

# Natural scene statistics of figure-ground motion in MT receptive fields

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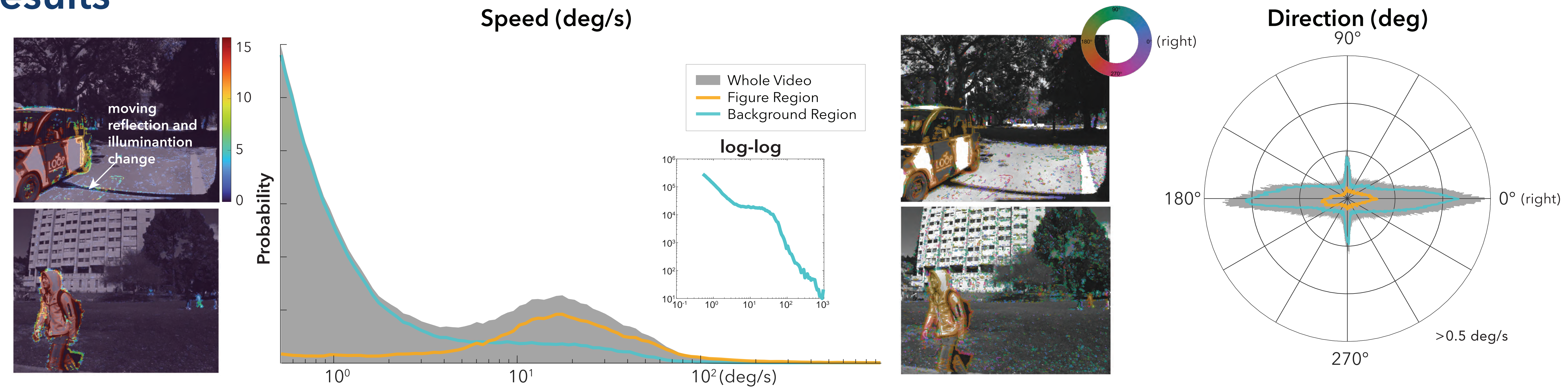
## Introduction

Differentiating figural content from its surroundings (figure-ground segregation) is a challenging task in natural environments. Motion has been found to be an important cue for grouping and object segmentation<sup>1,2</sup>. The middle temporal cortex (MT) in macaques plays an important role in motion and depth processing<sup>3,4</sup>. Recent work suggests that MT neurons are capable of representing multiple motion speeds<sup>5</sup> and sensitive to the spatial arrangement of visual stimuli<sup>6</sup>, and thus likely play a role in figure-ground segregation.

Question: Are there statistical regularities in the motion of natural scenes that MT neurons may exploit for figure-ground segregation?

To explore this, we calculated motion statistics (speed and orientation) in patches of natural videos simulating MT RFs.

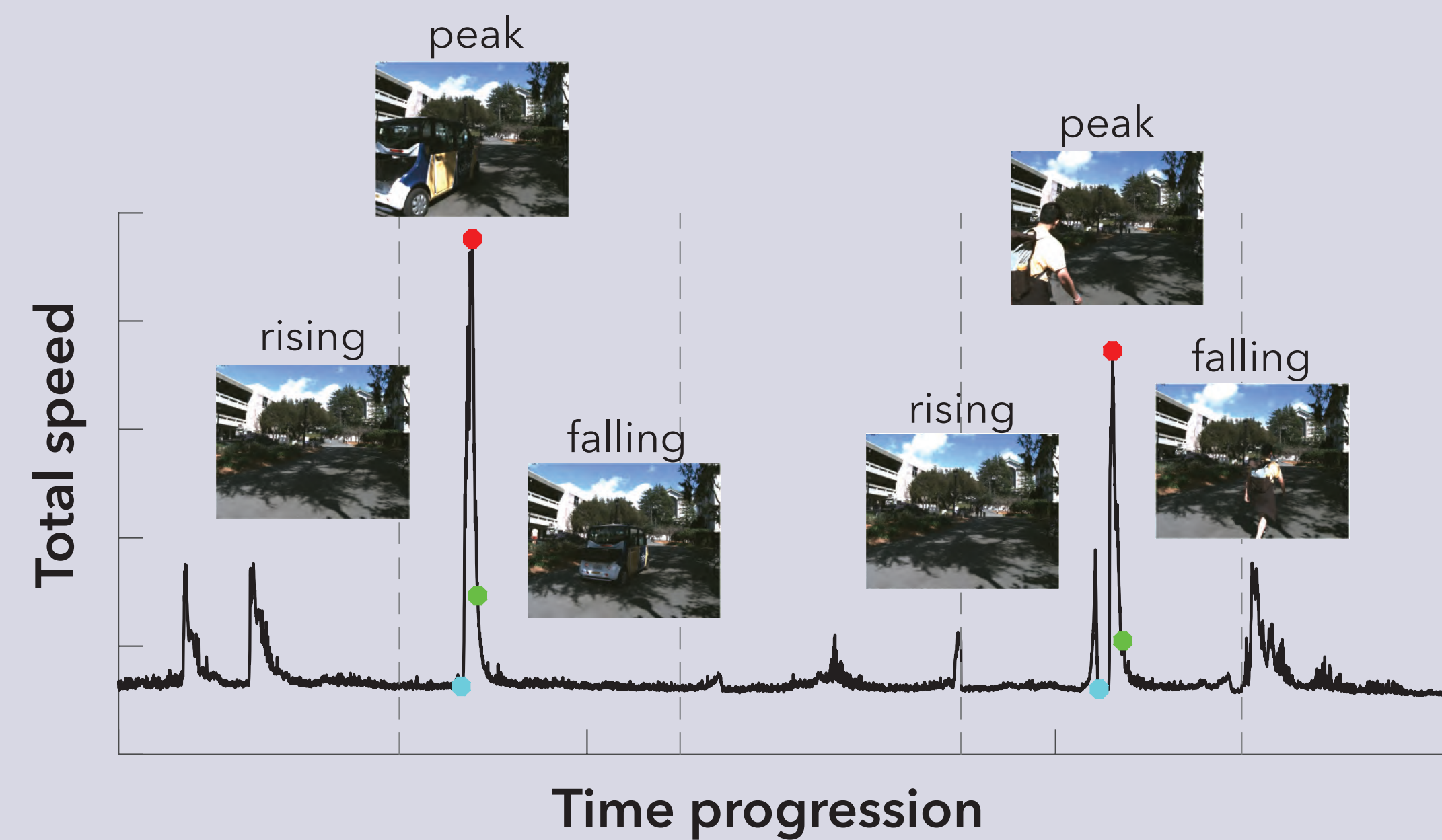
## Results



## Methods

**Dataset:** 11 scenes of UC Berkeley campus, stationary camera, 1280 x 1024px, 60Hz, uncompressed

**Motion estimation:** spatiotemporal derivative filter technique<sup>7</sup>

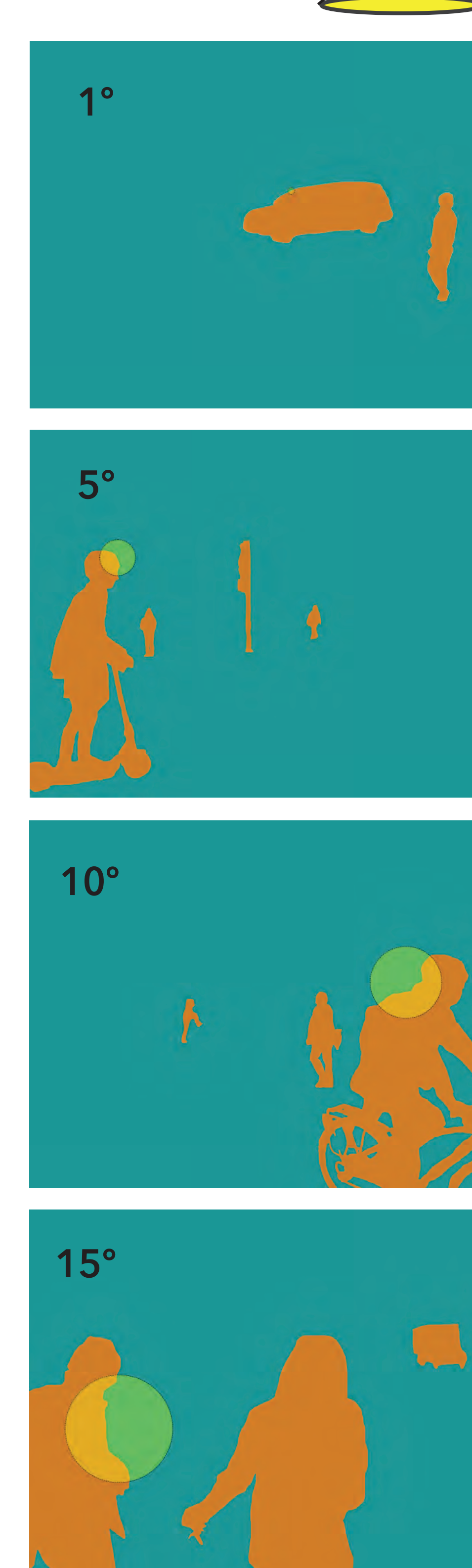


**Hand segmentation: figure ground**

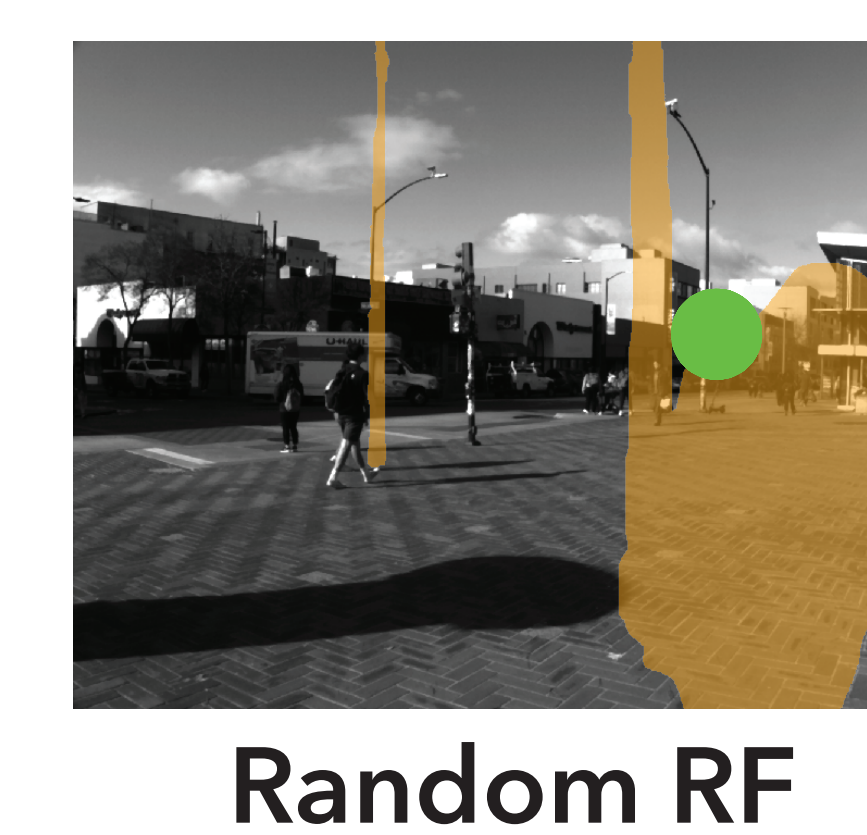
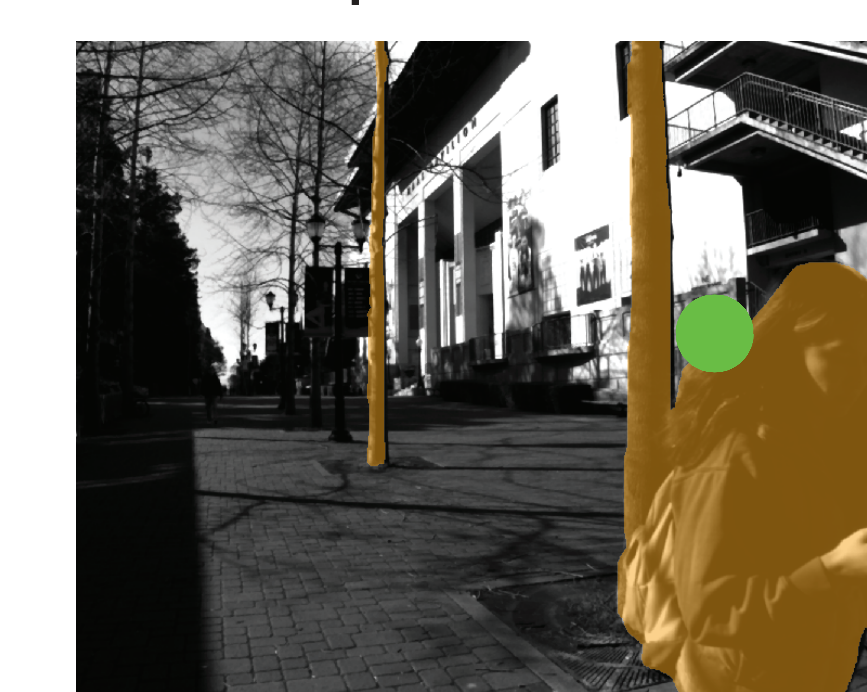


### MT receptive field (RF) simulation

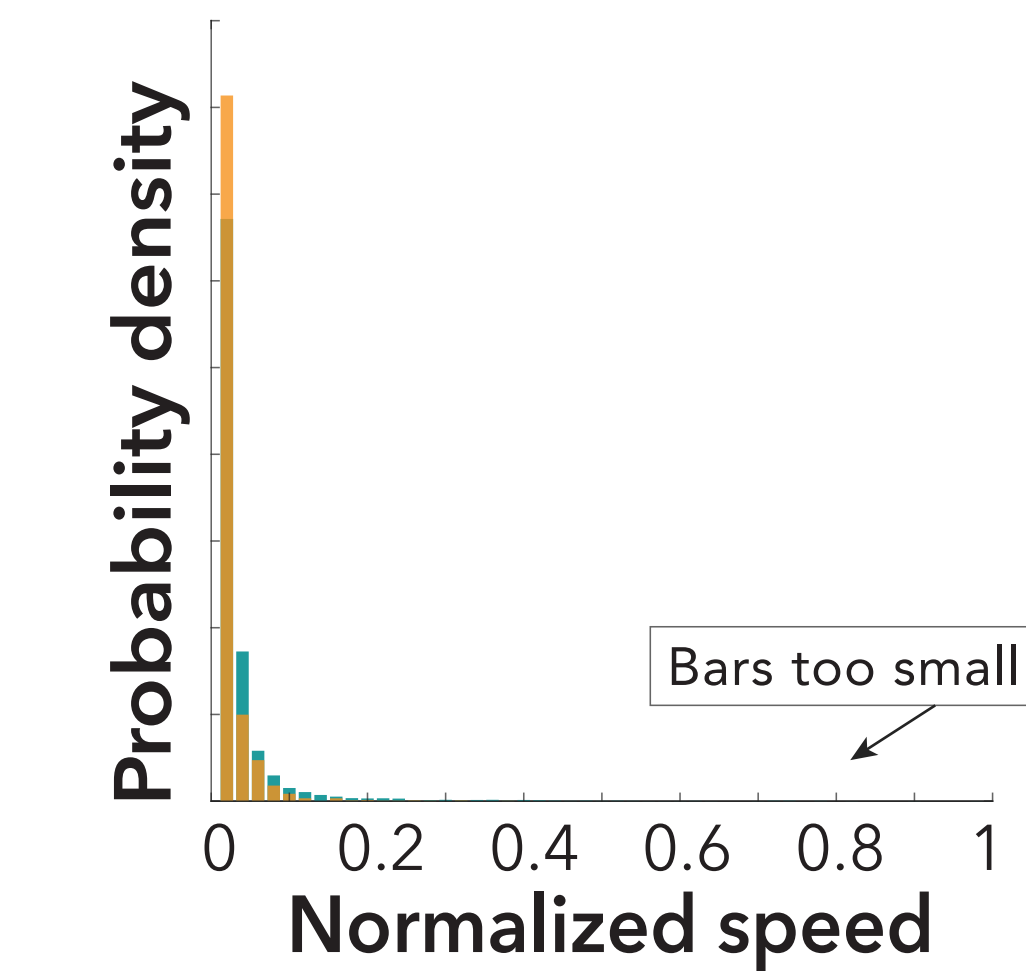
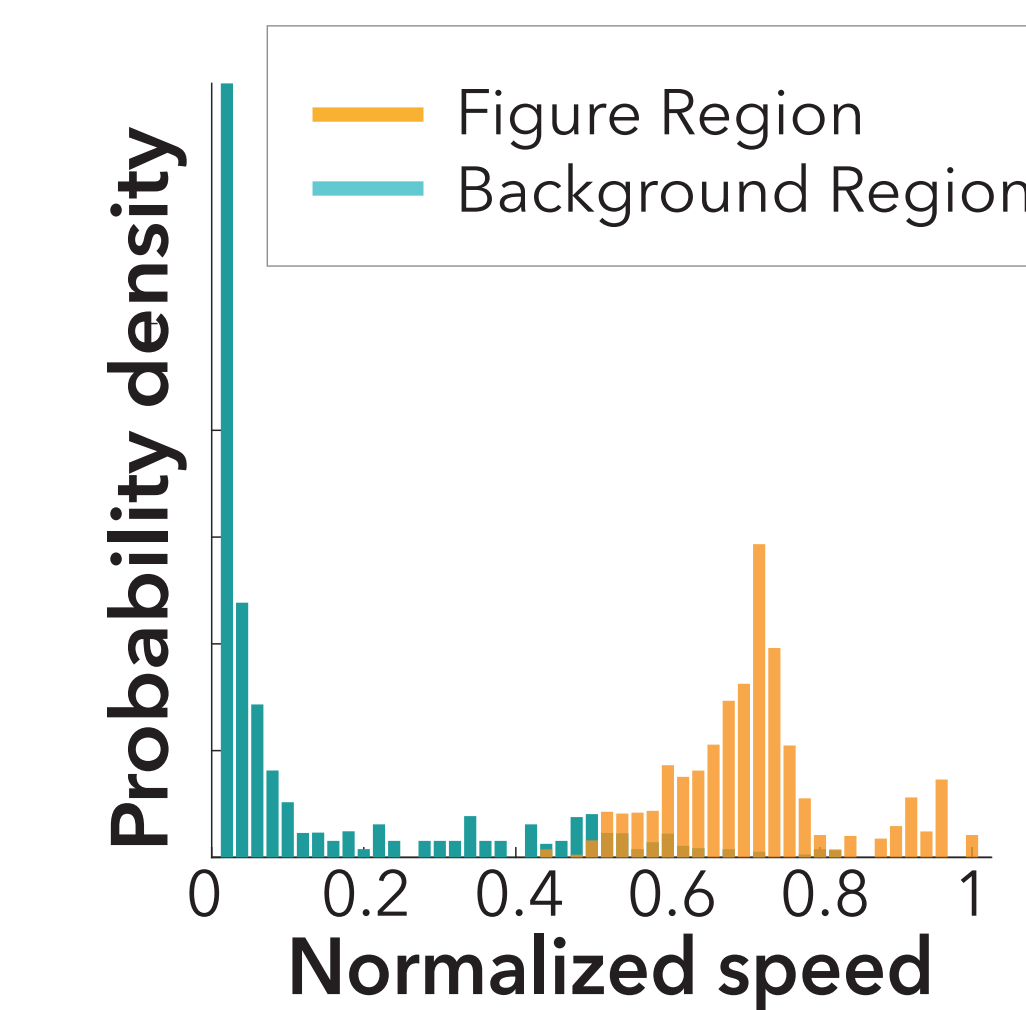
RF size



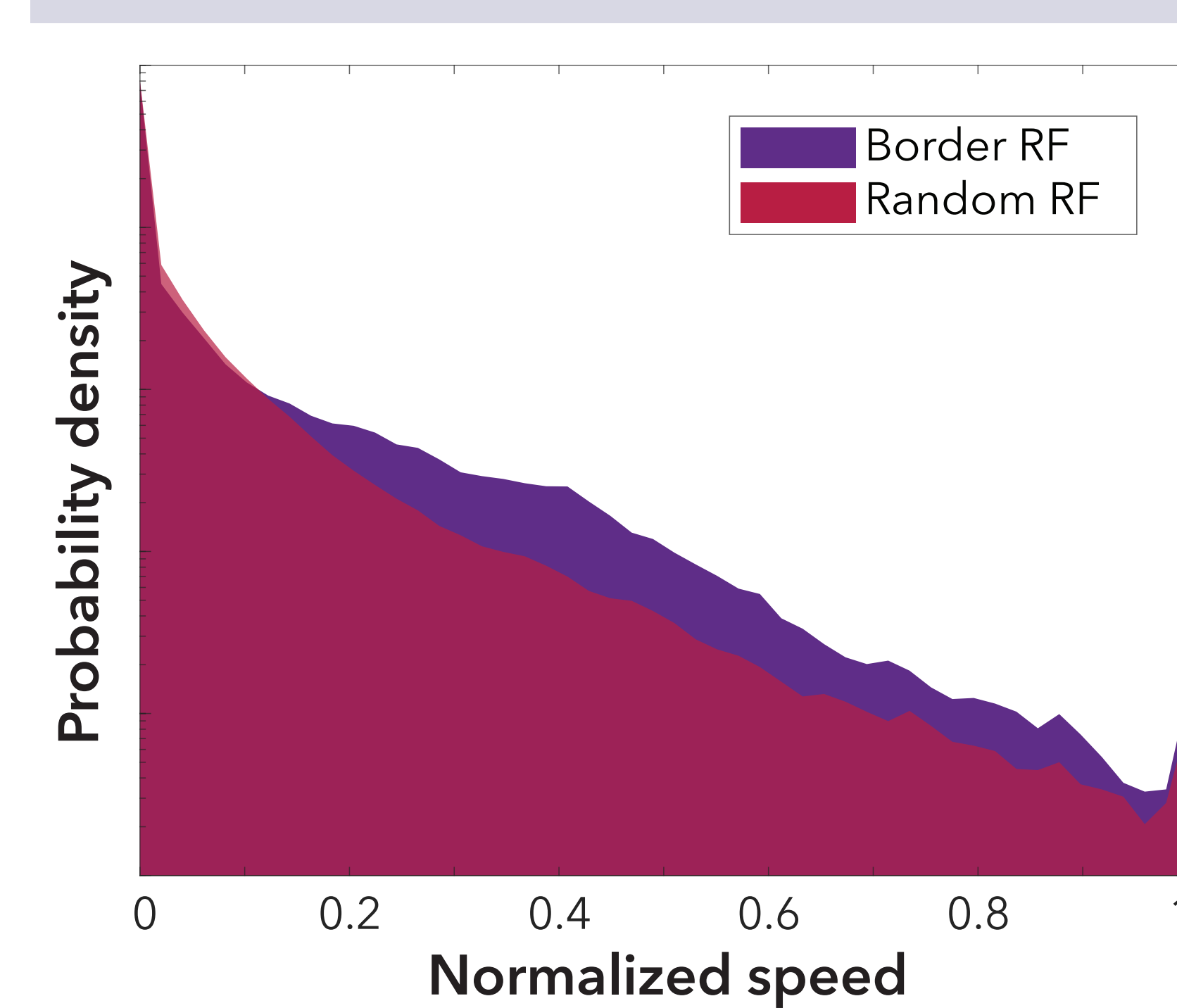
Example simulation



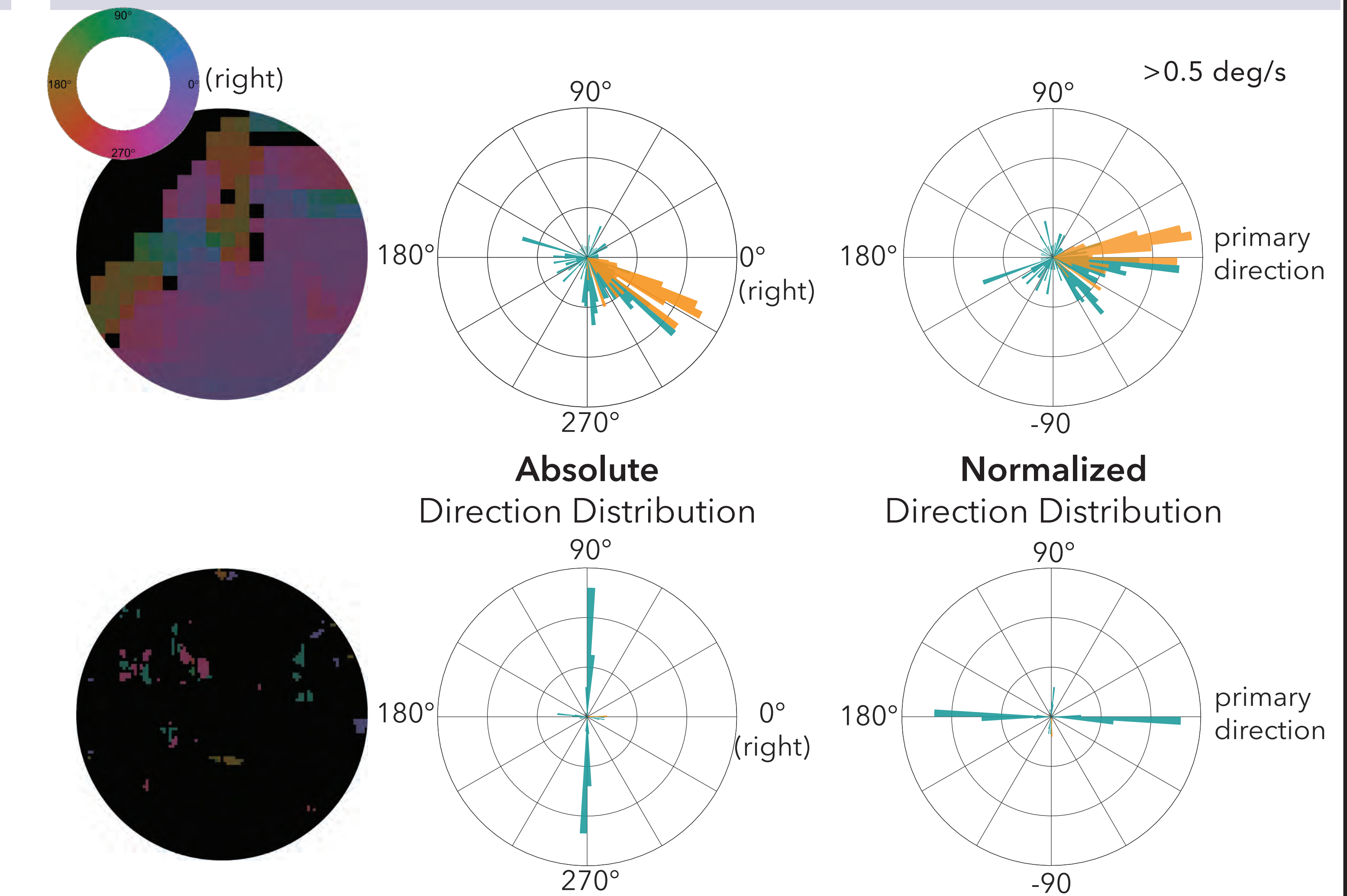
### Speed



### Full simulation



### Direction



## Conclusion

- Visual motion speed tends to be consistently higher in figural regions than background, while motion direction is similar between figure and ground with strong horizontal bias.
- Some evidence for different motion patterns between border RF and random RF, which MT neurons may utilize for figure-ground segregation
- Future analysis will look into the bimodality of speed distribution within MT receptive field and similar analysis in different environments.

## References

1. Bravo & Watamaniuk, Vision Research, 1995
2. Shioiri & Cavanagh, Vision Research, 1992
3. Dubner & Zeki, Brain Research, 1971
4. DeAngelis & Newsome, Journal of Neuroscience, 1999
5. Huang, Ghimire, Chakrala & Wiesner, bioRxiv 2023
6. Wiesner, Baumgart & Huang, Journal of Neuroscience, 2020
7. Farid & Simoncelli, IEEE Transactions on Image Processing, 2004

## Acknowledgements

NIH grant R01EY022443