Evaluating Haptics for Information Discovery While Walking

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Overview

- Motivation
- Background → Our approach
- Prototype system
- Experiment → Results
- Conclusions

Motivation

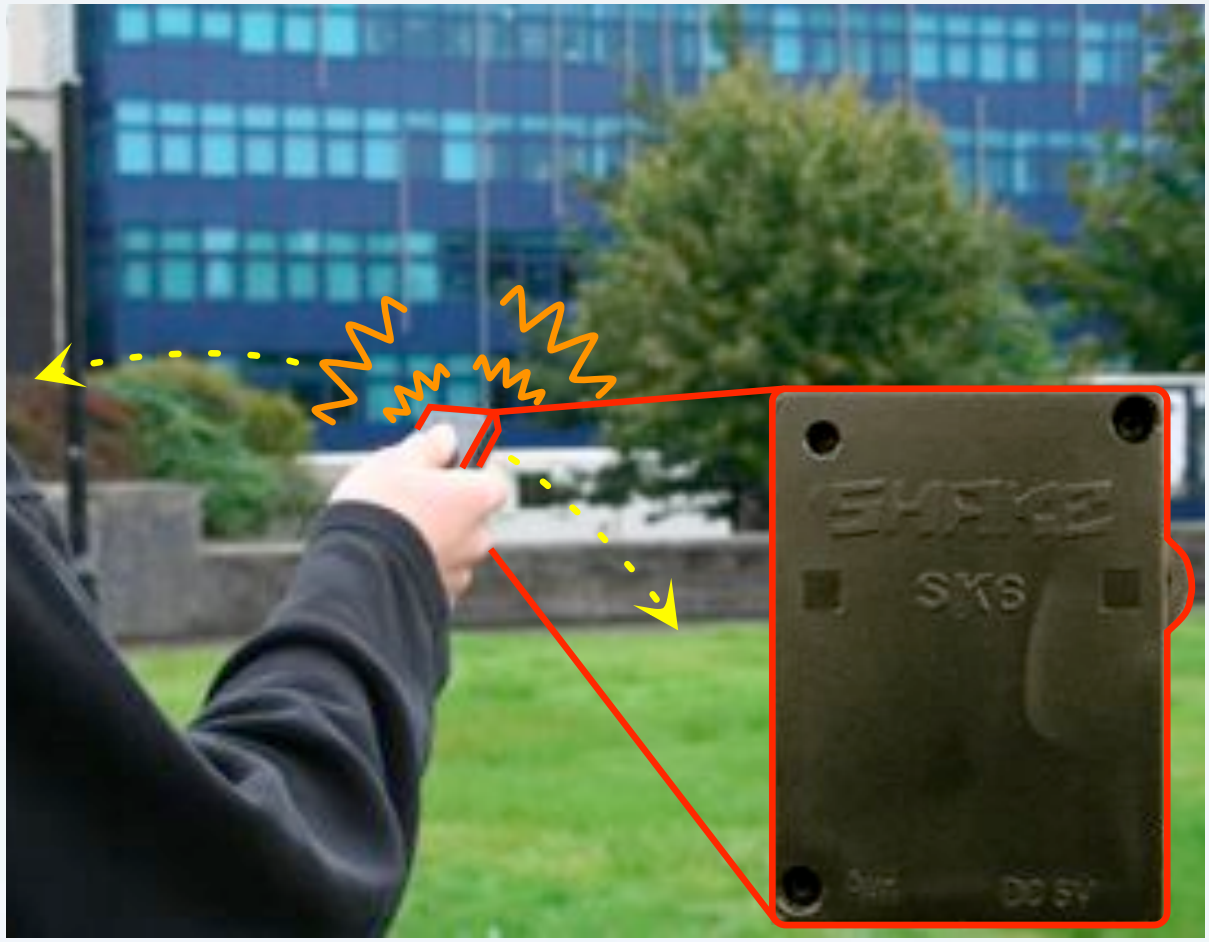
- Finding geo-tagged information about the places around you
- Engaging: remove the need to divide attention
- No reliance on screen for initial discovery
- Don’t need to stop: browse while moving

Background

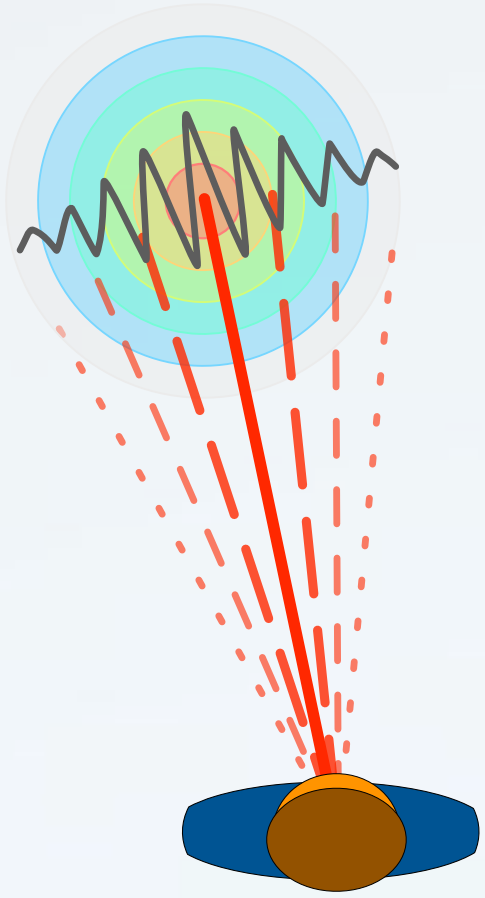
- Spatial Information Appliances (Egenhofer [2])
- Point to Discover (Fröhlich *et al.* [3], Simon *et al.* [15])
- Bearing-based selection (Strachan *et al.* [16, 17])
- AudioGPS (Holland *et al.* [5])
- Using while moving (Mustonen *et al.* [9], Oulasvirta *et al.* [10])

Our approach

- Move device to explore environment
- Hardware
  - SHAKE sensor pack
  - UMPC



Haptic prototype



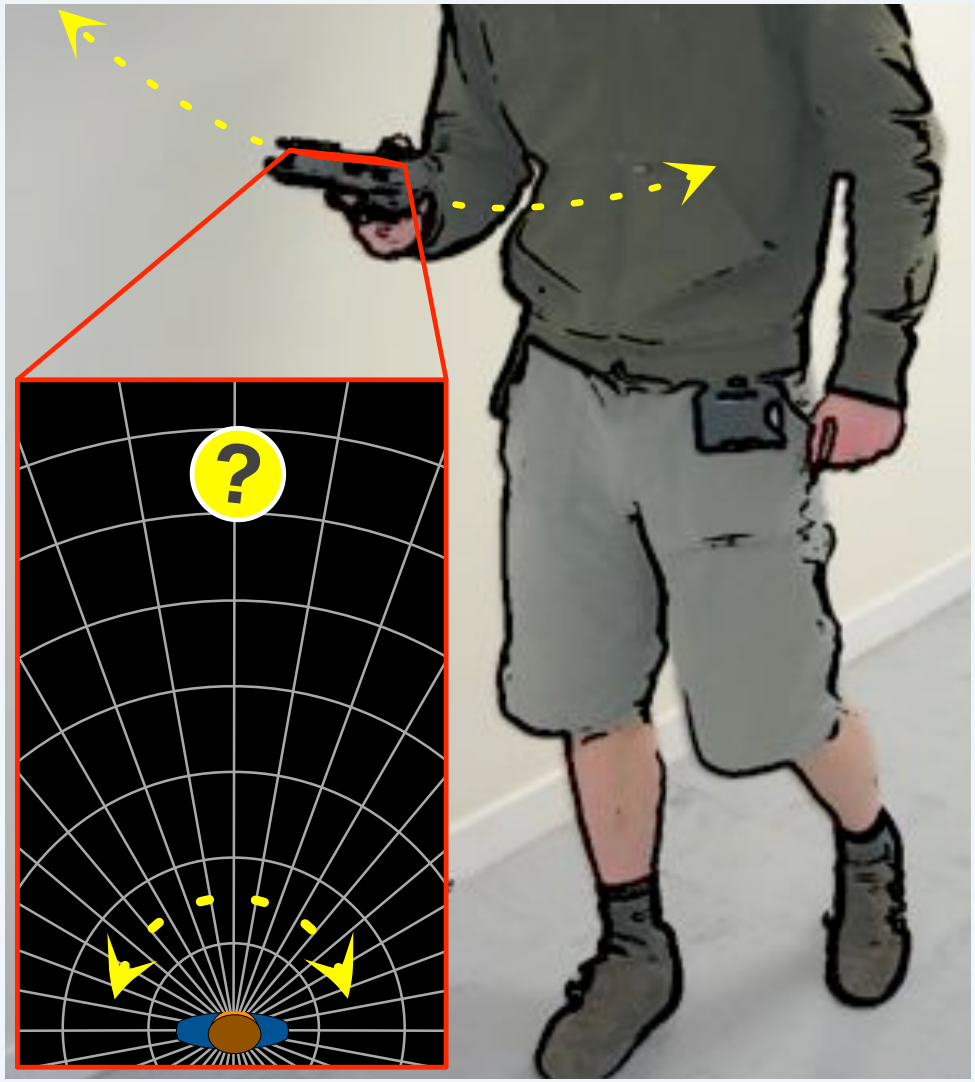
- Directional haptic feedback, button press to select
- Heads-up

Proposed benefits

- Allow seeking of digital resources without a screen
- Encourage interaction with the surroundings rather than the device
- Allow interaction while moving: no need to stop to discover interesting places

Experiment: Visual comparison system

- Visual analog of haptic prototype
- Turning the device rotates screen
- Target highlighted when selectable
- Heads-down

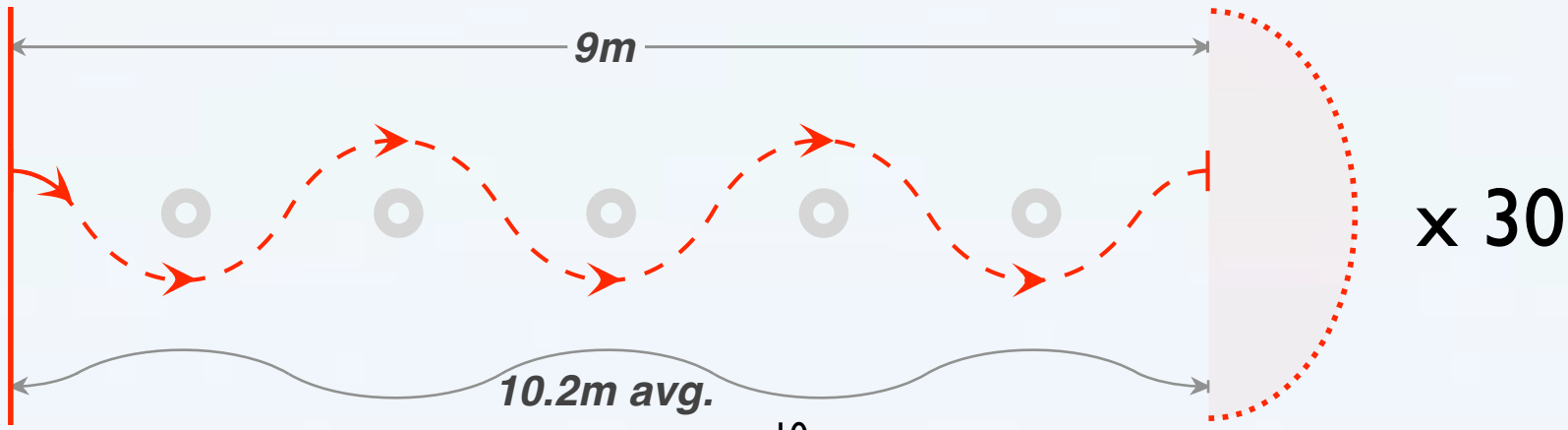


Experiment: Method

- Focus on discovery and selection: simulated targets
  - Scan device to discover
  - Press button to select
- Interested in usage while walking
  - Affect on walking speed (PPWS)
  - Time taken; false positives

Experiment: Method

- Method: comparing haptic to visual
  - 20 participants, 10 per system
  - Walk 30 lengths of circuit
  - Each time, find and select one target
  - 30 different targets, always in front of user

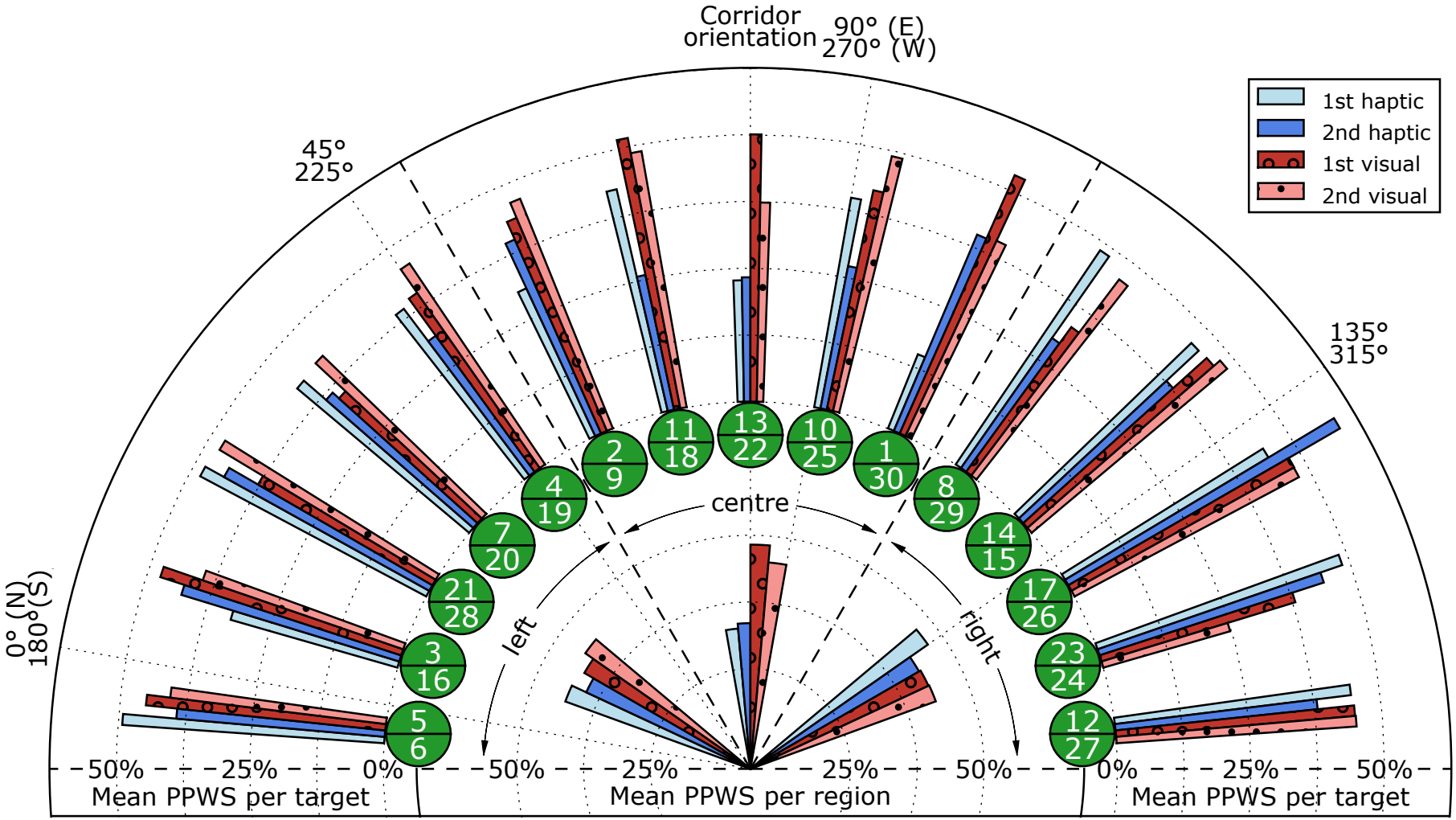


Results:

- 100% of targets found on each system

Measurement	Haptic	Visual
Time taken (seconds per target)	6.7 (sd: 4.8)	7.2 (sd: 4.5)
PPWS (% of original speed)	37.7 (sd: 19.6)	43.6 (sd: 18.1)
False positives (per target)	0.5 (sd: 1.2)	1.2 (sd: 1.7)
Distance walked (metres per target)	3.5 (sd: 2.5)	4.3 (sd: 2.8)

Target analysis



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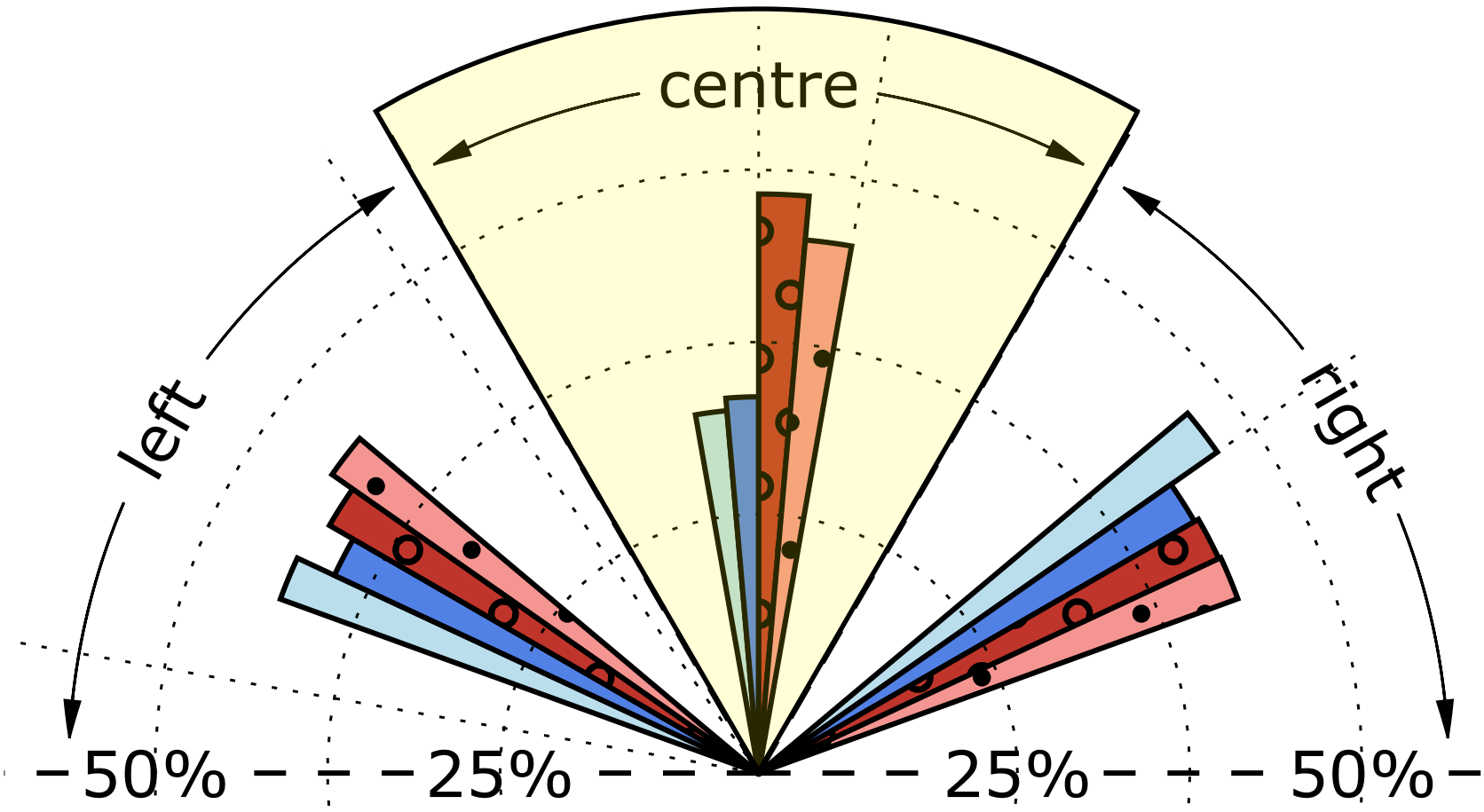
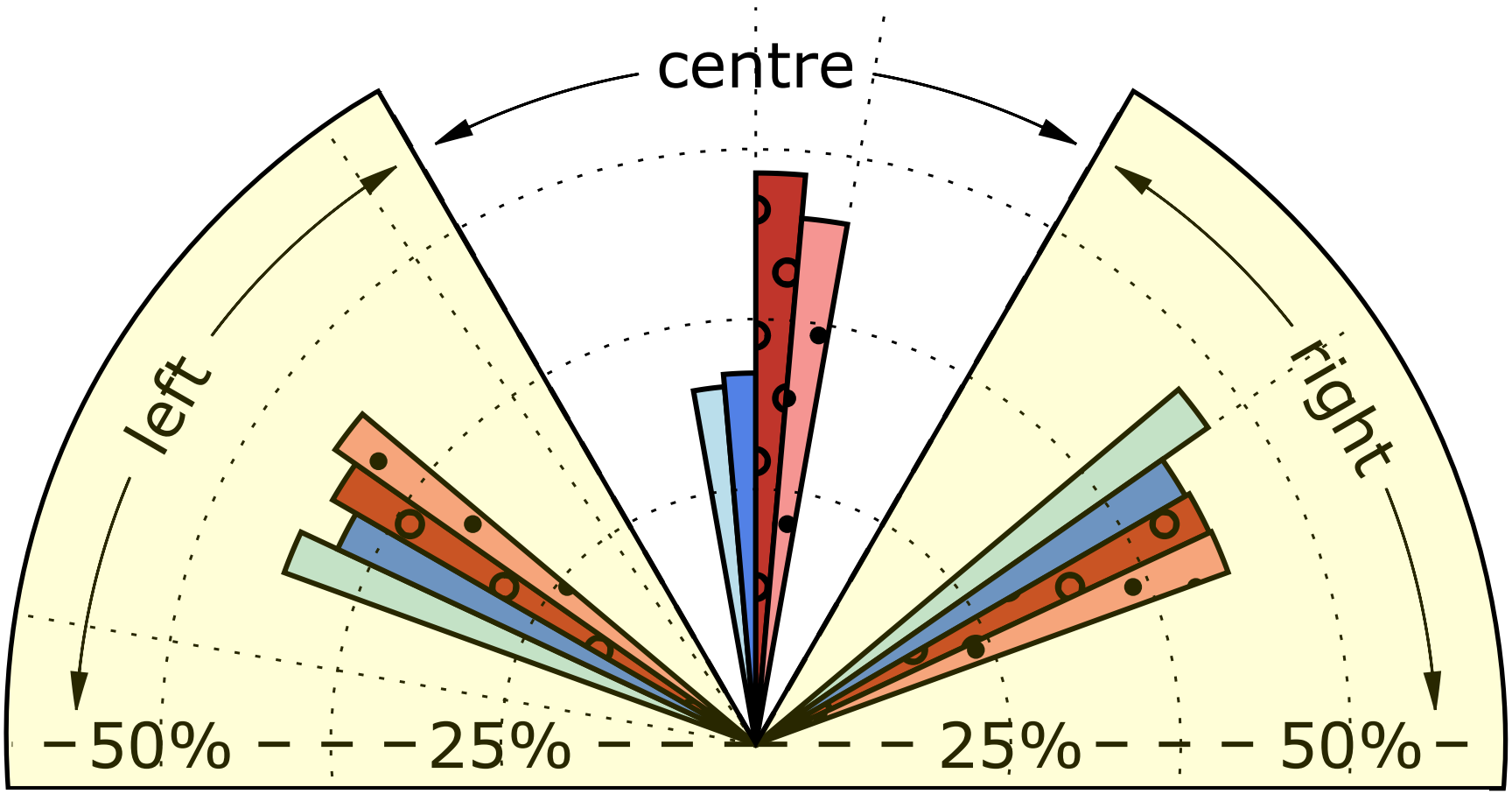


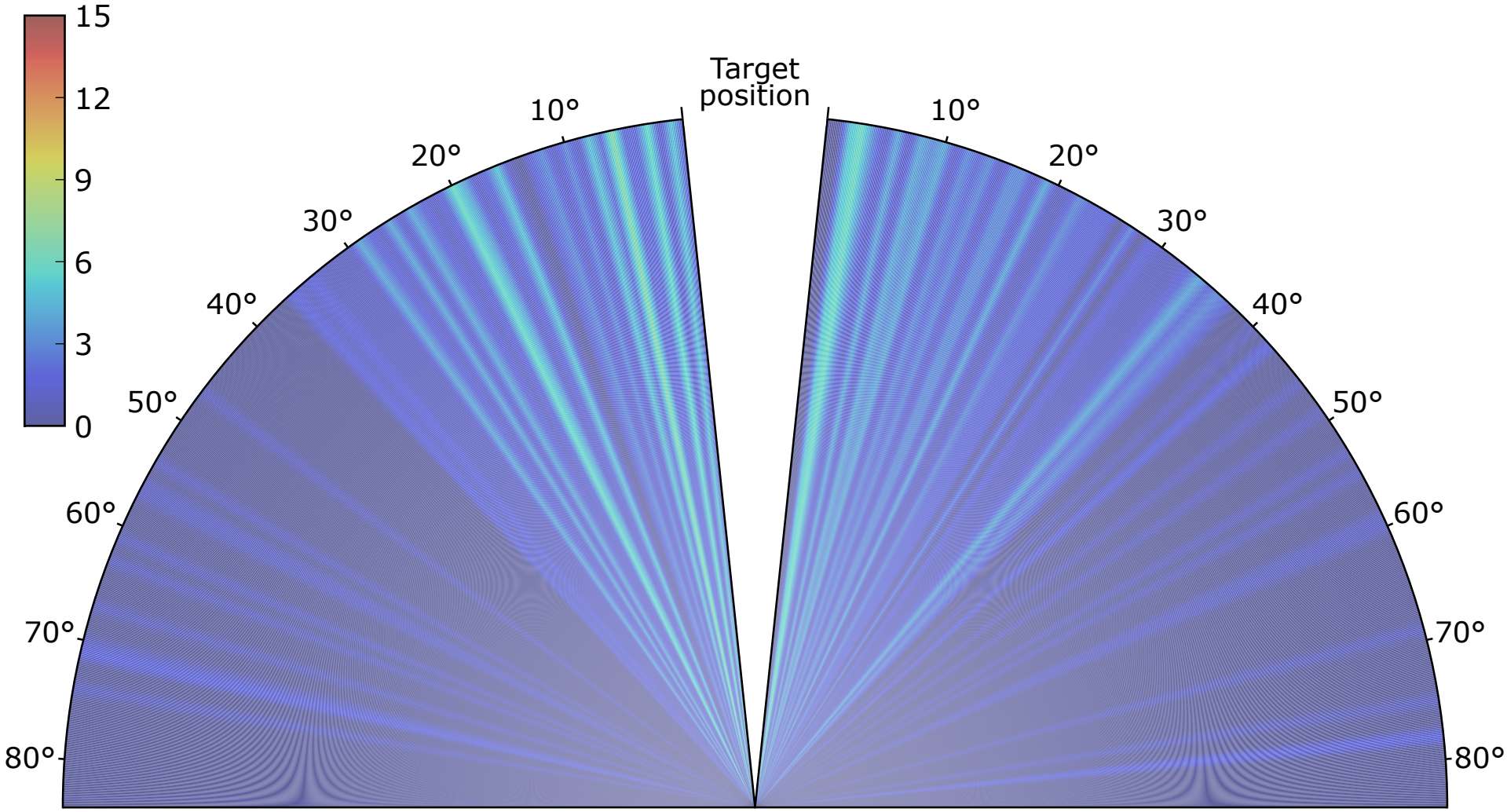
- Centre: visual maintains higher PPWS

Target analysis



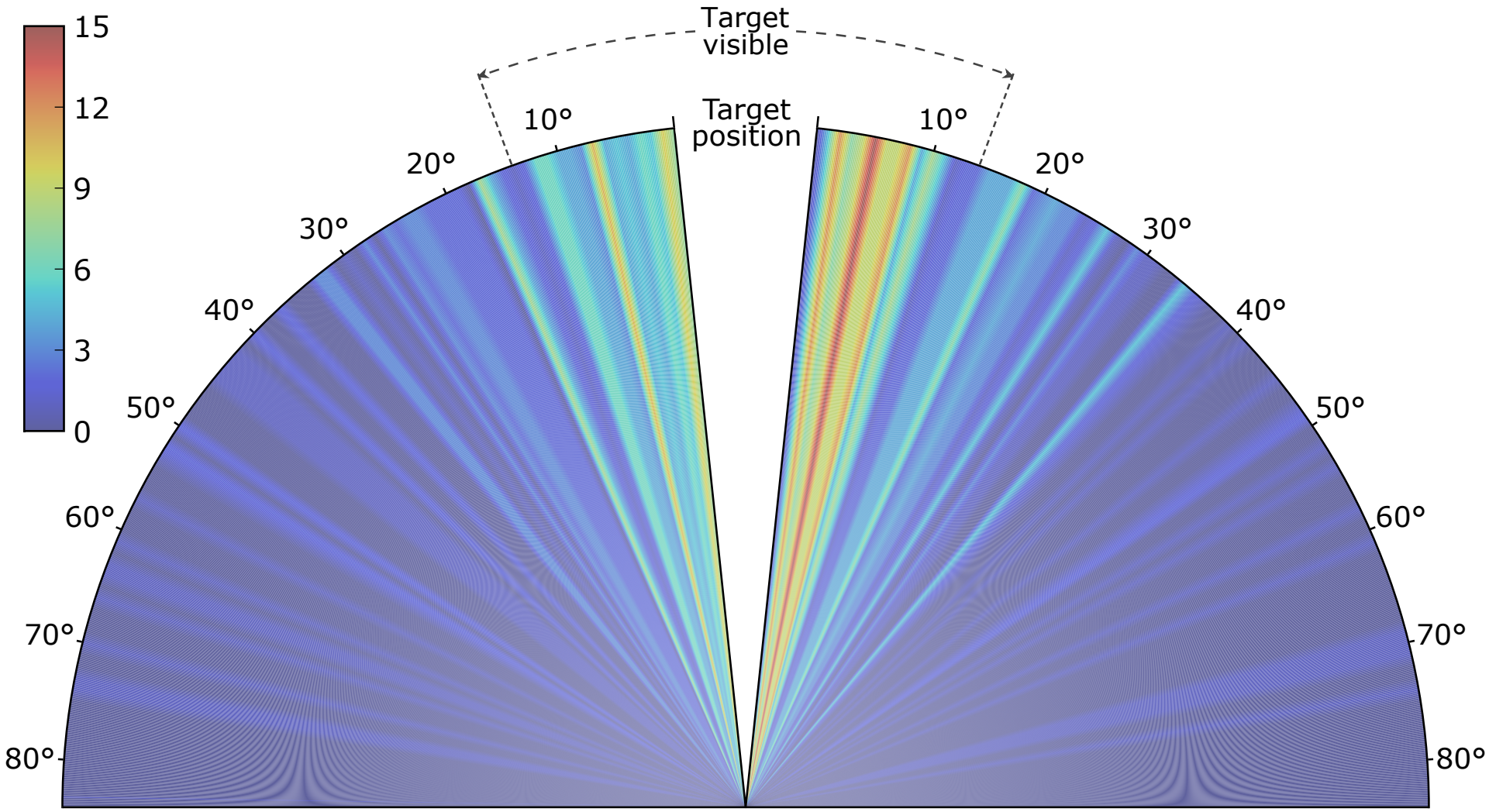
- Left and right: no significant difference

False positives



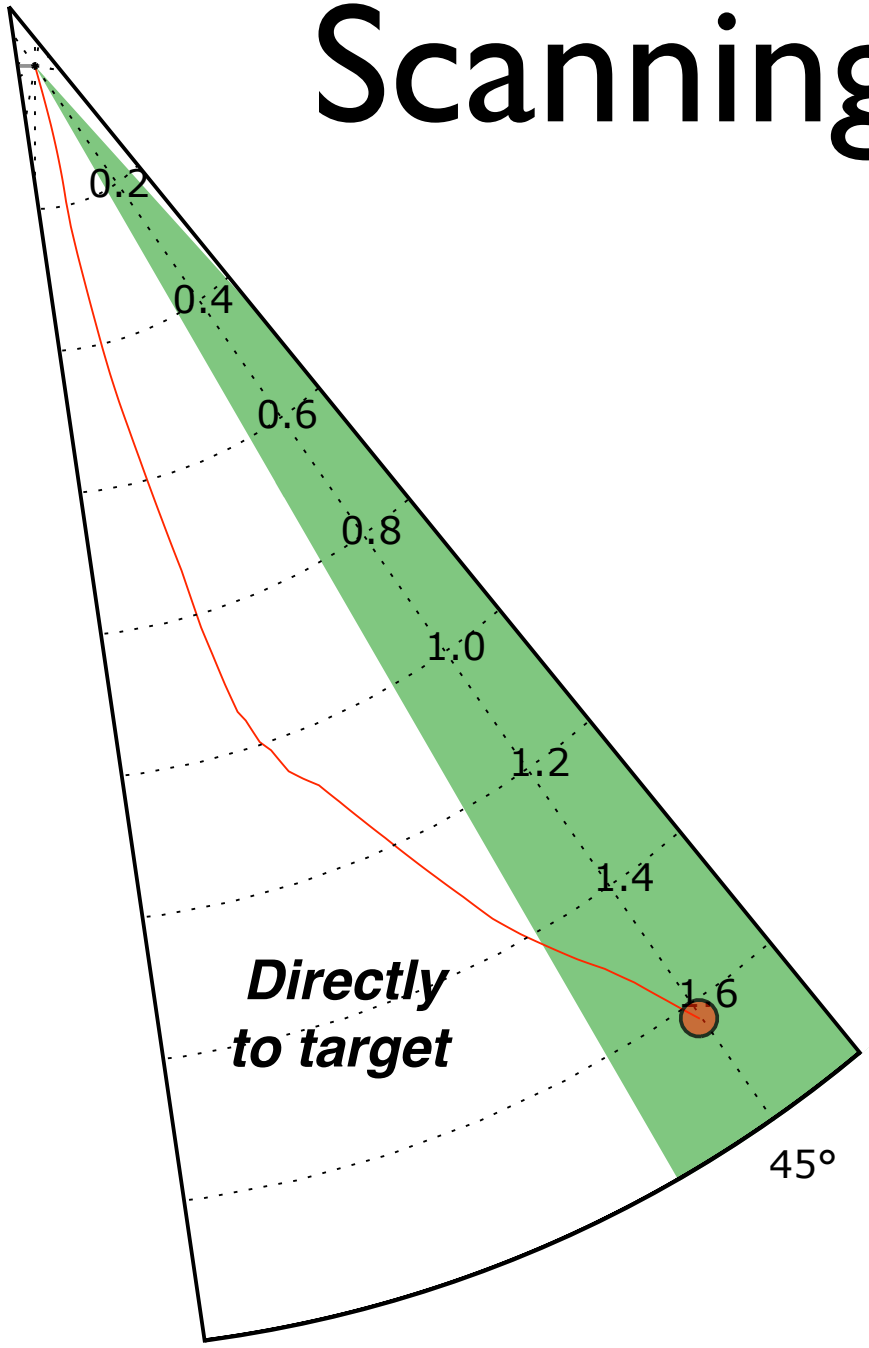
- Haptic: fairly evenly distributed

False positives

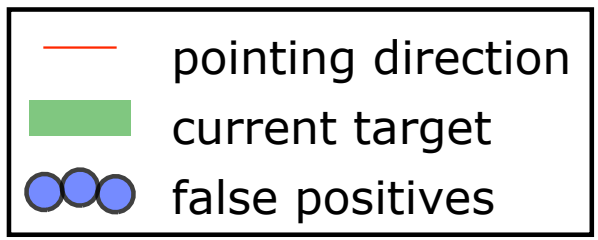


- Haptic: fairly evenly distributed
- Visual: 75% when target visible

Scanning strategies



Behaviour	Haptic %	Visual %
Direct	33	49
Probing	34	24
Expanding	18	14
Others	15	13



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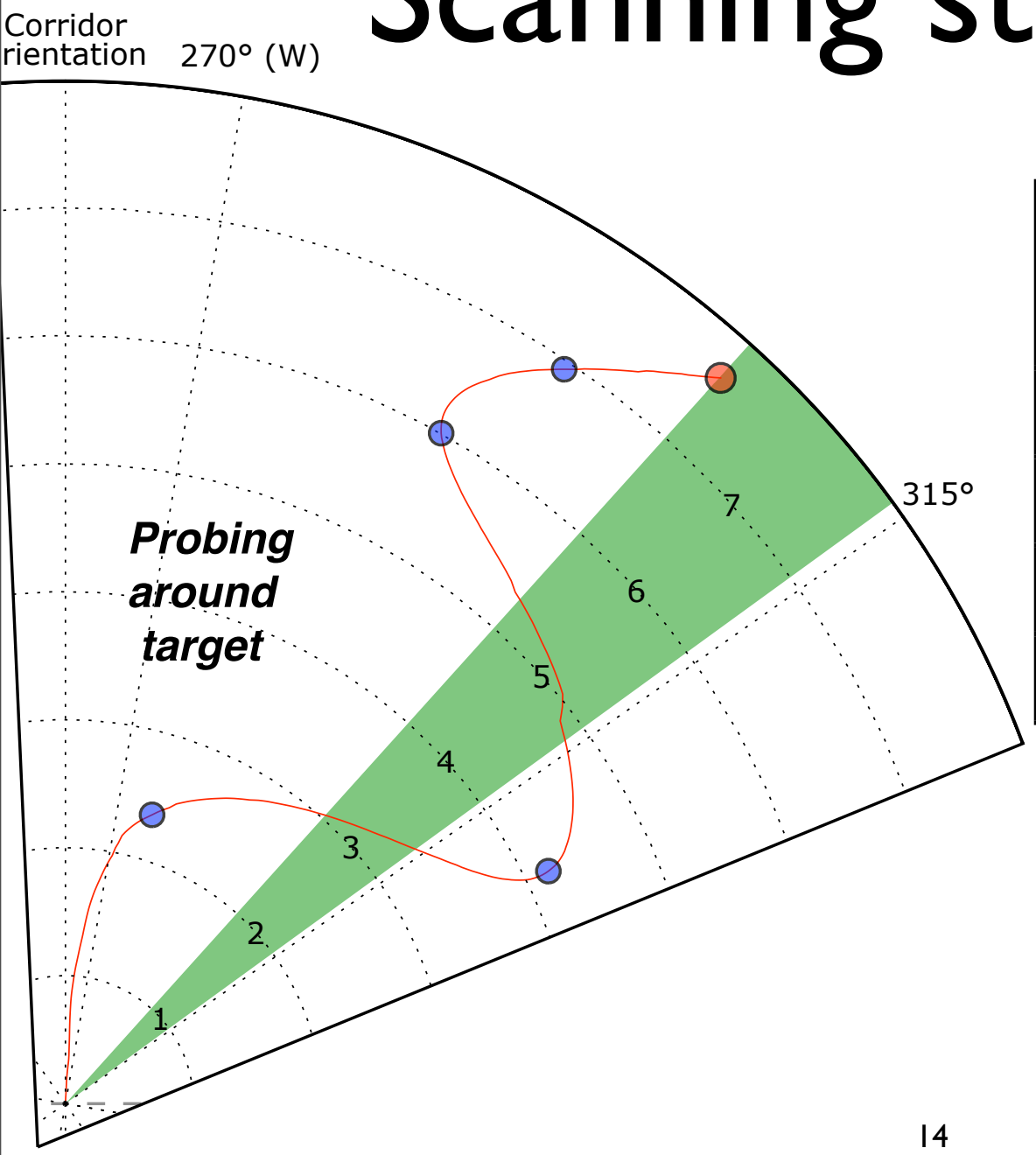

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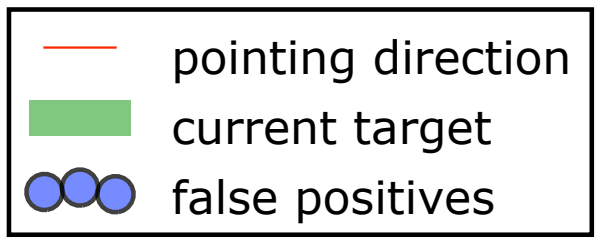

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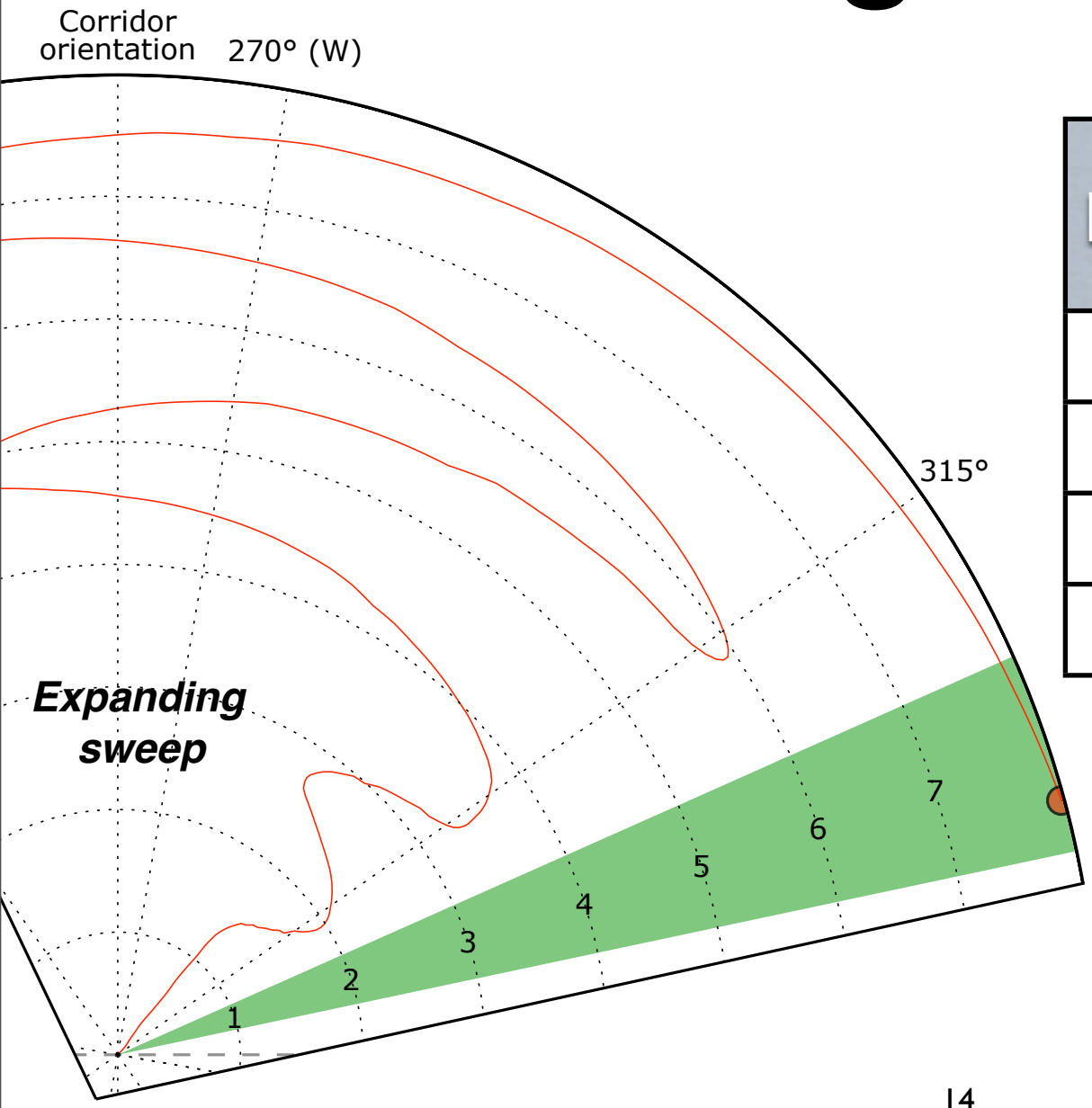

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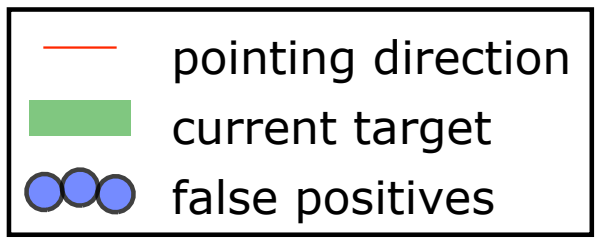

Observations and verbal feedback

- Haptic
  - Able to look at circuit instead of device
  - “very helpful”;“really easy”
  - Some issues with vibration lag
- Visual
  - Often struggled to look at screen and circuit

Reflections

- Users appreciated haptic feedback
- Found 100% of targets despite lack of haptic familiarity
- Visual shows no great gain in performance for ⅔ of targets

Reflections

- Heads-up interaction is possible
- Haptic usability improving
  - Still needs work
- Visual has its own problems
  - False positives

Conclusions

- Haptic feedback usable with very little familiarity
- Allows heads-up interaction while moving
- Similar experience to visual in some cases
- But...
  - Study limitations: simulated environment

Ongoing work

- Haptic feedback in other situations
  - Navigation
- Visually-impaired users
- Completely on-phone
  - Low-cost applications
  - No specific hardware needed

Thank you

- Questions?

- Haptic system demo: 6:30pm, Computer Lab (William Gates Building)

- Research funded by EPSRC project EP/E042171/1, undertaken in collaboration with colleagues at Glasgow University

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