Auditory Locomotion Guidance System For Spatial Localization

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Introduction

Head anticipation is the turning of the head towards the future heading direction. The auditory guidance system (see Figure 1) is proposed to investigate head anticipation without visual influence. The objective of this work is to describe the system setup and validate it's accuracy with 2 experiments for locomotion research.

Method

- 10 sighted subjects (27 ± 3.5 years)
- Eyes open and eyes closed conditions
- Counterbalanced targets/trajectories
- Motion tracking of position and orientation of head and body
- 8 target positions (45° steps) for localization task
- 3 trajectories for guidance task:
  eight shape, circle clockwise and counterclockwise

Tasks

1. Localize a sound position.
2. Follow a moving sound source for 60 seconds.

Results

Participants localized sounds with an accuracy was 0.16 m with open eyes and 0.14 m with closed eyes. Figure 2 shows results for the localization task. Participants were able to follow the moving sound with eyes open and eyes closed. Figure 3 shows results for the guidance task.

Conclusions

The proposed auditory guidance system is sufficient to create spatialized sounds and guide participants during locomotion experiments.

References

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- M. Gori, G. Cappagli, G. Baud-Bovy, and S. Finocchietti, "Shape perception and navigation in blind adults," in Frontiers in Psychology, 2017, vol. 8, doi: 10.3389/fpsyg.2017.00010.
- F. Dollack, M. Perusquia-Hernandez, H. Kadone, and K. Suzuki, "Head anticipation during locomotion with auditory instruction in the presence and absence of visual input," in Frontiers in Human Neuroscience, 2019, 13:293, doi: 10.3389/fnhum.2019.00293.

Figures

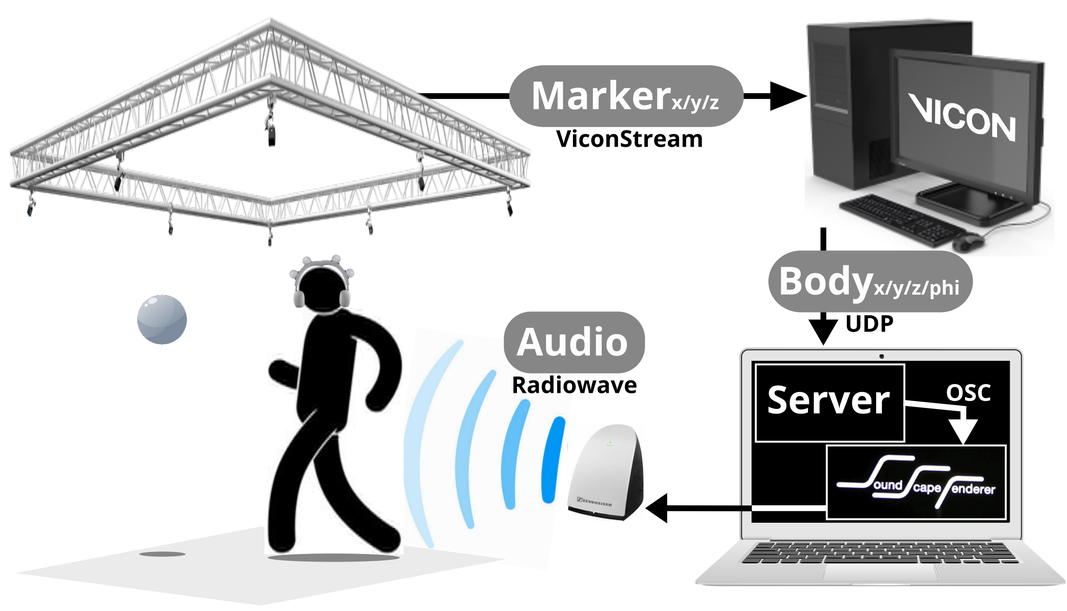

Figure 1: Overview of the auditory guidance system. Body position and orientation are captured with motion tracking cameras and software. The motion tracking data is forwarded as UDP message to the local network. An openFrameworks program receives the UDP message and sends them together with commands to position the sound source to a sound synthesis software. Synthesized sound is played via a wireless headphone.

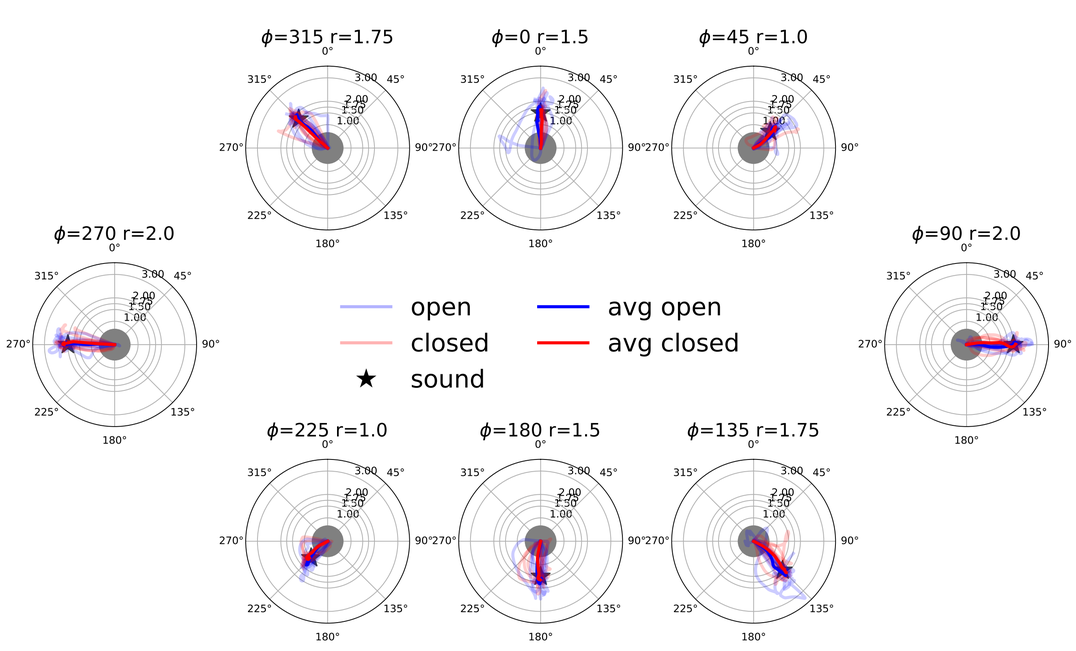

Figure 2: Locomotion trajectories during the static sound localization task with eyes open (blue) and eyes closed (red). The participants' trajectory is represented with shaded lines, the average path with a solid line, and the sound position with a black asterisk.

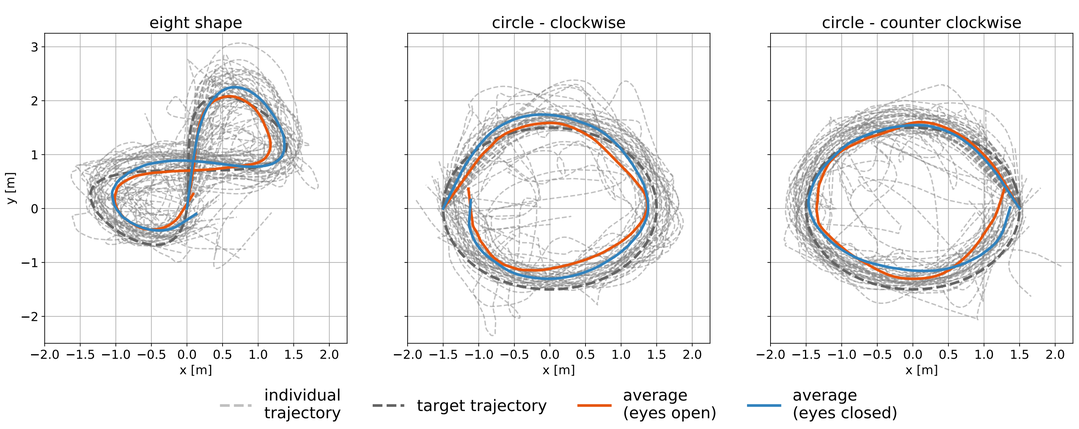

Figure 3: Locomotion trajectories during the dynamic sound guidance task. The participants' trajectory is represented with a dashed lightgray line. The average path is shown during eyes open (solid blue line) and eyes closed condition (solid red line). The target trajectory representing the moving sound source is shown with a dashed black line.

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