Modeling Urban Soundscape for Adaptive Pedestrian Navigation

Bachelor- or Masterthesis

Motivation

- Urban navigation is not purely visual: sound plays a crucial role in how people orient themselves
- Current approaches often represent sound as static points, ignoring:
  - Spatial spread (how far sound travels)
  - Temporal variation (time-of-day changes)
  - Human perception (different user needs)
- This thesis explores how sound should be modeled in GIS to better support pedestrian wayfinding







Colourbox

Possible Extensions

- Time-dependent sound mapping
- Crowdsourced sound data
- Accessibility-focused navigation (visually impaired users)
- Integration of other senses (smell)

Research Questions

- How do different spatial representations of sound (point, buffer, surface) compare?
- Which model best supports human navigation and perception?
- Can a hybrid model improve usability?
- How can sound-based navigation adapt to user preferences and abilities?
- How does the choice of sound representation influence users' cognitive map formation during navigation?

Methodology

- Data Collection
  - Select urban study area
  - Record sound sources (location + intensity)
  - (Optional) Capture data at different times
- Modeling Approaches
  - Points: discrete sound locations
  - Buffers: estimated hearing range
  - Surface: interpolated sound field
  - (Optional) Hybrid model combining all three
- Evaluation
  - Technical:
    - Coverage, accuracy, sensitivity
  - User-based:
    - Navigation tasks
    - Preference & interpretability

Tools

- GIS: QGIS / ArcGIS
- Python: GeoPandas
- Interpolation: IDW / Kriging
- Visualization: Web maps

Eva Nuhn
University of Augsburg, Geoinformatics Group, eva.nuhn@uni-a.de