

Bachelor/Master Theses Topics Cognitive Systems Lab

Summer Term 2021 & Winter Term 2021/22

Selective Auditory Attention

Interesting theses topics on the disentanglement of speech and sounds

1. Topic: “Should I listen?” Target speaker activity detection for cocktail party scenes

→ Type: Bachelor’s thesis

→ When: As of now

2. Other topics on selective auditory attention (e.g. multilingual, noisy speech, etc.)

→ Types: Bachelor’s and master’s theses

→ When: According to consultation

General requirements: Good knowledge in Python, at least basic knowledge in machine learning, motivation, reliability, personal responsibility, willingness to learn new topics

We offer: Intensive support, regular meetings, feedback discussions, nice work environment

Smarthelm Speech

Small-footprint Spoken Language Identification (BA – available now)

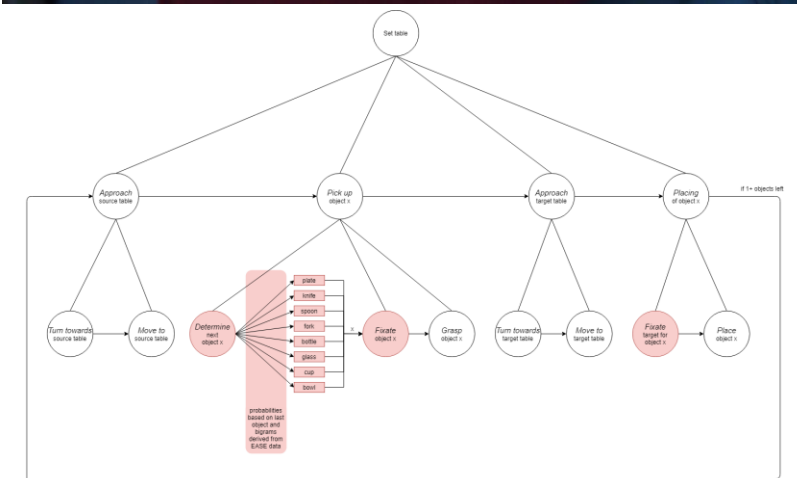
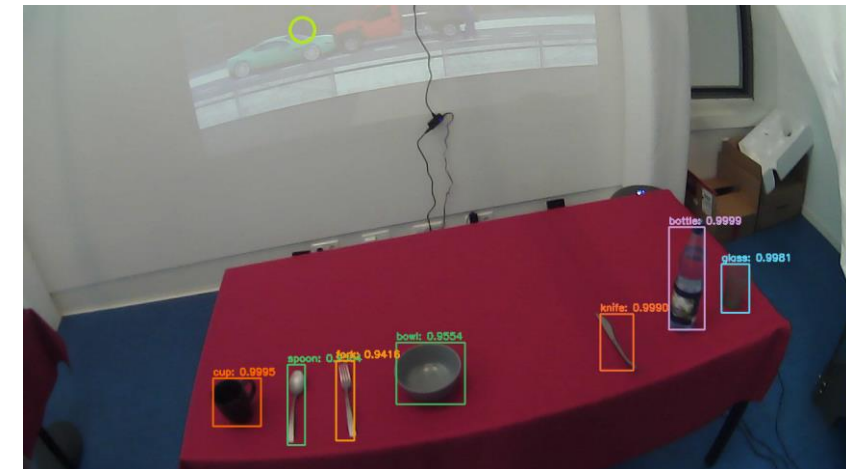
- Train a machine learning model to predict the spoken language in audio.
- The focus should be on low memory and CPU footprint models which still have adequate classification performance.
- You can train neural-network-based models from scratch or try fine-tuning approaches.

- Requirements: Machine Learning basics, good Python skills
- Nice to have: Basic understanding of audio signals, completed the Advanced Machine Learning course
- Contact: Kevin Scheck, mail to scheck@uni-bremen.de; Please add a small introduction about yourself and your CV.

Cognitive Scene Understanding

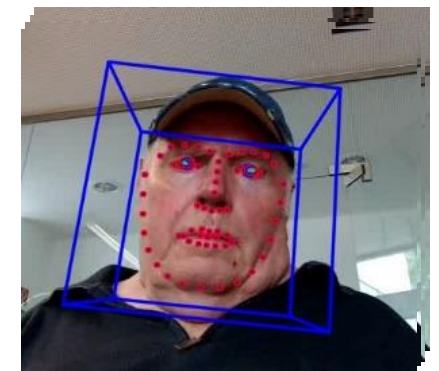
Make a system understand how a person perceives a situation

- What is the person doing? And *why*? What are they paying attention to? And what will they do in three minutes from now?
- Classify multimodal observations: Head-mounted camera, low-cost EEG, eye-tracking
- Cognitive models: Probabilistic task graphs, saliency maps
- Hybrid embeddings: Combine symbolic and sub-symbolic knowledge representation in a joint space
- Contextual visualization in Augmented Reality
- Build a full pipeline as master thesis or parts in a bachelor thesis
- Start possible immediately or later
- Contact: Felix Putze, felix.putze@uni-bremen.de



I-CARE

- Tablet-basiertes Aktivierungssystem für Menschen mit Demenz und (in)formal Pflegende
- Einzigartiger, multimodaler Datensatz (Video, Audio, Physio)
- Erkennung von verbalem Engagement
 - Unterscheidung zwischen Sprache und nicht Sprache
 - Anwendung maschineller Lernverfahren wie neuronaler Netze
- Automatisches Tagging von Aktivierungsinhalten
 - Was ist in einem Video oder einer Bilderreihe zu sehen?
 - Evaluation bestehender Modelle basierend auf neuronalen Netzen
- Interessiert? → Lars Steinert (lars.Steinert@uni-bremen.de)



Eye-tracking based Annotation of External Attentional Distractions

Topic

- Attention modeling in a smart helmet (SmartHelm)
- Eye-Tracking fixation modeling
- Automatic annotation of distractions in a biking video scene

We offer

- On-demand meetings and regular weekly meetings for support
- Access to our Lab and guiding to the required devices:

Eye-Tracking in an Augmented-Reality device. Continuous support in experiments

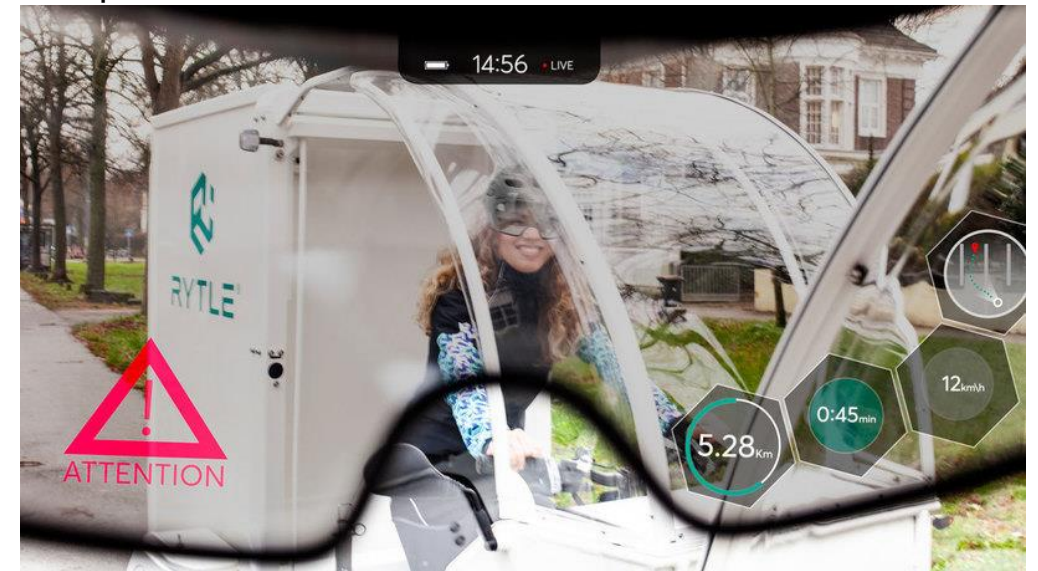
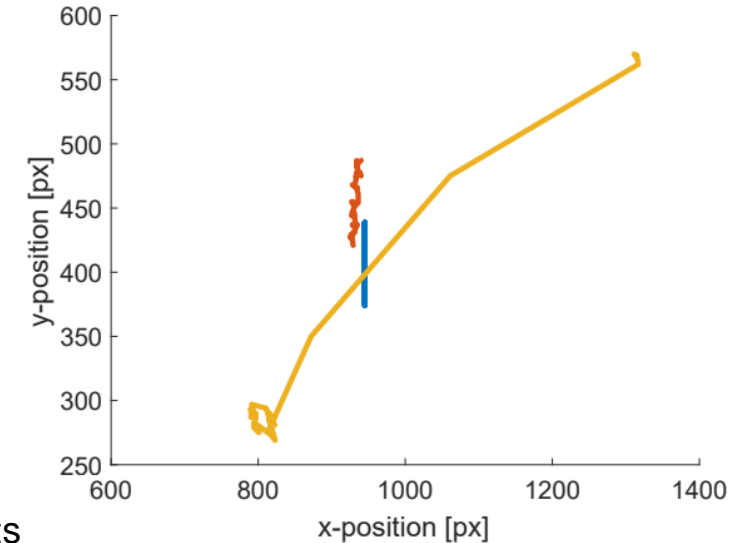
- Continuous feedback for implementation and writing

Requirements

- Interested in the topic
- Foundation of machine learning
- Basics in Python
- Recommended: video annotation tools

When? Winter semester 2021/2022 (Bachelor Thesis)

Interested? Contact: Mazen Salous, E-mail: salous@uni-bremen.de



Adaptive Augmented-Reality UI Using EEG and Eye-Tracking in a Smart Helmet

Topic

- Attention modeling in a smart helmet (SmartHelm)
- EEG and Eye-Tracking fixation modeling
- Adaptive User Interface

We offer

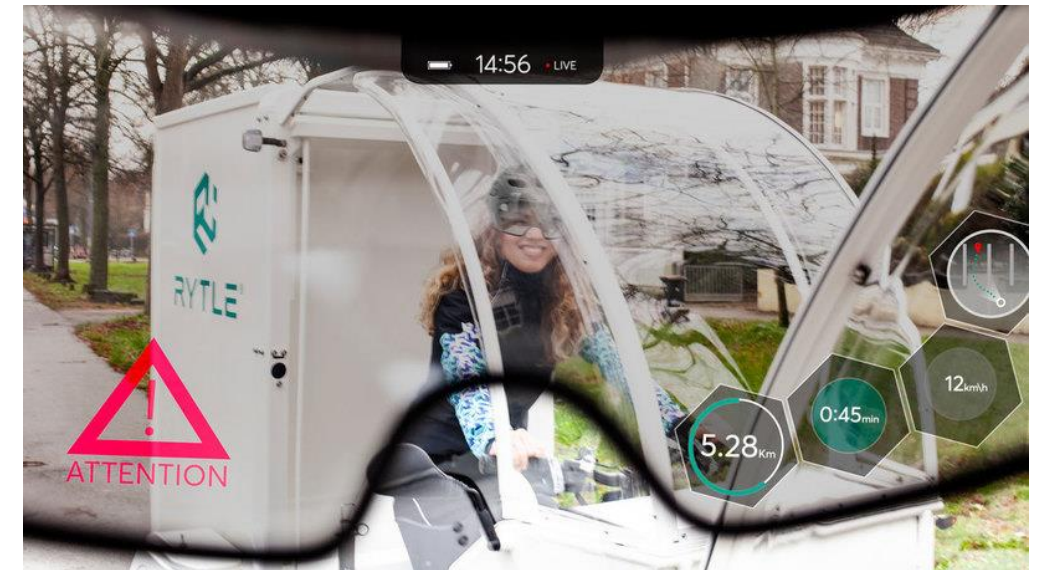
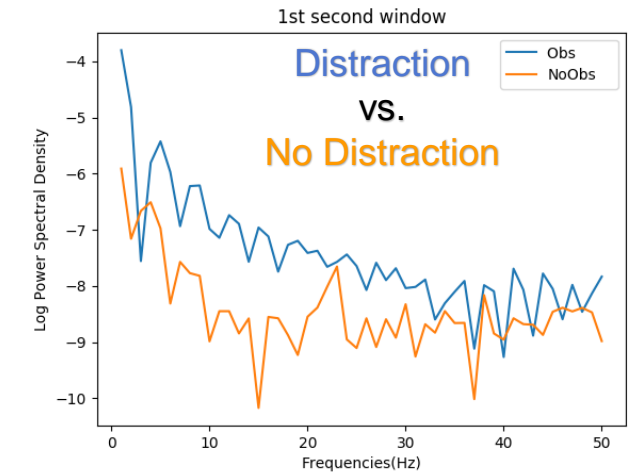
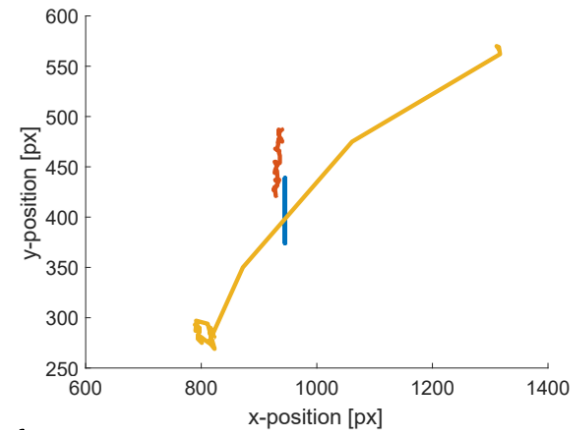
- On-demand meetings and regular weekly meetings for support
- Access to our Lab and guiding to the required devices:
EEG-System, Eye-Tracking and Augmented-Reality
- Continuous feedback for implementation and writing

Requirements

- Interested in the topic
- Foundation of machine learning
- Programming languages: Python and Unity
- Recommended: Basics in EEG data processing

When? Winter semester 2021/2022 (Master Thesis)

Interested? Contact: Mazen Salous, E-mail: salous@uni-bremen.de



Video based Object Tracking in Everyday Activities

- **Data:** First and third person videos of Everyday Activities
- **Methods:** Apply state of the art deep learning object recognition models
- **Bachelor Thesis:** build a well-performing object tracking system of first person videos
- **Master Thesis:** additionally combine with gaze data from eye-tracking & apply object tracking to third person videos
- **Contact:** Moritz Meier, mome@uni-bremen.de



Augmented Reality, BCI and ML

Classifying Real and Virtual Targets of Human Visual Attention

→ Tasks:

1. Implement appropriate HoloLens application
2. Record Eye Tracking and/or EEG data
3. Use Machine Learning for classification of attention

→ Optional adaptation for Bachelor or Master Thesis

→ Starting date: between now and September

→ Programming skills: C# and Python



→ Contact: Lisa-Marie Vortmann, vortmann@uni-bremen.de

ALMED¹ – ILSE Data

- **ILSE**: Interdisciplinary Longitudinal Study on Adult Development and Aging
- Biographical interviews with more than 1000 participants over 20 years
- About 4200 hours of interviews
 - 440 hours of interviews have been manually transcribed
 - Existing Automatic Speech Recognition (ASR) system for ILSE data with Word Error Rate: 33.55%
 - Over 1200 hours of interviews have been automatically transcribed with existing ASR
- Cognitive diagnoses of the participants in each measurement are available
 - Healthy → mild cognitive impairment → Alzheimer's dementia
- Speech based dementia detection
 - Acoustic and linguistic features are extracted from speech

1: <https://www.uni-bremen.de/en/csl/projects/current-projects/almed>

ALMED¹ – ILSE Data

Developing semi-supervised ASR system for ILSE data

- using the existing interviews with manual transcripts and interviews with automatic transcripts to develop deep neural network-based ASR system

Deep Neural Network (DNN) based dementia detection

- DNN based feature selection and features ranking
- Extracting semantic features for dementia detection

Speech based dementia detection on DementiaBank²

Requirements:

- Python, basic knowledge in machine learning (specially in deep learning)

Contact: Ayimnisagul Ablimit, ay.ablimit@uni-bremen.de

1: <https://www.uni-bremen.de/en/csl/projects/current-projects/almed>

2: <https://dementia.talkbank.org/>

BA/MAs in Human Activity Recognition

→ Open Topics:

- No Sensor No Problem: Sensor Synthesis for Motion Data – MA(/BA)
- Predicting Future Motion Data - MA / Predicting Missing Motion Data – BA
- Watch me Speak: Sign Language Recognition - BA/MA
- What did you just do? (Real-time) user in the loop system - BA/MA
- Generating Motion: Generative Models for Motion Data – MA
- Open for your ideas, just drop me an email!

→ Interested?

- yale.hartmann@uni-bremen.de
- <https://www.uni-bremen.de/en/csl/institute/team/staff/yale-hartmann>

BA/MAs in Human Activity Recognition

- No Sensor No Problem: Sensor Synthesis for Motion Data – MA(/BA)
 - Example:
 - Synthesise data for upper arm IMU given hand and shoulder IMU
 - Synthesise IMU data from EMG data
- Predicting Future Motion Data - MA / Predicting Missing Motion Data – BA
 - Example: Predict the next x frames of data (/ x missing frames of data)
- Watch me Speak: Sign Language Recognition - BA/MA
 - Example: Record data and create ML to automatically recognize sign language
- What did you just do? (Real-time) user in the loop system - BA/MA
 - Example: Improve/Develop an HAR System that asks the user if it's unsure in it's classification
- Generating Motion: Generative Models for Motion Data – MA
 - Example: Develop models (GAN/HMM/or similar) to conjure synthetic motion data