Popular science summary of the PhD thesis

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Title of the PhD thesis	Personalizing Audiology with User-Centered, Private AI
PhD school/Department	DTU Compute / CogSys

Science summary

User-Centered AI: From Personalized Audio to Space Exploration

Imagine navigating a bustling city street, the cacophony of traffic horns and conversations threatening to drown out your friend’s voice. Or perhaps you’re struggling to follow a lecture in a crowded hall, the professor’s words lost in the background hum. These are just a few of the daily challenges faced by millions with hearing loss. While hearing aids exist, their static settings often fall short in dynamic environments. This thesis explores the potential for data-driven machine learning methods to improve personalized hearing adapted to individual preferences.

Analyzing data from over 32,000 audio device users demnostrates the need for personalized audio settings. While this broad dataset highlights general trends, it doesn't capture the individualized context of each user's listening experiences. To address this scarcity of individualized preference data, a joint diffusion model is developed, offering a unique advantage: it can both generate synthetic data and directly improve the prediction of optimal audio settings. User privacy, however, is equally important. To this end, a federated learning approach ensures that sensitive data remains local by training models directly on smartphones, and secret sharing further secures the model update process.

The federated learning framework has broader applications, extending to robotic exploration inspired by NASA's Cooperative Autonomous Distributed Robotic Exploration (CADRE) mission. Conducted in collaboration with the Jet Propulsion Laboratory (JPL), this work applies federated learning to lunar rover mapping of the Reiner Gamma region. Pre-training the rovers' neural networks on Earth-based data accelerates their adaptation to the lunar environment. Then, during the mission, local maps are generated by each rover, and learned neural network parameters are shared through federated learning, reducing data transmission—a key challenge in planetary exploration. This collaborative process allows the rovers to create a unified global map for path planning.