



# Work conducted in WP2

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# Outline

- Impulse response & HRTF measurements
  *Hendrik Barfuss*
- Sound-localization & ego-noise datasets
  *Antoine Deleforge*
- Fan noise reduction using multichannel Wiener filtering
  *Antoine Deleforge*
- Spatial filtering
  *Hendrik Barfuss*
- Sound source localization for NAO: a benchmark
  *Antoine Deleforge*

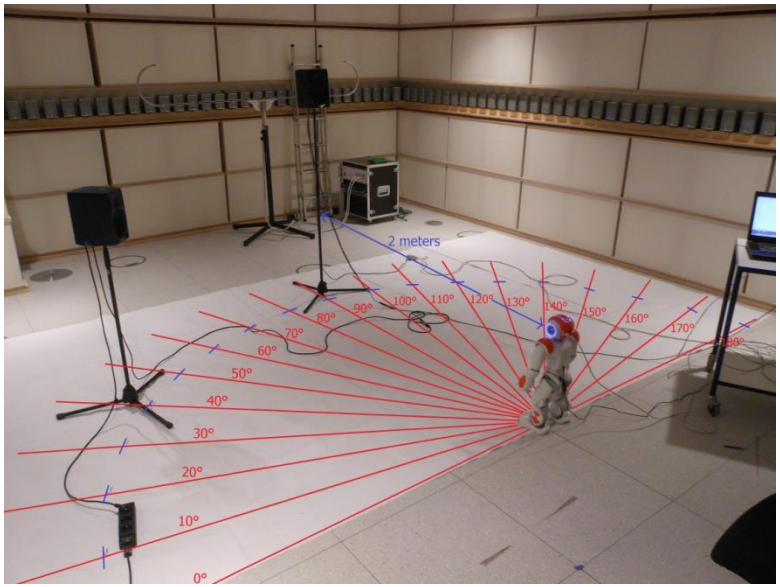
# Impulse Response and HRTF Measurements

- Head-related impulse responses for the original NAO head
  - Azimuth between 0° and 360° with 5° steps
  - Fixed elevation
  - Online soon

- Room impulse responses
  - Azimuth between 0° and 360° with 5° steps
  - Fixed elevation
  - Distances of 1m, 2m, and 4m
  - Absorbing and reverberant configuration of laboratory
  - Work in progress

# Sound-localization & ego-noise datasets

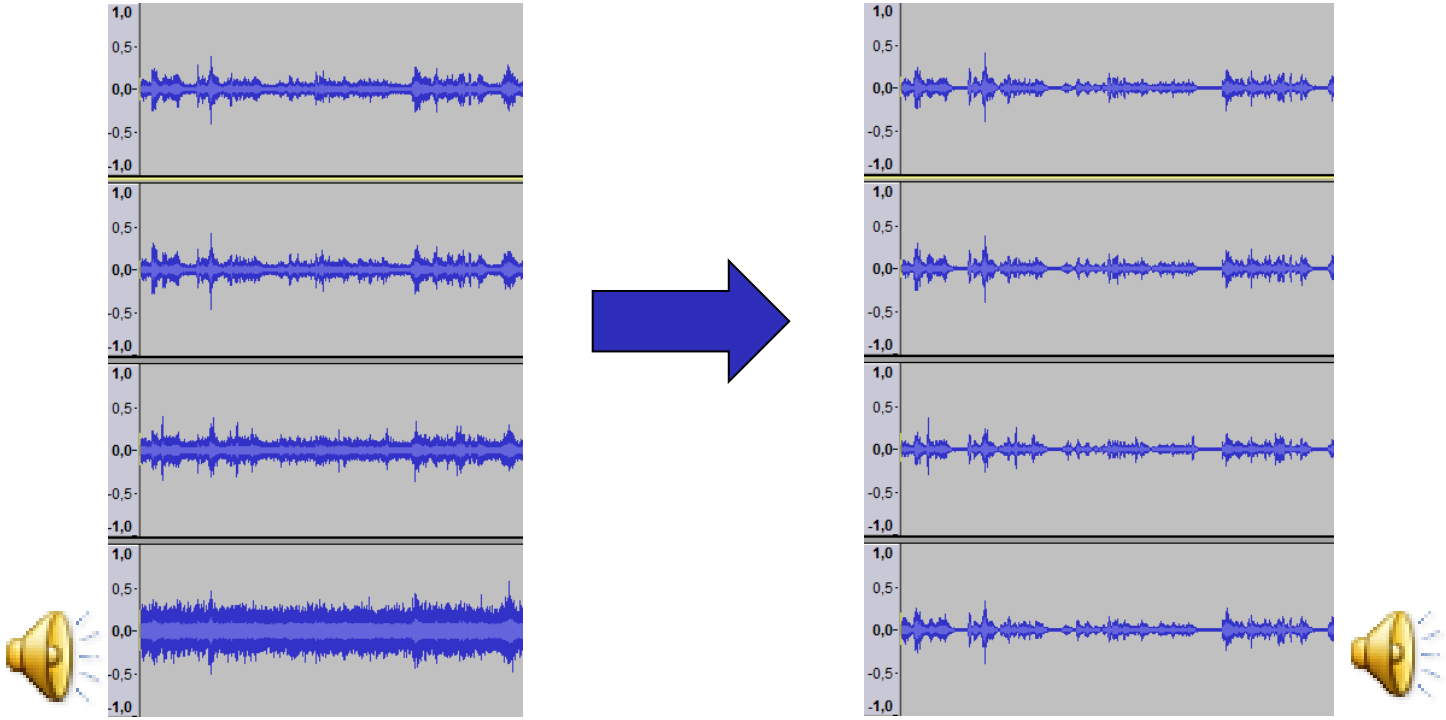
- NAO_LOC dataset
  - ~1 hour of annotated recordings
  - 19 azimuth (0°-180°), 2 elevations
  - Absorbing and reverberant
  - 1 and 2 sources recordings
  - Speech and white-noise
  - Fixed distance




- NAO_EGONOISE dataset
  - External (arms) and internal microphones
  - 2 arm positions
  - Walking, waving and nodding movements
  - 1 and 2 source recordings
  - Sound pressure levels available

# Fan noise reduction using multichannel Wiener filtering

- 4-channel Wiener filtering
- Good noise reduction performance due to the stationarity of the fan noise
- Matlab code will be made available to all partners



# Spatial filtering

- HRTF-based robust frequency-invariant least-squares beamformer
  - **Main idea**: Use HRTFs instead of free-field steering vectors for already existing beamformer design **[Mabande et al. 2009]**
  - Data-independent beamformer
  - Ongoing student master thesis

- Linearly constrained minimum variance signal extraction based on minimum mutual information criterion
  - **Main idea**: Use TRINICON-BSS to create a constrained beamformer and the blocking matrix, using the RTF **[Reindl et al. 2014]**
  - Data-dependent beamformer
  - Started in June

**[Mabande et al. 2009]**: E. Mabande, A. Schad, and W. Kellermann. Design of robust superdirective beamformers as a convex optimization problem. In *Proc. IEEE Int. Conf. Acoustics, Speech, Signal Processing (ICASSP)*, pages 77-80, Taipei. Taiwan, Apr. 2009

**[Reindl et al. 2014]**: K. Reindl, S. Meier, H. Barfuss, and W. Kellermann. Minimum mutual information-based linearly constrained broadband signal extraction. *IEEE Trans. Audio, Speech, and Language Processing,* May 2014

# Sound source localization for NAO: a benchmark

- Comparison of 3 state-of-the-art sound-source localization methods using NAO's signals
  - The HUMAVIPS method (GCC + az/el mapping)
  - MUSIC with generalized eigeinvalue decomposition
  - TRINICON-BSS + average directivity pattern
- Results are improved using MWF pre-processing
- The most stable and precise method is TRINICON
- Results of all methods degrade in reverberation