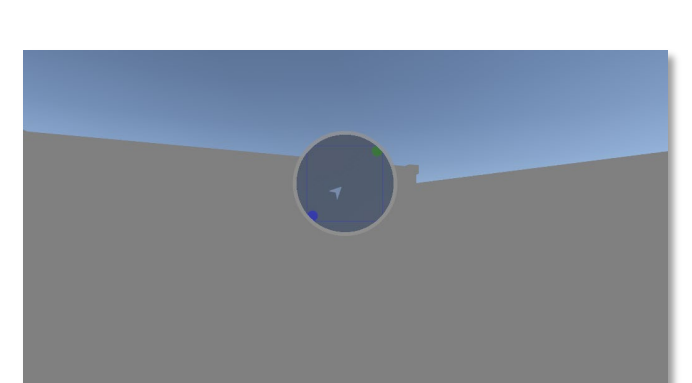
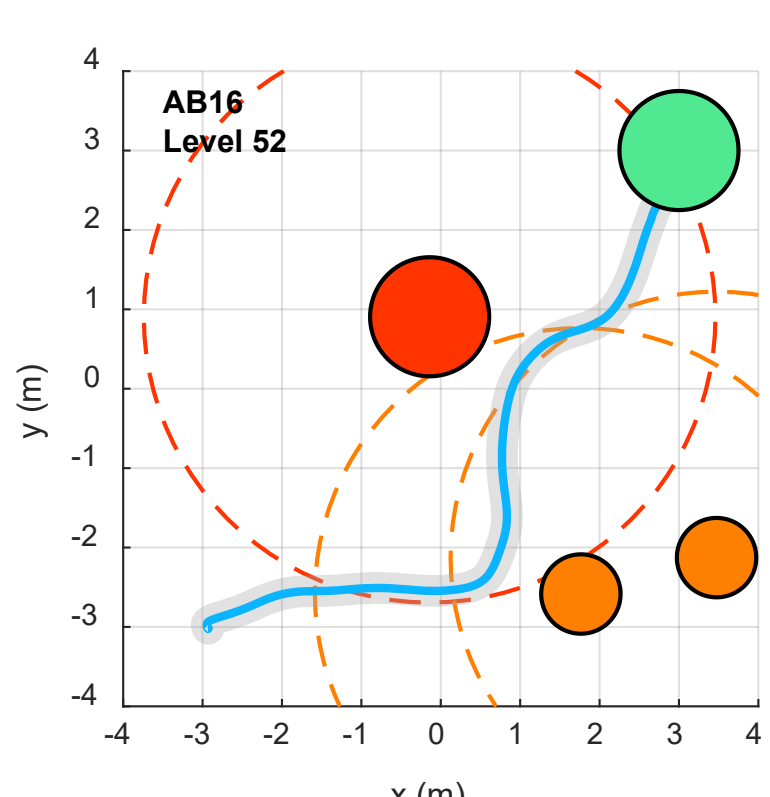
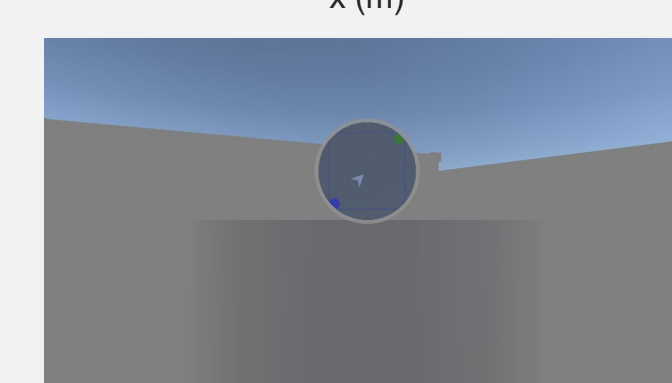
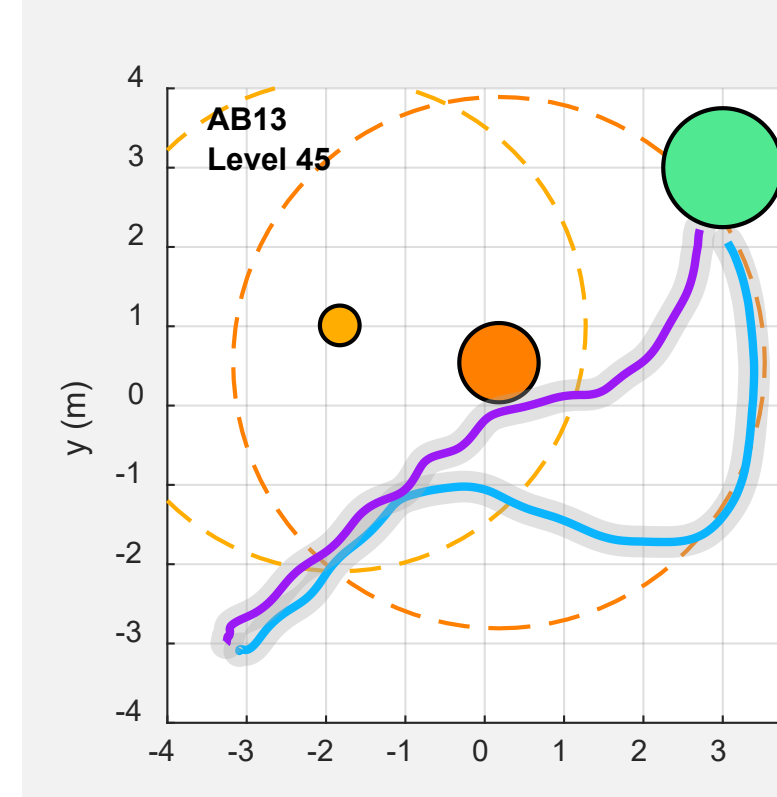
## Obstacle Danger Levels



Clear



Decreased Visibility



Blind

## 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.

