Search patterns

Group 1

Introduction

This study:

Examine search behaviour when performing a visual search task in VR

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Research question

More specifically ⟶ Varying task difficulties

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Research questions:

- How will task-difficulty of the search task influence the search behaviour of individual participants in VR?
- What search techniques are used by different participants in a VR environment?

Research question

- Participant is placed in a room filled with the letter M
- Among those letters there is one letter W

- HMD: Egocentric view
- Track head movement
- Green sphere + Floating tile: Encourage head movement

M
M
M
M
W
M
M
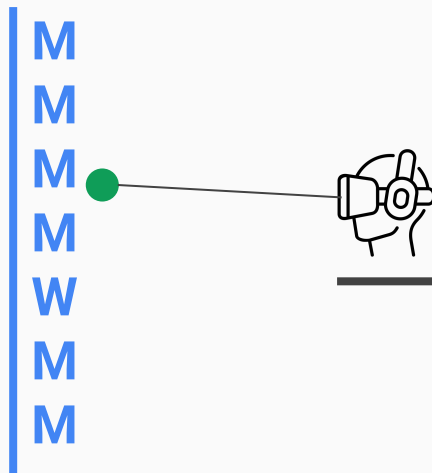
Related work

Kalff, C., Hills, T., & Wiener, J. M. (2010). **Human foraging behavior: A virtual reality investigation on area restricted search in humans.** In Proceedings of the annual meeting of the cognitive science society (Vol. 32, No. 32).

- Area-restricted search (ARS)
- Local and global search strategies
- Lacking: environment is different

Related work

Amor, T. A., Lukovic, M., Herrmann, H. J., & Andrade Jr, J. S. (2017). **How images determine our visual search strategy.** arXiv preprint arXiv:1709.00339.

- Finding the number 5 between 2's
- Degree of difficulty (more 2's)
- Lacking: investigates efficient search

Related work

Marek, N., & Pollmann, S. (2020). **Contextual-cueing beyond the initial field of view—A virtual reality experiment.** Brain Sciences, 10(7), 446.

- Search a T-shaped target among L-shaped distractors
- Contextual-cueing: learn spatial target configurations
- Lacking: faster search times & patterns in environment

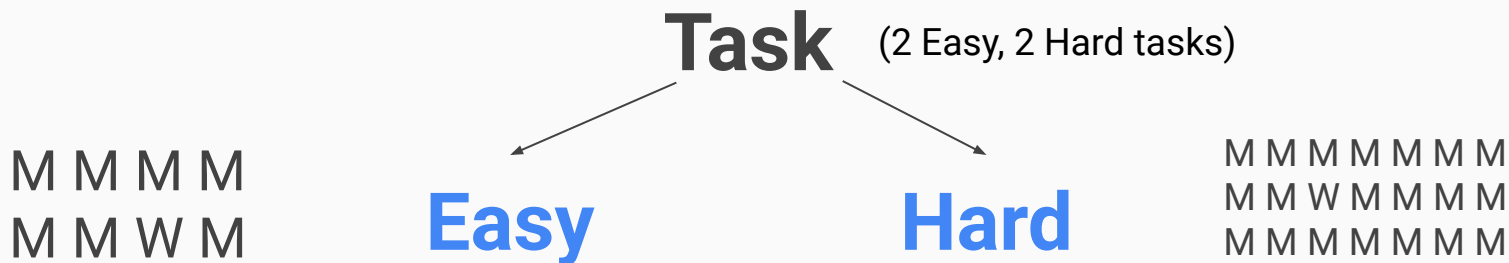# Experimental setup

General procedure:

1. Participant is seated on rotatable chair and HMD is fitted **[1 min]**
2. Explanation of the search task **[1 min]**
3. (Optional) Participant experiences demo scene **[3 min]**

4. Task 1 - Task 4 are performed **[8 min]**
5. Participant is asked if he/she applied any search strategies **[2 min]**

[Total time: 15 minutes]

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Task (2 Easy, 2 Hard tasks)

M M M M
M M W M

Easy

Hard

M M M M M M
M M W M M M
M M M M M M

Experimental setup

Nuisance factors: factors that may affect the experimental result but are not of primary interest.

→ **Our approach:** Nuisance factors we can control, control them. Those that we cannot control, randomize them

Experimental setup

A **controllable nuisance factor:**

- *Before executing the tasks, the participants that do not have much experience with virtual reality will first be placed in a demo scene*

Experimental setup

A **controllable nuisance factor:**

- *Before executing the tasks, the participants that do not have much experience with virtual reality will first be placed in a demo scene*

An **uncontrollable nuisance factors:**

- Participant performs 2 Easy tasks and 2 Hard tasks, but in what order?

↓

Nuisance factor: Learning capability

<u>Minimize impact:</u> Randomize order of tasks (for each person)

Experimental setup: Demo
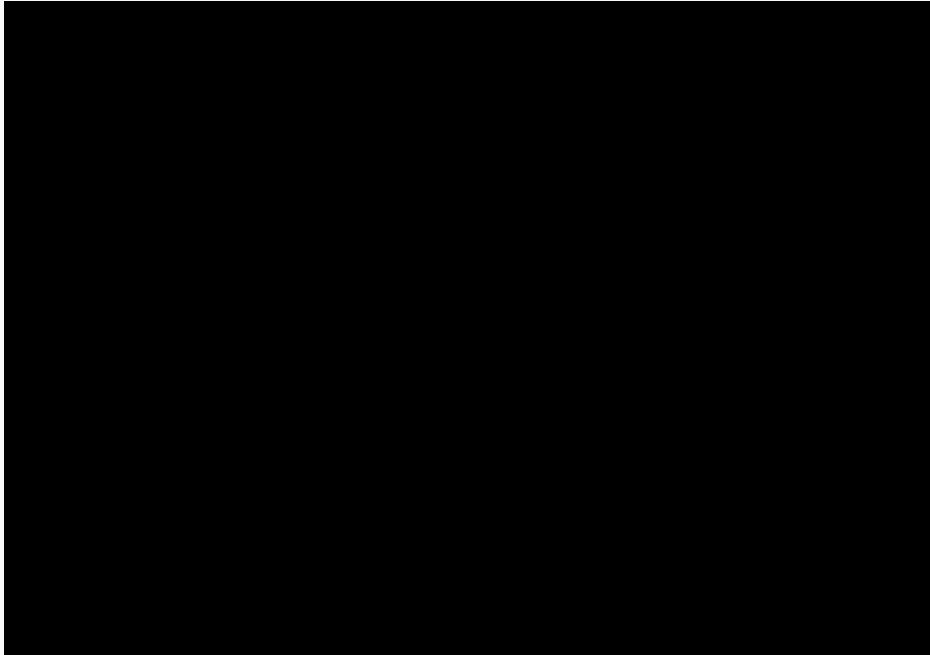
Implementation

Made in Unity:

- Randomized scene generation
- #tiles can be altered
- Left controller to start experiment
- Raycast from head to find the tile looked at
- Looked at tile logged to file 30x per second
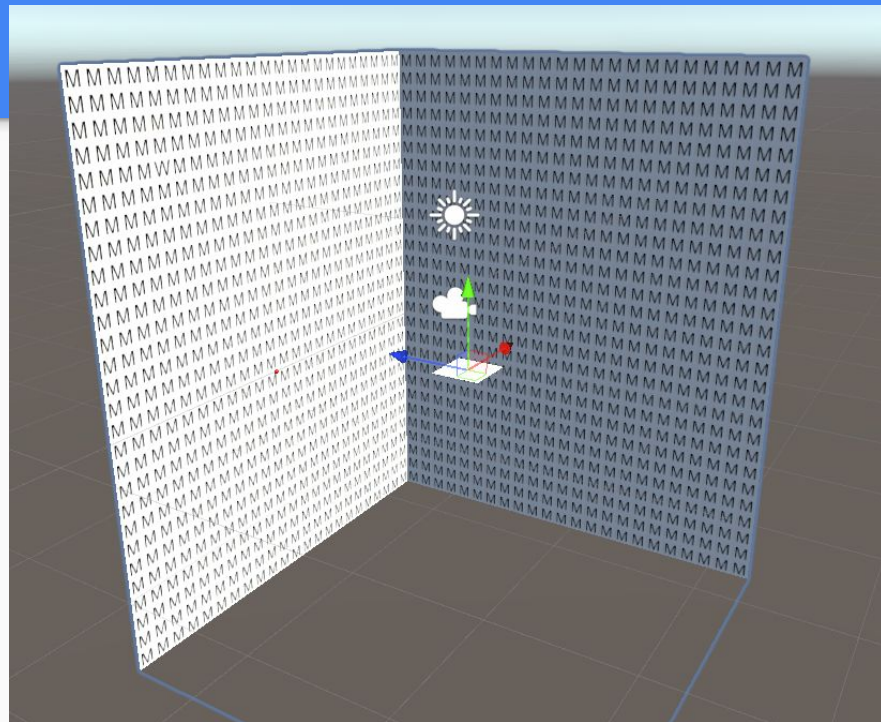
Results and analysis

- 2D plots of head movement
- 7 categories
- Scale 0 to 3
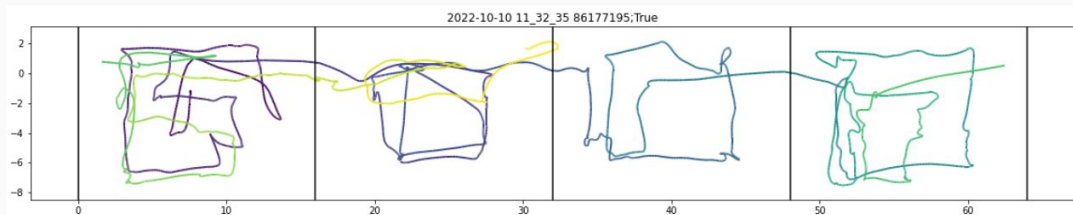- Averages in bar chart
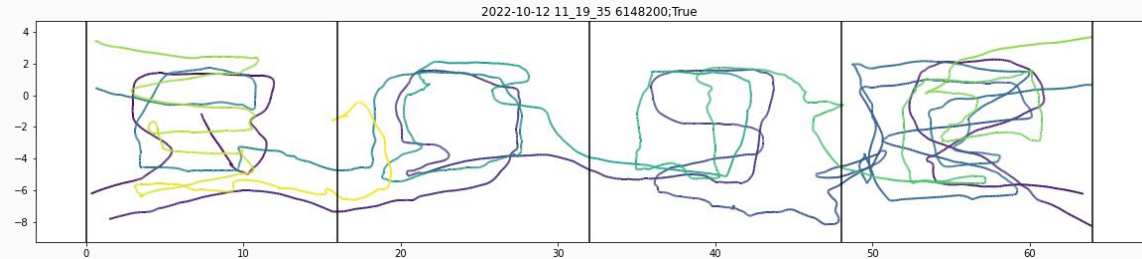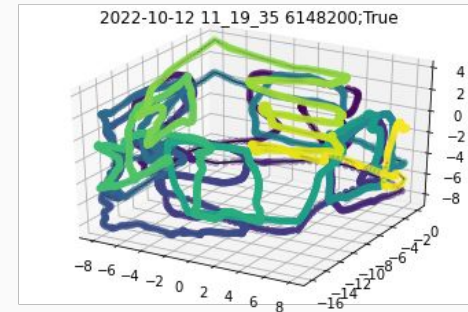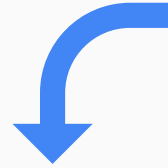
Results and analysis
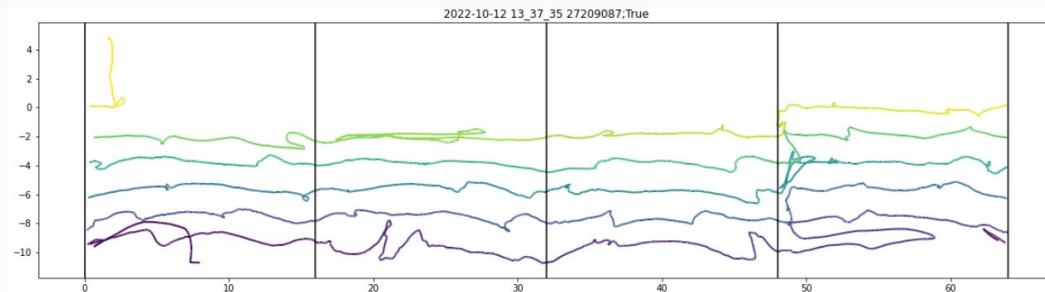## Pattern categories
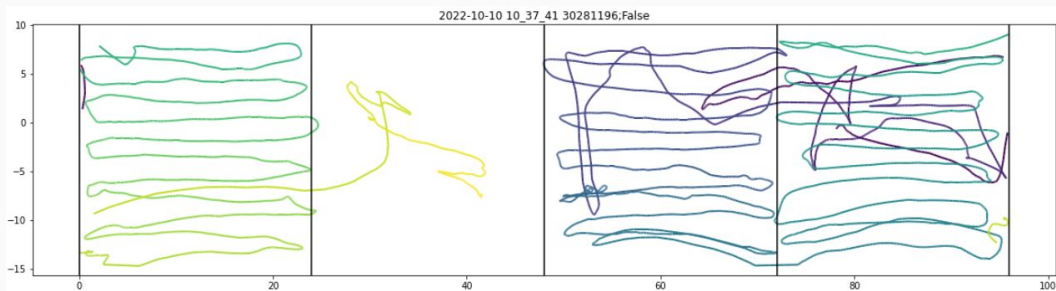
Horizontal

Vertical

Results and analysis
Pattern categories

2022-10-10 11_32_35 86177195;True
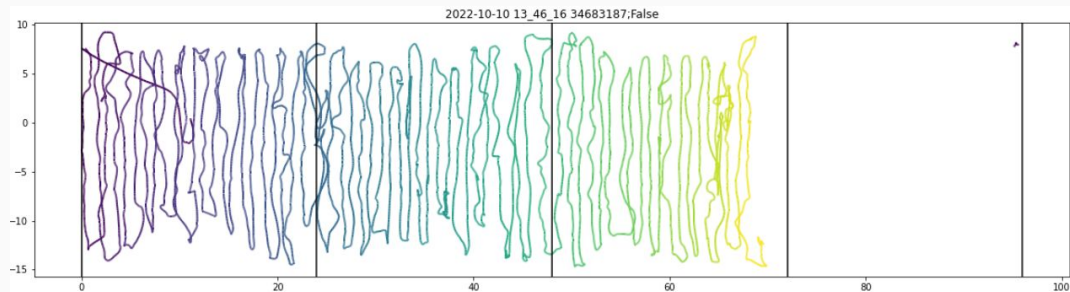
Circles 1 wall

Horizontal spiral

2022-10-12 13_37_35 27209087;True

Results and analysis
Pattern categories

2022-10-12 12_49_26 19710989;True

Global

2022-10-12 13_16_35 16096348;False

Chaos

Results and analysis
Pattern categories

2022-10-10 09_30_30 64257089;False
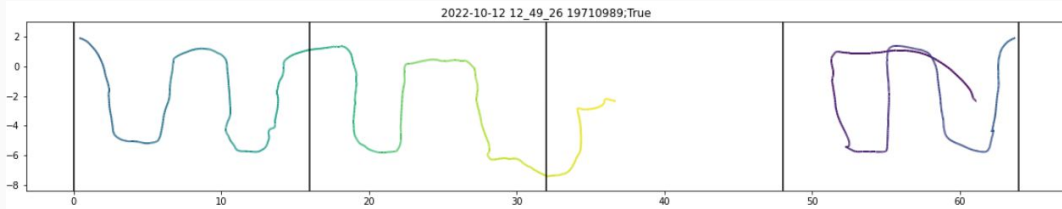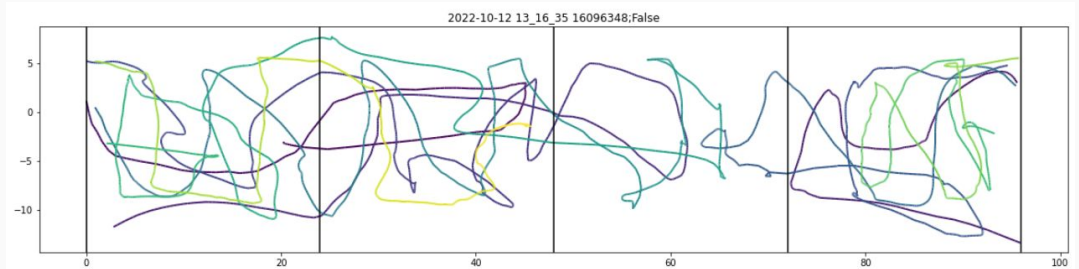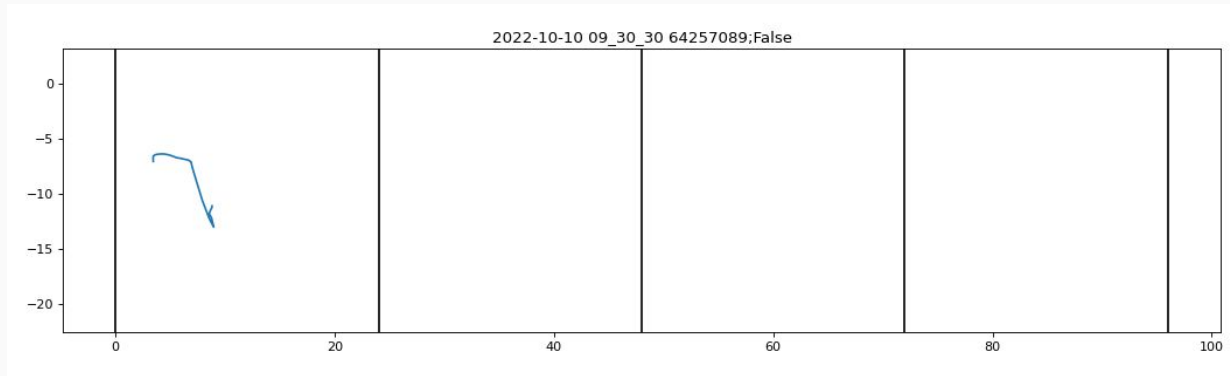
Lucky

Results and analysis
Average degrees

Average degrees for 7 patterns (scale 0 to 3)
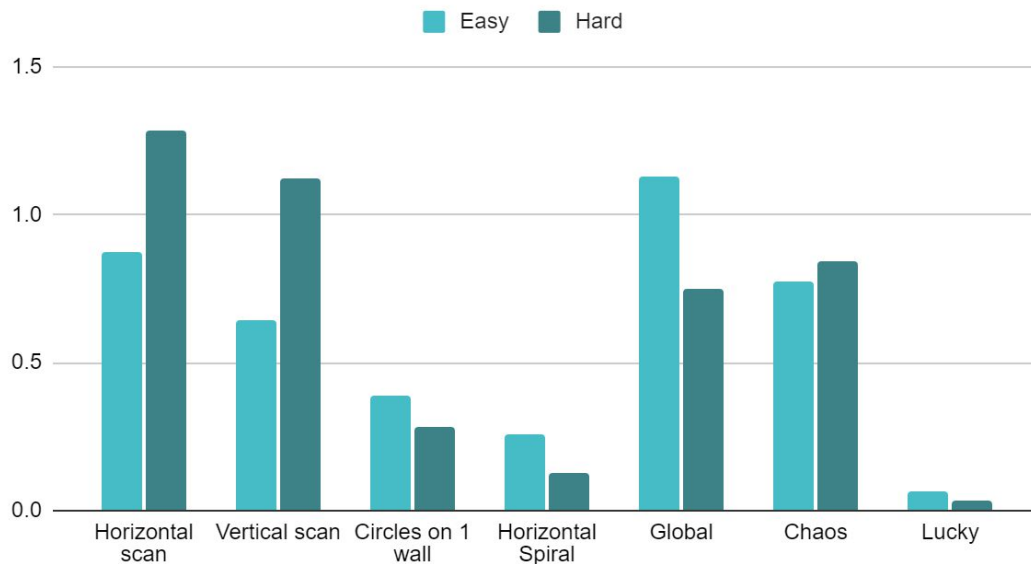
Results and analysis
Easy vs hard
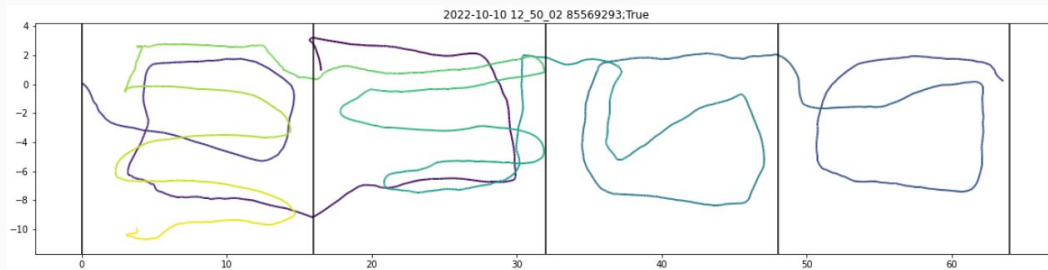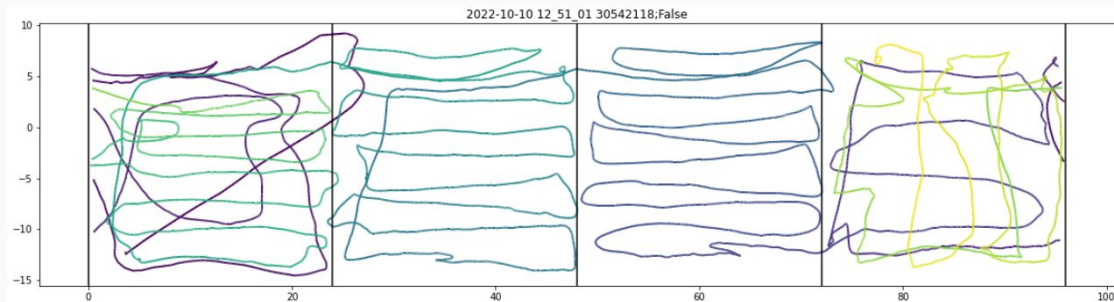
2022-10-10 12_50_02 85569293;True
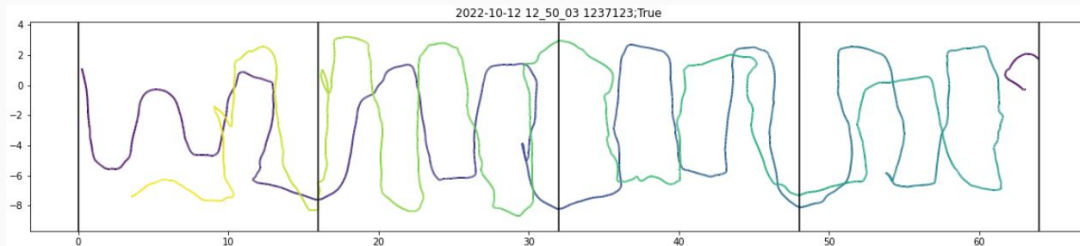
Easy

2022-10-10 12_51_01 30542118;False
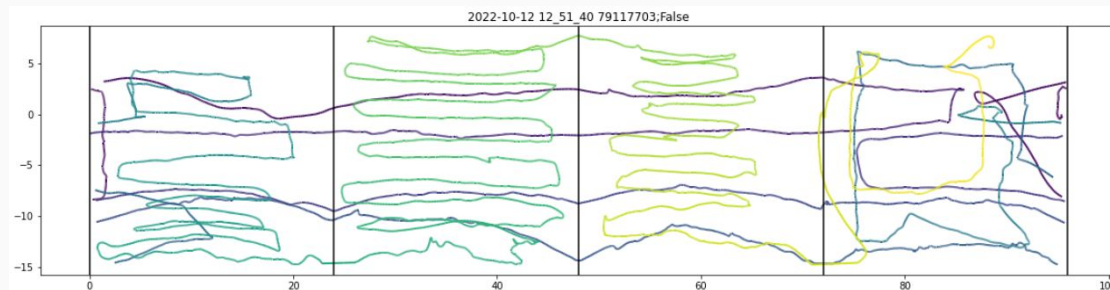
Hard

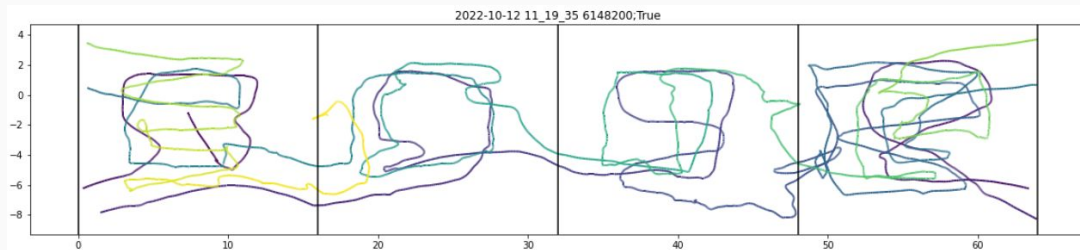# Results and analysis
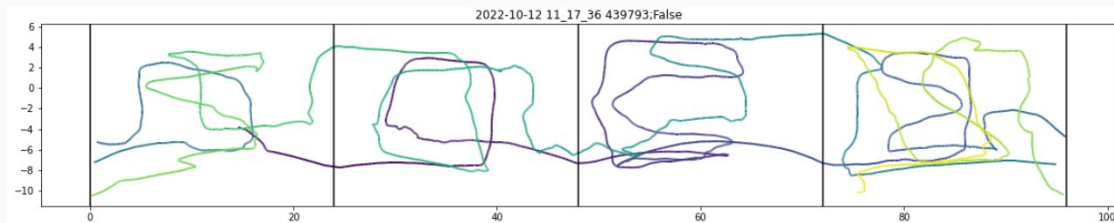## Easy vs hard

Easy

Hard

Results and analysis
Easy vs hard

Easy
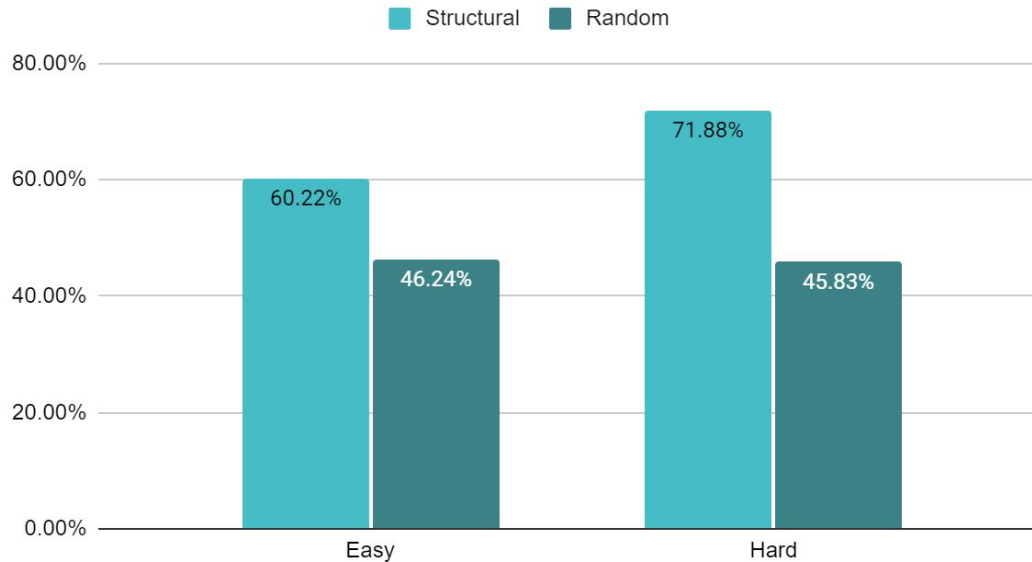

Hard

Results and analysis
Structural vs random

- Structural: horizontal, vertical, circles on 1 wall & spiral
- Random: global and chaos
- Percentage of cases
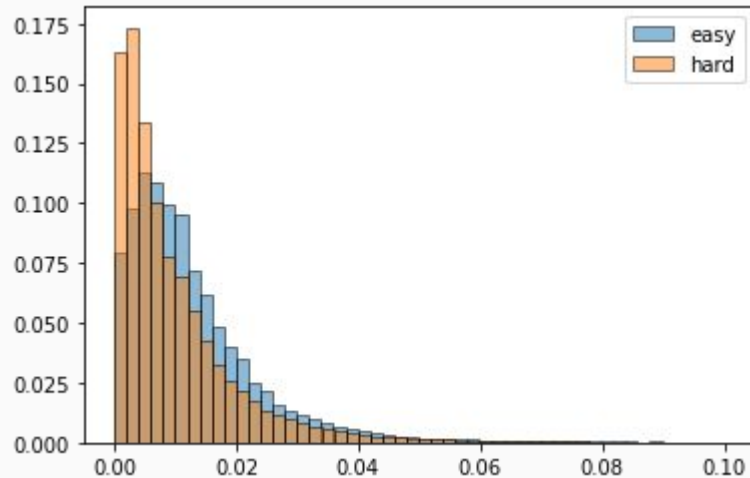
Results and analysis
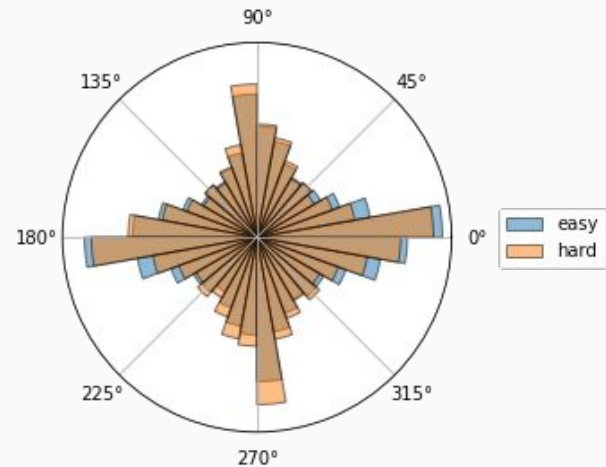## Structural vs random

Structural vs Random Search

■ Structural ■ Random

Easy: Structural 60.22%, Random 46.24%
Hard: Structural 71.88%, Random 45.83%

Results and analysis
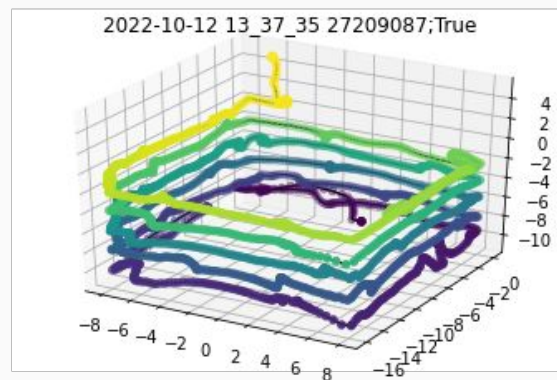## Structural vs random

Speed distribution

Heading distribution

Discussion

- predefined locations of targets
- different scene structure
- different grids
- head-tracking vs eye-tracking
- egocentric vs exocentric

2022-10-12 13_37_35 27209087;True

Conclusion

Search patterns in dense scenes

- More structural by human observation
- Lower speed by metrics

Structural vs Random Search