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

**Contact:** Marvin Borsdorf ☎ 0421-218-64291 ✉ marvin.borsdorf@uni-bremen.de
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

g→ Tablet-basiertes Aktivierungssystem für Menschen mit Demenz und (in)formal Pflegende
g→ Einzigartiger, multimodaler Datensatz (Video, Audio, Physio)

g→ Erkennung von verbalem Engagement
  – Unterscheidung zwischen Sprache und nicht Sprache
  – Anwendung maschineller Lernverfahren wie neuronaler Netze

g→ Automatisches Tagging von Aktivierungsinhalten
  – Was ist in einem Video oder einer Bilderreihe zu sehen?
  – Evaluation bestehender Modelle basierend auf neuronalen Netzen

g→ 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
➢ Continuos 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
ALMED\(^1\) – 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

ALMED\(^1\) – 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 DementiaBank\(^2\)

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