

Project/Thesis Proposal

Facial Action Unit Manipulation in Avatar Meshes Using Python Medusa for Emotion and Uncanniness Perception Studies

Background: Understanding how humans interpret emotions from facial expressions is crucial in fields such as affective computing, human-computer interaction, and the design of virtual avatars. As virtual agents become more prevalent in social applications, there is an increasing need to systematically explore how subtle facial distortions influence perceptions of emotional authenticity and contribute to the "uncanny valley" phenomenon. Facial action units (AUs), as defined in the Facial Action Coding System (FACS), represent a scientifically grounded approach for encoding facial expressions [1]. However, little work has explored how controlled distortions of these AUs in facial avatars influence users' perceptions.

In this project, you will work with the Python <u>Medusa</u> library—an open-source tool for extracting and visualizing 3D face meshes from videos [2]. You will first implement a mapping function that helps mapping the 3D face meshes to more interpretable AU configurations and vice-versa using several open video datasets with AU annotations and the <u>OpenFace</u> toolkit for extracting AU [3]. The goal is to distort 3D face meshes extracted from the open and annotated dataset DISFA(+) [4] by introducing temporal and structural noise disturbations (i.e., repeated "freezing", "jitter", "random noise").

By processing real annotated video data, we aim to generate avatar meshes with accurate facial expressions, followed by configurable distortions of AUs. The project can be extended to a master thesis where these manipulated meshes will be used in an online study to investigate how changes in facial expressions impact the perception of emotion and uncanniness.

• Tasks:

- Implement a bidirectional mapping function between 3D face meshes and AU configurations using the Python Medusa library and annotated video datasets.
- Apply temporal and structural noise to 3D face meshes from the DISFA(+) dataset.
- \circ Visualize and export distorted facial expressions as animated 3D avatars.
- **Optional:** Prepare an online study to assess users' perception of emotional authenticity.
- Incentives:
 - Opportunity to contribute to cutting-edge research in affective computing and avatar realism.
 - Close supervision within the interdisciplinary Human-centered Artificial Intelligence Group

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