Embodied Audition for Robots

EARS

robot-ears.eu

Vision for EARS

Robot 'ears' with auditory abilities for a natural human-robot interaction in complex acoustic environments.

Funding

Objectives

Acoustic Scene Analysis
- ▶ Extract desired sound from noisy and reverberant soundscapes
- ▶ Distinguish desired speaker from interference

Complementing Audition by Vision
- ▶ Localize and track silent sources
- ▶ Recognize and disambiguate sounds and gestures

Human-Robot Interaction (HRI)
- ▶ Use of disambiguated and classified sounds and source position for interaction via voice dialog
- ▶ Development of a natural robot behavior

Challenges

- ▶ Interfering speakers and noise sources
- ▶ Room reverberation
- ▶ Robot self-noise from actuators, CPU cooling fan and movements of the joints
- ▶ Double-talk situations where the robot speaks while listening to a speaker
- ▶ Mechanical restrictions for the mounting of the microphones
- ▶ Asynchronous microphone, camera and motor signals
- ▶ Moving sensors

Possible Applications

- ▶ Domestic robots supporting, e.g., elderly people
- ▶ 'Welcoming robots' serving as a first point of contact in a hotel lobby or a shop
- ▶ Service robots in hospitals or care facilities
- ▶ Robots for education, infotainment, entertainment, …

Photo: Ed Alcock (Aldebaran)

Addressed Topics & Tasks

- ▶ Microphone array design for humanoid robots
- ▶ Focusing by adaptive robomorphic arrays
- ▶ Sound field representation and analysis
- ▶ Audio-visual data alignment
- ▶ Acoustic source localization and tracking
- ▶ Multichannel noise reduction and interference suppression
- ▶ Acoustic echo cancellation
- ▶ Dereverberation for robot audition
- ▶ Audio-visual event localization and classification
- ▶ Learning of internal models for robot interaction
- ▶ Attention systems for humanoid robots
- ▶ Optimal behaviors for event recognition and localization
- ▶ Software architectures for audio integration

Foreseen Prototype

A naturally behaving 'welcoming robot' in a hotel lobby should understand and answer the questions of the customers in a noisy and reverberant environment.

Photo: Ed Alcock (Aldebaran)

Project Partners

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