Dereverberation for Hearing Aids with Binaural Link

- Real-time Demonstration using RTProc -

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I. Background

Digital Audio/Speech Processing and Communication

- Noise reduction and dereverberation
- Acoustic echo control
- Speech and audio coding
- Voice over internet protocol (VoIP)
- Next generation communication systems

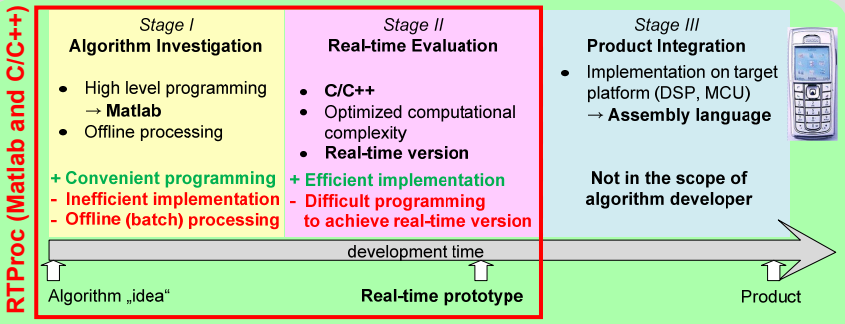
Demand for Real-time Prototypes
→ Algorithm evaluation and demonstration in **real-world scenarios**

RTProc Development Tool

- Rapid real-time prototyping for audio signal processing
- →Massive reduction of programming effort
- →Guidance through all development stages

→Shorten the Time-to-market

II. Development Stages

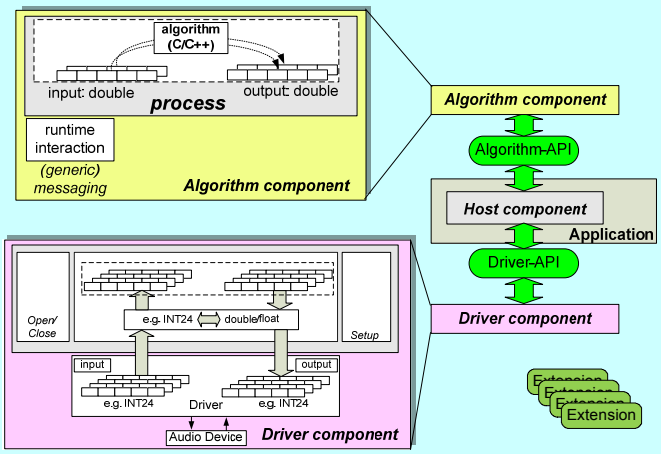


Benefits of RTProc

- Solve problems related to real-time hardware and application control
- Avoid development “gap” between stages I and II
- Support during offline and real-time development stages
- Product-like algorithm realization
- Profound preparation of development stage III

III. Principle

Decomposition of Applications into Components

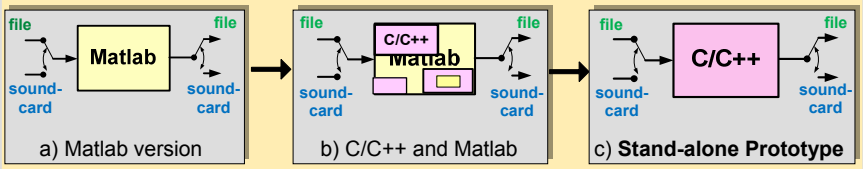


+ Driver and host components **provided by RTProc**
+ Extensions for enhanced functionality **provided by RTProc**
- Algorithm component **developed by algorithm developer**

→ Developer focus solely on algorithm

IV. Special Features

+ Matlab and C/C++ Real-time Prototype Co-Development

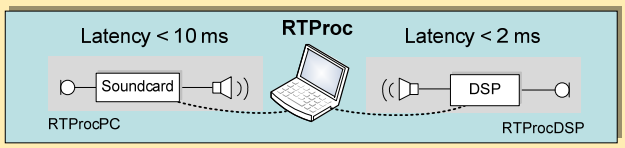


+ Mix of C/C++ and Matlab functions
+ Efficient verification of modules during transition from Matlab to C/C++
+ Real-time prototype usable in **stand-alone host** without modification

+ Examples of Additional RTProc Features and Tools

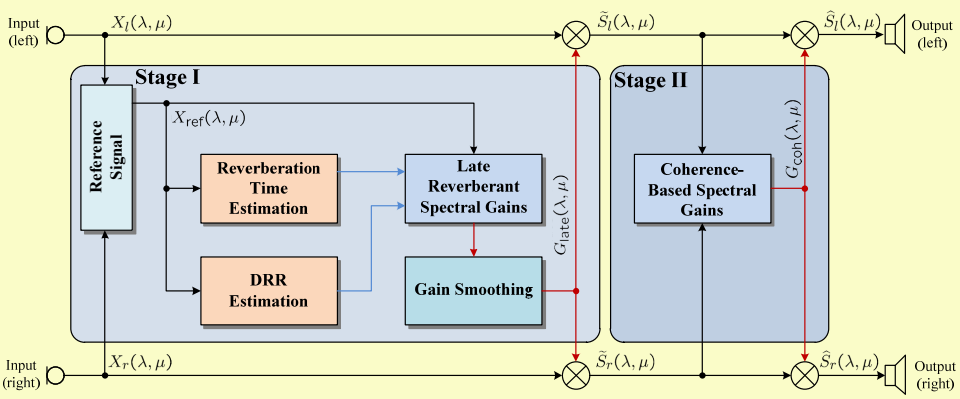
+ Generic and QT based graphical user interfaces (GUI)
+ **Design automation**: source code for common tasks generated automatically
+ Tools for real-time debugging
+ Tools to realize **real world concept studies**

+ PC and DSP (ADSP-21369) based Solutions (mostly) Code Compatible



V. Real-time Demonstration

System Overview (FFT or Subband Domain)



λ frame index, μ frequency index

Benefits

+ No influence on binaural cues (ILD, ITD) [1]
+ Blind reverberation time (T60) estimation [2]
+ Coherence model which takes head-shadowing into account [3]
+ Works within (DRR > 0dB) and outside the critical distance (DRR < 0dB) [4]

References

[1] M. Jeub, M. Schäfer, T. Esch, and P. Vary: "Model-Based Dereverberation Preserving Binaural Cues", IEEE Transactions on Audio, Speech, and Language Proc., Sept. 2010

[2] H.W. Löllmann, E. Yilmaz, M. Jeub, and P. Vary: "An Improved Algorithm for Blind Reverberation Time Estimation", Proc. Int. Workshop on Acoustic Echo and Noise Control (IWAENC), Tel Aviv, Israel, Aug. 2010

[3] M. Jeub, M. Dörbecker, and P. Vary: "A Semi-Analytical Model for the Binaural Coherence of Noise Fields", IEEE Signal Processing Letters, March 2011

[4] E.A.P. Habets, S. Gannot, and I. Cohen: "Late Reverberant Spectral Variance Estimation Based on a Statistical Model", IEEE Signal Processing Letters, Sept. 2009

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- Graphical User Interface -

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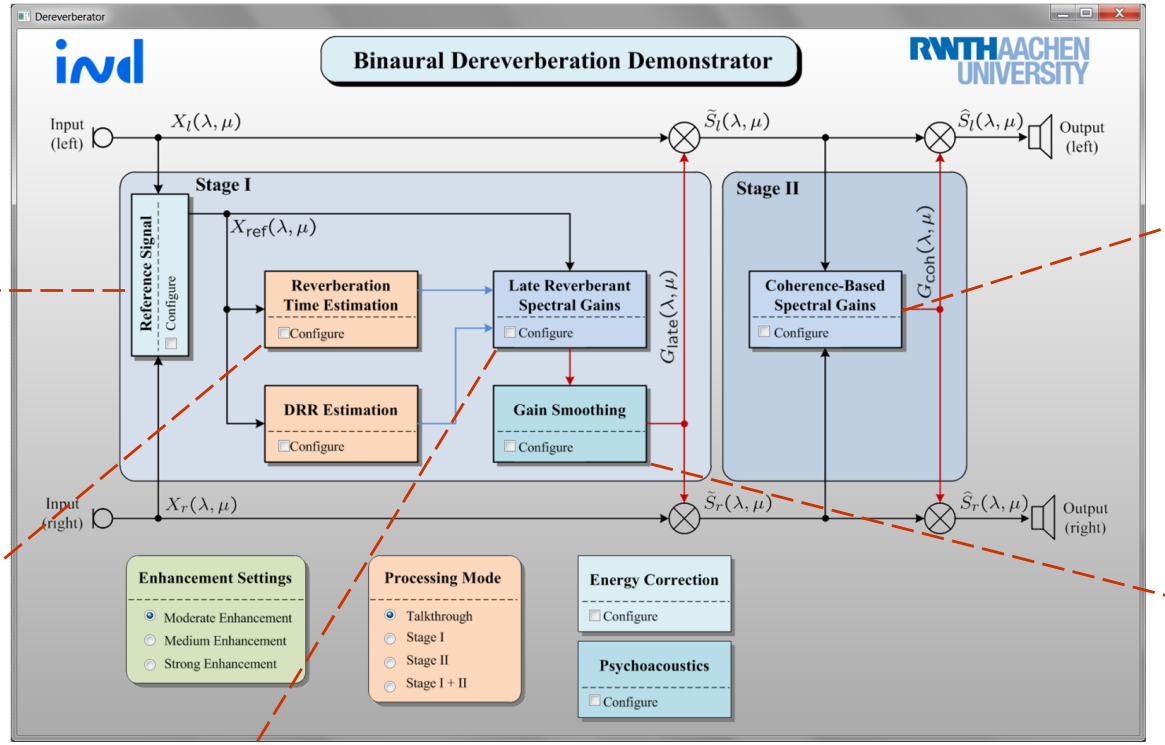
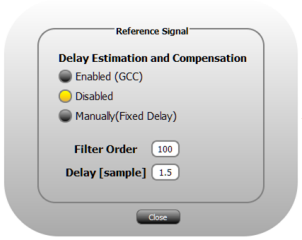
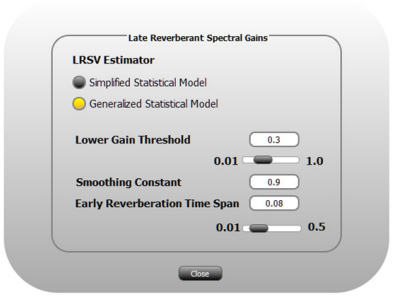
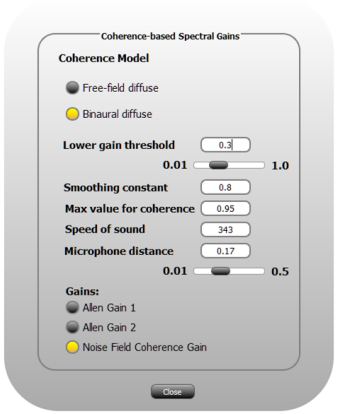
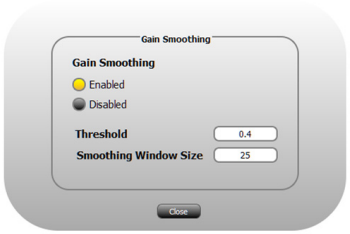
Main GUI











Used room impulse responses measured with dummy head

[5] M. Jeub, M. Schäfer, and P. Vary:
"A binaural room impulse response database for the evaluation of dereverberation algorithms," in Proc. Int. Conference on Digital Signal Processing (DSP), Santorini, Greece, 2009