Personalized Immersive and Secure Audio for Metaverse

You (Neil) Zhang
University of Rochester

Audio Information Research Laboratory

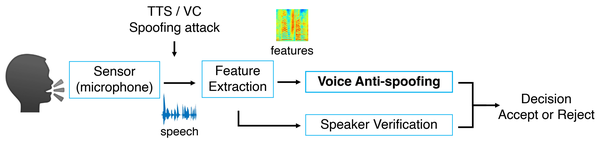
OVERVIEW

Metaverse is a virtual universe comprised of interconnected shared spaces that enable unique experiences through augmented reality (AR) and virtual reality (VR).
My research goal is to design algorithms and systems to support AR/VR with **immersive, personalized, and secure** audio technology.
My work has been focusing on **audio-visual rendering and analysis, personalized spatial audio, and speech anti-spoofing**.

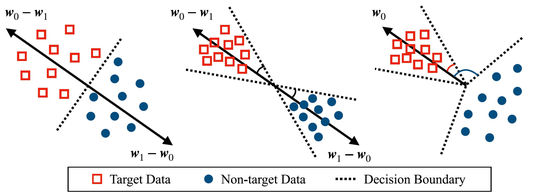
SECURITY

Speech Anti-Spoofing

Synthetic Speech Detection

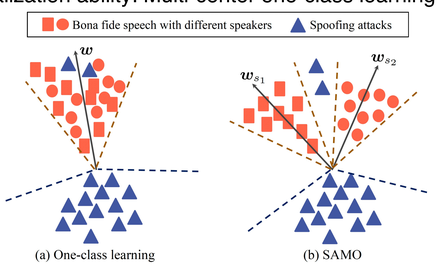


Generalization ability: One-class learning -- OC-Softmax [1, 2]



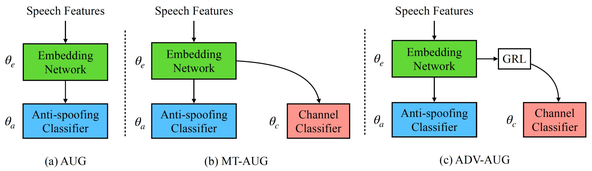
(a) Original Softmax (b) AM-Softmax (c) OC-Softmax (Proposed)

Generalization ability: Multi-center one-class learning [3]



(a) One-class learning (b) SAMO

Channel robustness [2, 4, 5, 6]



(a) AUG (b) MT-AUG (c) ADV-AUG

Joint optimization with speaker verification [7]

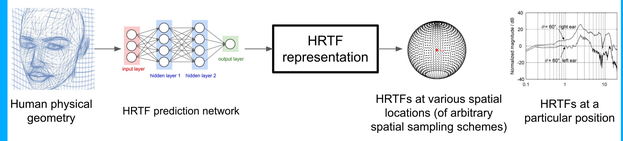
$$P(y^t = 1|x^e_{ASV}, x^t_{ASV}, x^t_{CM}) = P(y^t_{ASV} = 1|x^e_{ASV}, x^t_{ASV}) P(y^t_{CM} = 1|y^t_{ASV}, x^t_{CM}).$$

Future work:
Generalized audio deepfake detection

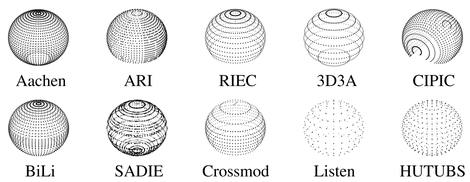
PERSONALIZATION

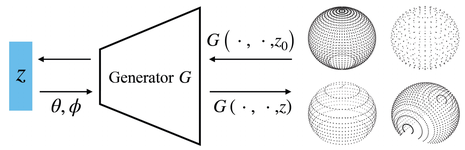
Personalized Spatial Audio

Head-Related Transfer Function (HRTF) Personalization

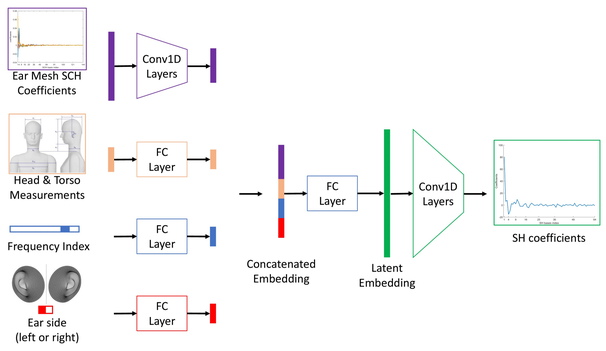


Unified HRTF representation across databases [8, 9]





HRTF personalization across all directions [10, 11]

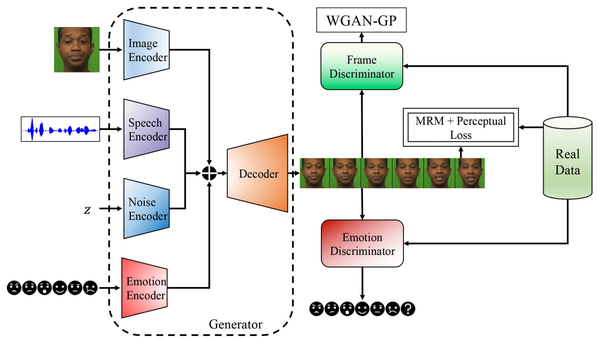


Future work:
Personalized binaural synthesis from mono audio

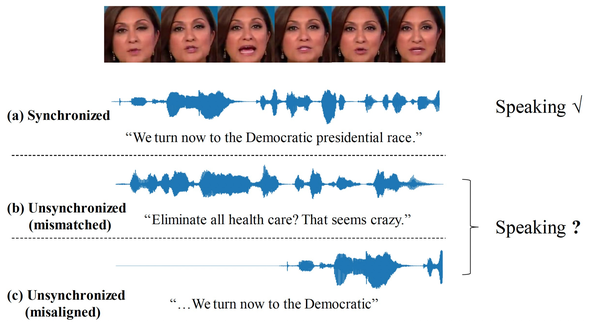
IMMERSIVENESS

Audio-Visual Rendering and Analysis

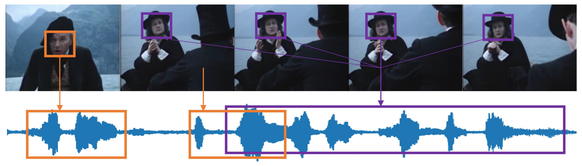
Talking Face Generation: Emotional Rendering [12]



Active Speaker Detection: Audio-Visual Synchronization [13]



Audio-Visual Speaker Diarization: Off-screen Speakers [14]



Future work:
Audio-visual scene understanding

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Personal Website

https://yzyouzhang.com

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