Open Community Platform for Hearing Aid Algorithm Research

Hendrik Kayser[1], Tobias Herzke[2], Giso Grimm[1,2] and Volker Hohmann[1,2]
[1]Medizinische Physik and Cluster of Excellence Hearing4all, Universität Oldenburg
[2]Hörtech gGmbH, Oldenburg

Motivation and project goals

Providing open tools to the hearing aid research community...

- lowers barriers for hardware and software refinement
- accelerates studies with novel acoustic processing algorithms
- facilitates translation of these advances into widespread use with hearing aids, cochlear implants, and consumer electronics devices

The **"Open community platform for hearing aid algorithm research"** aka

open
Master
Hearing
Aid

- is an open-source software platform for real-time audio signal processing
- provides a standard set of reference hearing aid algorithms
- enables the integration own signal-processing methods and measures
- allows for realistic assessment of hearing aid algorithms
- is suitable for comparative studies and collaborative research efforts

Project time table

Project start: July 2016

Yearly releases of openMHA

Y1 First official software release (June 2017)
- including a reference set of realtime hearing aid algorithms
- fully functional for algorithm development under Linux on PC platforms
- Linux realtime runtime support for PC / Beaglebone black ARM platforms

Y2 Extended support
- algorithm development on Windows operating system
- multi-channel (6/4 channel) AD/DA converters on Beaglebone black

Y3 Extended set of algorithms for extensive evaluations by the community

Y4 Development kit updates based on the feedback of the community, updated versions of algorithms and new experimental algorithms

Y5 Development kit updates based on the feedback of the community, updated versions of algorithms and new experimental algorithms

Availability

www.openMHA.org

HörTech gGmbH and Universität Oldenburg published an **openMHA** pre-release on GitHub in February 2017 under an open-source license (AGPL3)

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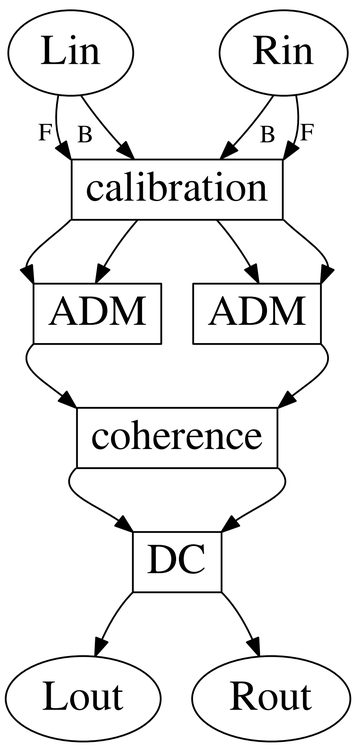
Processing chain



The pre-release version of the openMHA features a basic hearing aid processing chain including

- openMHA command line application, basic toolbox and libraries
- plugins and example configurations of
  - bilateral adaptive differential microphones (ADM, [2])
  - binaural coherence filtering [5]
  - multi-channel dynamic range compression (DC, [4])

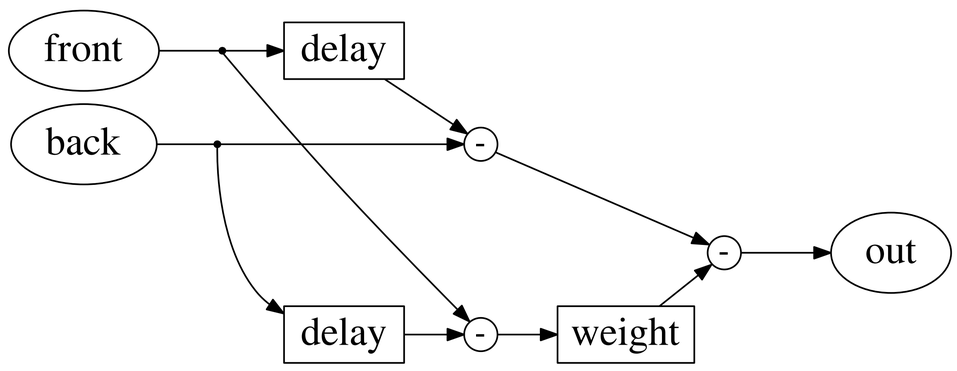
Delay: 4.4 ms algorithmic and a total input-output delay of ~8.8 ms on regular hardware

The current setup will be extended in the first full release in **June 2017** by

- beamforming
- adaptive feedback management
- single-channel noise reduction

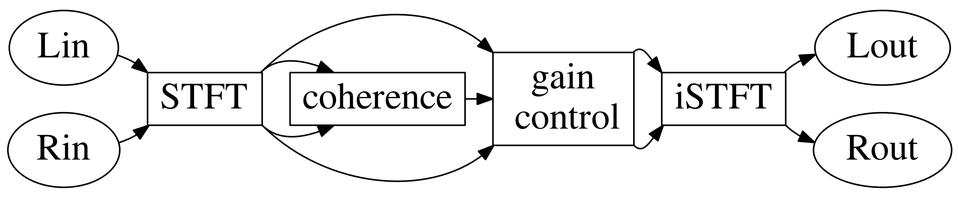
Hearing aid processing plugins

Adaptive differential microphones



- noise suppression from rear hemisphere
- state-of-the-art, robust hearing aid algorithm

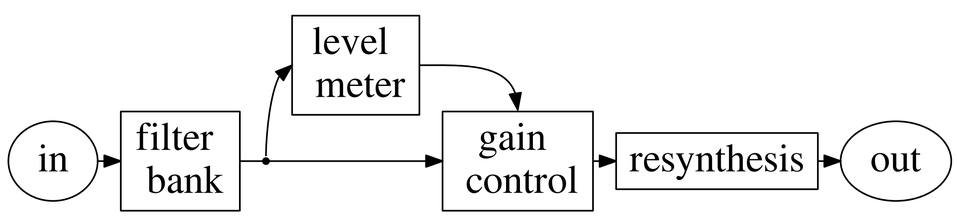
Binaural Coherence filtering



Interaural coherence-based gain control for

- feedback reduction
- diffuse noise suppression

Multi-channel dynamic range compressor



- hearing loss compensation
- recruitment compensation

References

[1] Regina M. Baumgärtel, Martin Krawczyk-Becker, Daniel Marquardt, Christoph Völker, Hongmei Hu, Tobias Herzke, Graham Coleman, Kamil Adiloglu, Stephan M. A. Ernst, Timo Gerkmann, Simon Doclo, Birger Kollmeier, Volker Hohmann, and Mathias Dietz. Comparing Binaural Pre-processing Strategies I: Instrumental Evaluation. *Trends in Hearing*, 19:article No. 2331216515617916, 2015.

[2] G. W. Elko and Anh-Tho Nguyen Pong. A Simple Adaptive First-order Differential Microphone. In *Proceedings of 1995 Workshop on Applications of Signal Processing to Audio and Accoustics (WASPAA)*, pages 169–172, 1995.

[3] Giso Grimm, Tobias Herzke, Daniel Berg, and Volker Hohmann. The Master Hearing Aid: a PC-based Platform for Algorithm Development and Evaluation. *Acta acustica united with Acustica*, 92:618–628, 2006.

[4] Giso Grimm, Tobias Herzke, Stephan Ewert, and Volker Hohmann. Implementation and Evaluation of an Experimental Hearing Aid Dynamic Range Compressor Gain Prescription. In *DAGA 2015*, pages 996–999, 2015.

[5] Giso Grimm, Volker Hohmann, and Birger Kollmeier. Increase and Subjective Evaluation of Feedback Stability in Hearing Aids by a Binaural Coherence-based Noise Reduction Scheme. *IEEE Transactions on Audio, Speech, and Language Processing*, 17(7):1408–1419, 2009.