

**Project title: Sound motion pursuit**

**Project:** Ongoing non-project based study in the field of Psychoacoustics, Hearing Research, Audiology

**Donders Institute Theme:** Perception, Action and Control

**Project description**

We can localize sounds near-perfectly. We clearly hear sounds moving. However, inspired by the visual ocular smooth-pursuit system, several studies have used eye movements to track moving sounds, and obtained poor pursuit performance. This led to the idea that the auditory system lacks sensitivity to sound velocity. We recently demonstrated accurate head-pursuit of sounds, moving along unpredictable trajectories in the horizontal plane. This suggests that we, humans, have an auditory pursuit system sensitive to sound position and velocity.

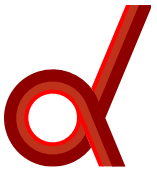
In one subproject of this research line, we will have normal-hearing listeners track unpredictable broad-band sounds with head movements, while varying the sound-motion spectrum. We hypothesize that the auditory pursuit system is optimized to pursue a moving sound both rapidly and accurately. If this hypothesis is true, we predict that through sensorimotor feedback and prior knowledge, pursuit will adapt to the statistics of sound motion.



**Figure 1. The Sphere.** One of the sound-localization labs.

**Project Alternatives**

- Sound motion pursuit in elevation and 2D
- Audio-visual motion pursuit
- Predictable sound motion pursuit
- Sound motion pursuit during self-motion
- Sound motion pursuit through gaze (eye and head)
- *Clinically oriented (Medical Biology, Biomedical Sciences):* Sound motion pursuit by single-sided deaf, listeners with asymmetric hearing impairment, and bimodal cochlear implant users (in collaboration with the Otorhinolaryngology department of the Radboudumc)
- *Modelling oriented (Physics, AI, Informational and Computer Sciences):* Characterizing and Modelling the Auditory Pursuit System (e.g., Linear Systems Theory)
- *Thesis/Review Article:* How is sound motion represented in the nervous system?



### Key words

Humans | Sound Motion | Smooth Pursuit | Head Movements | Sound Localization | Spatial Hearing | Auditory System | Interaural Time and Level Differences | Spectral Pinna Cues | Psychophysics | Psychoacoustics | Perception | Hearing Research

### Relevant literature

- Calvo, J. A. G.-U., Wanrooij, M. M. van, & Opstal, A. J. Van. (2021). Adaptive Response Behavior in the Pursuit of Unpredictably Moving Sounds. *ENeuro*, 8(3).  
<https://doi.org/10.1523/ENEURO.0556-20.2021>

### Tasks & skills

You will become familiar with psychophysics and psychoacoustics. At the end of this internship, you will be able to:

- Design and develop sound-pursuit tasks in state-of-the art sensorimotor labs (Fig. 1).
- Measure eye and head movements (with the search coil technique and/or with eye trackers and inertial measuring units)
- Analyze data in Matlab and quantify sound-motion tracking behavior (through systems analysis)
- Write a report in the form of an academic paper (IMRaD)

### Background

*Master Cognitive Neuroscience:* Perception and action track

*Biology/Sciences/Physics:* Psychophysics I and II, Neurobiophysics, Neural Basis of Cognition and Perception, The Auditory System

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