A Computational Auditory Model based on Signal Dependent Compression

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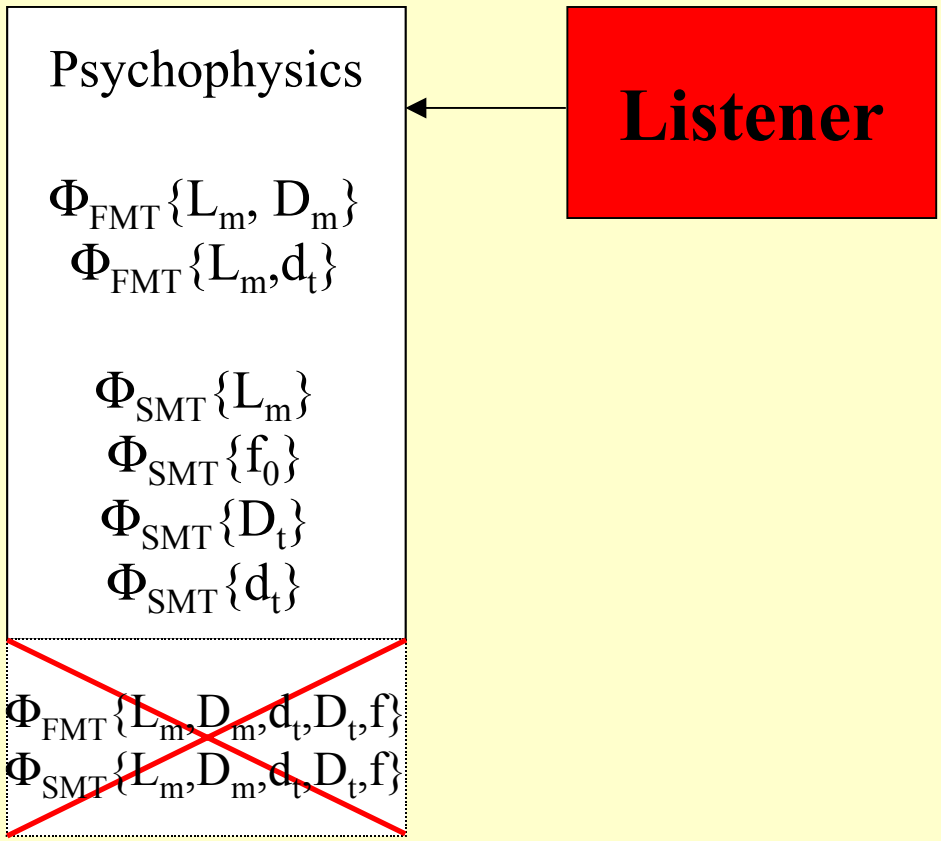
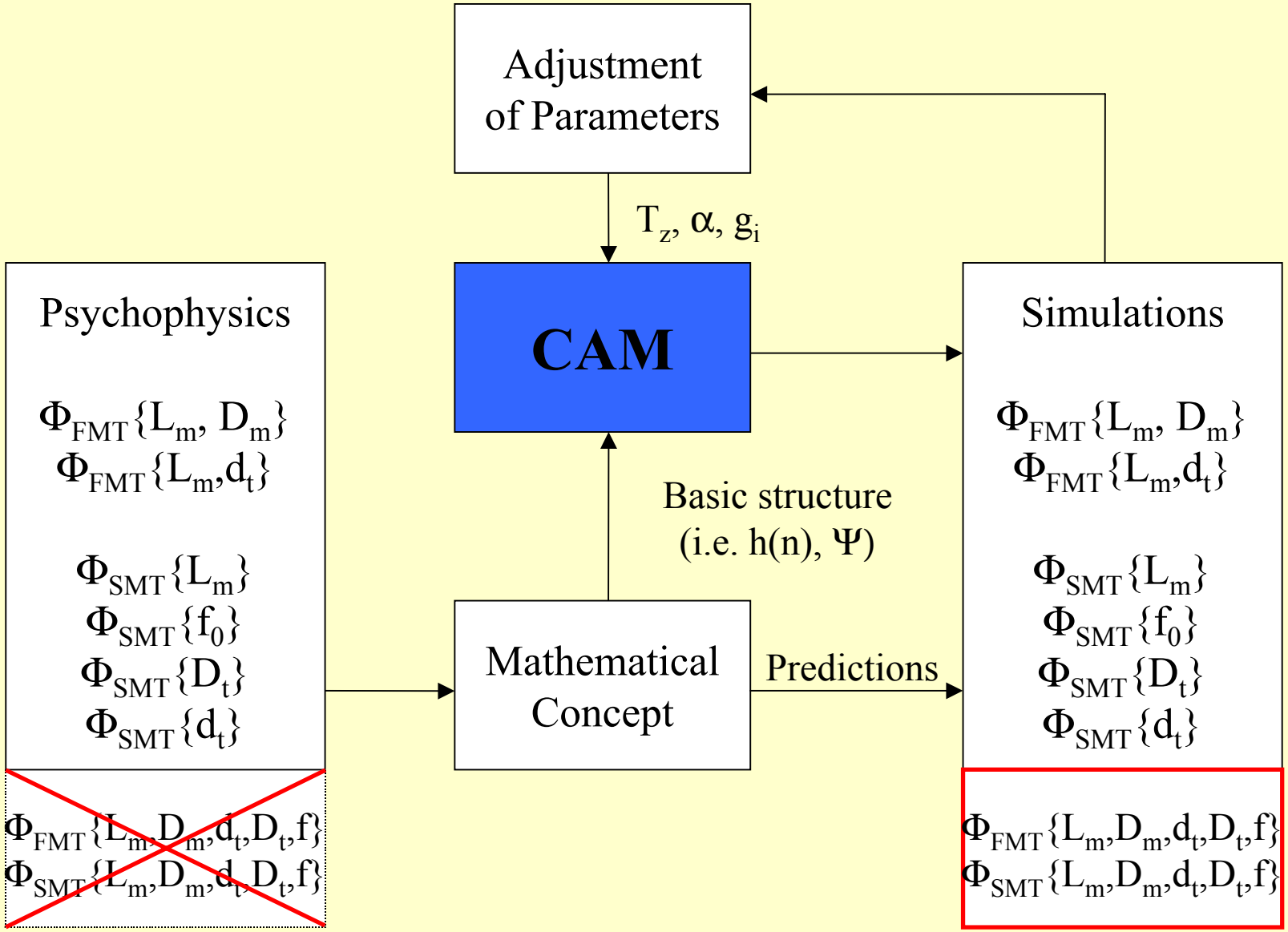
- Introduction
- Introduction to the CAM
- Description of a SDC concept/realization
- Masking simulations
- Signal processing examples
- Summary

CAM applied to masking (Development & Function)

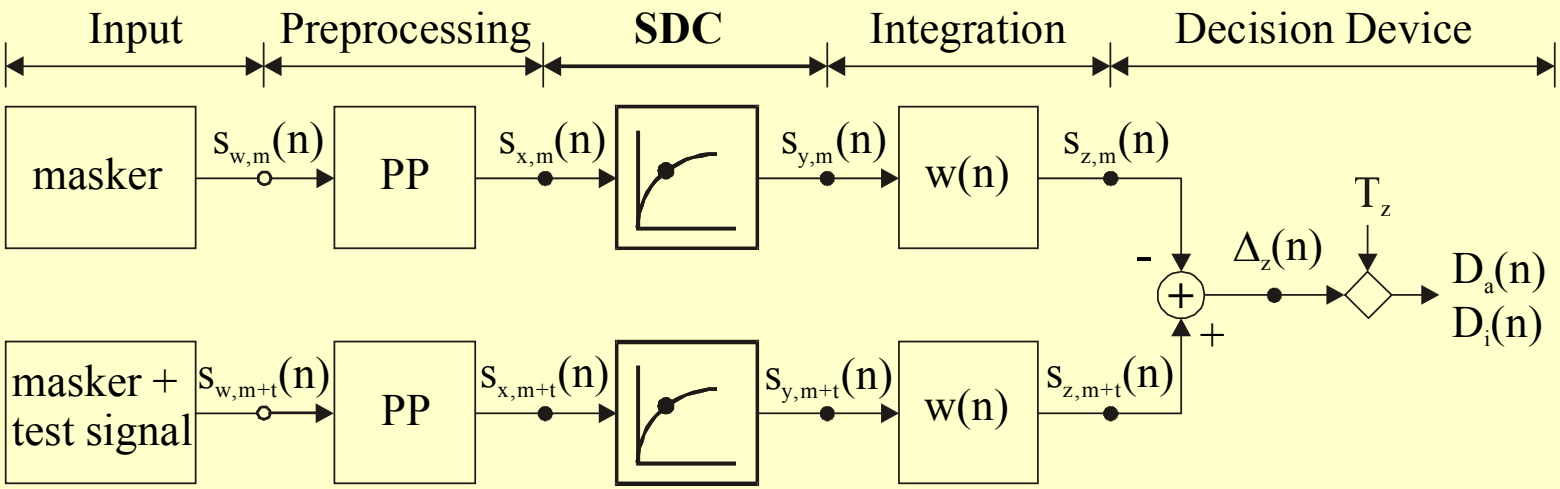


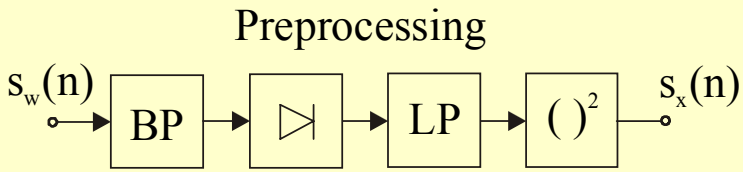
CAM applied to masking (Development & Function)



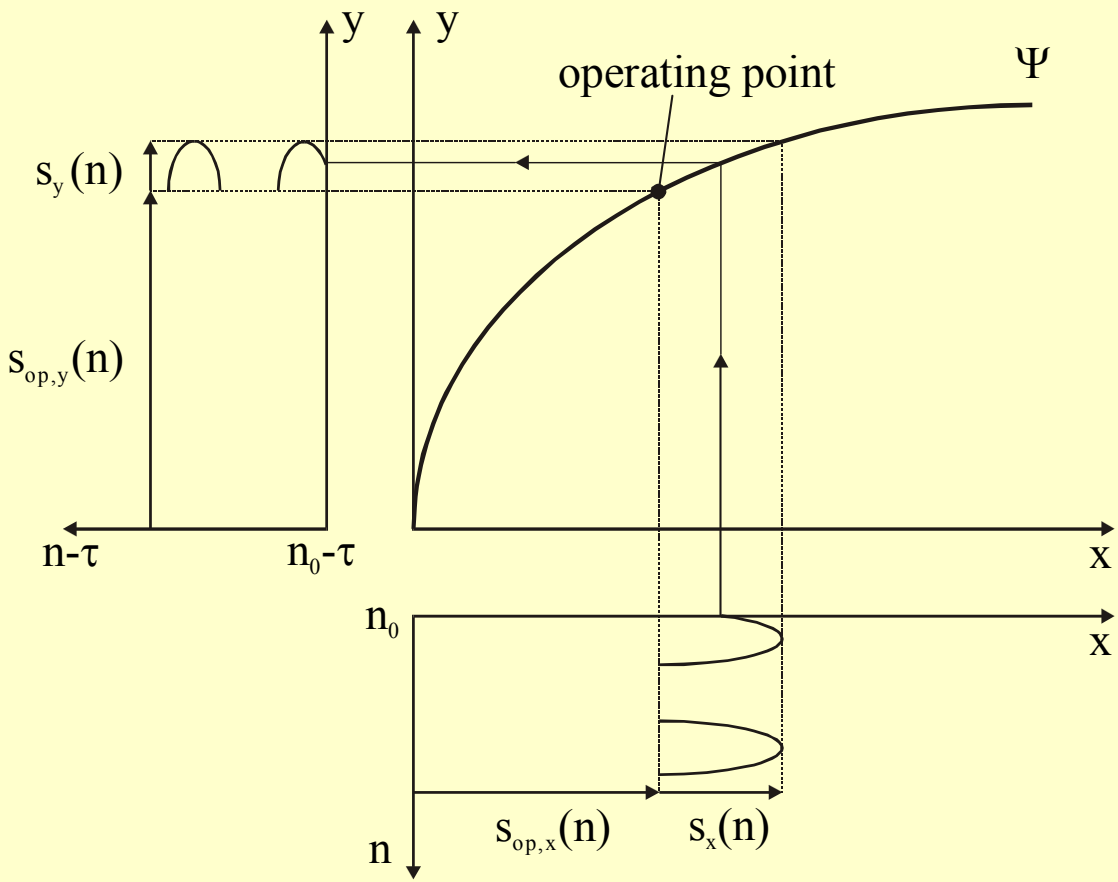
Computational Auditory Model (CAM) Block Diagram

One Frequency Channel !



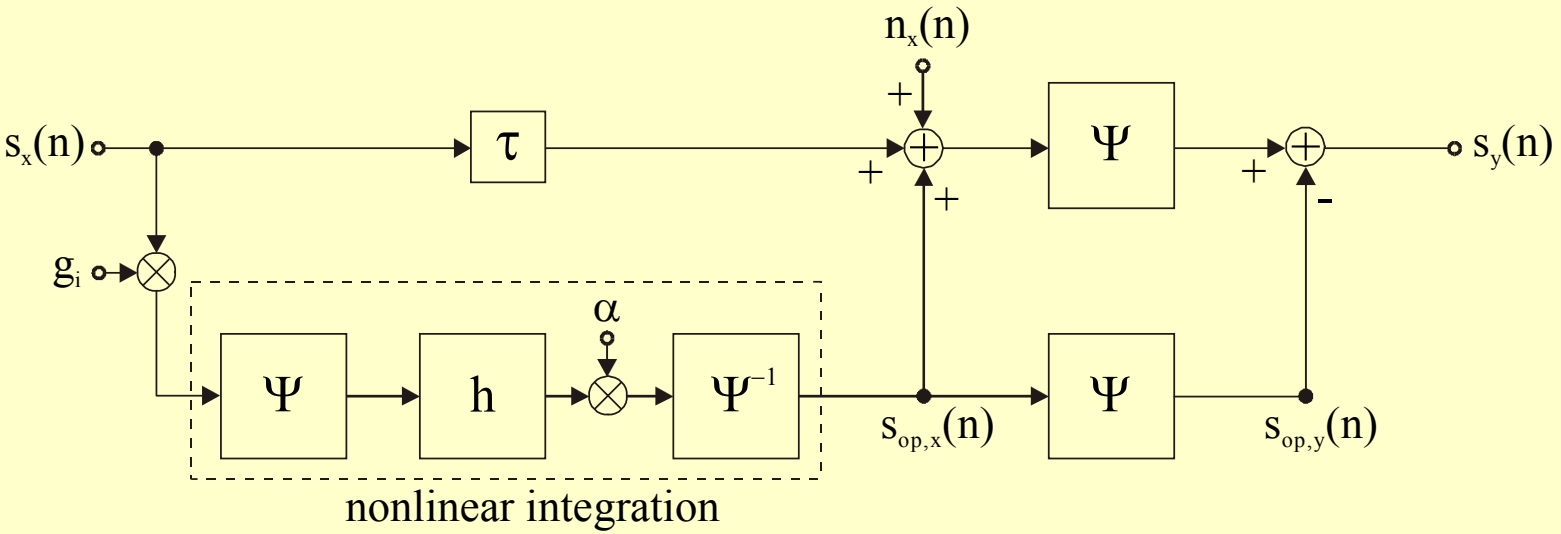


Principal Mechanism of the SDC



$$s_y(n) = \Psi\{s_x(n) + s_{op,x}(n)\} - \Psi\{s_{op,x}(n)\}$$

Block Diagram of the proposed SDC realization

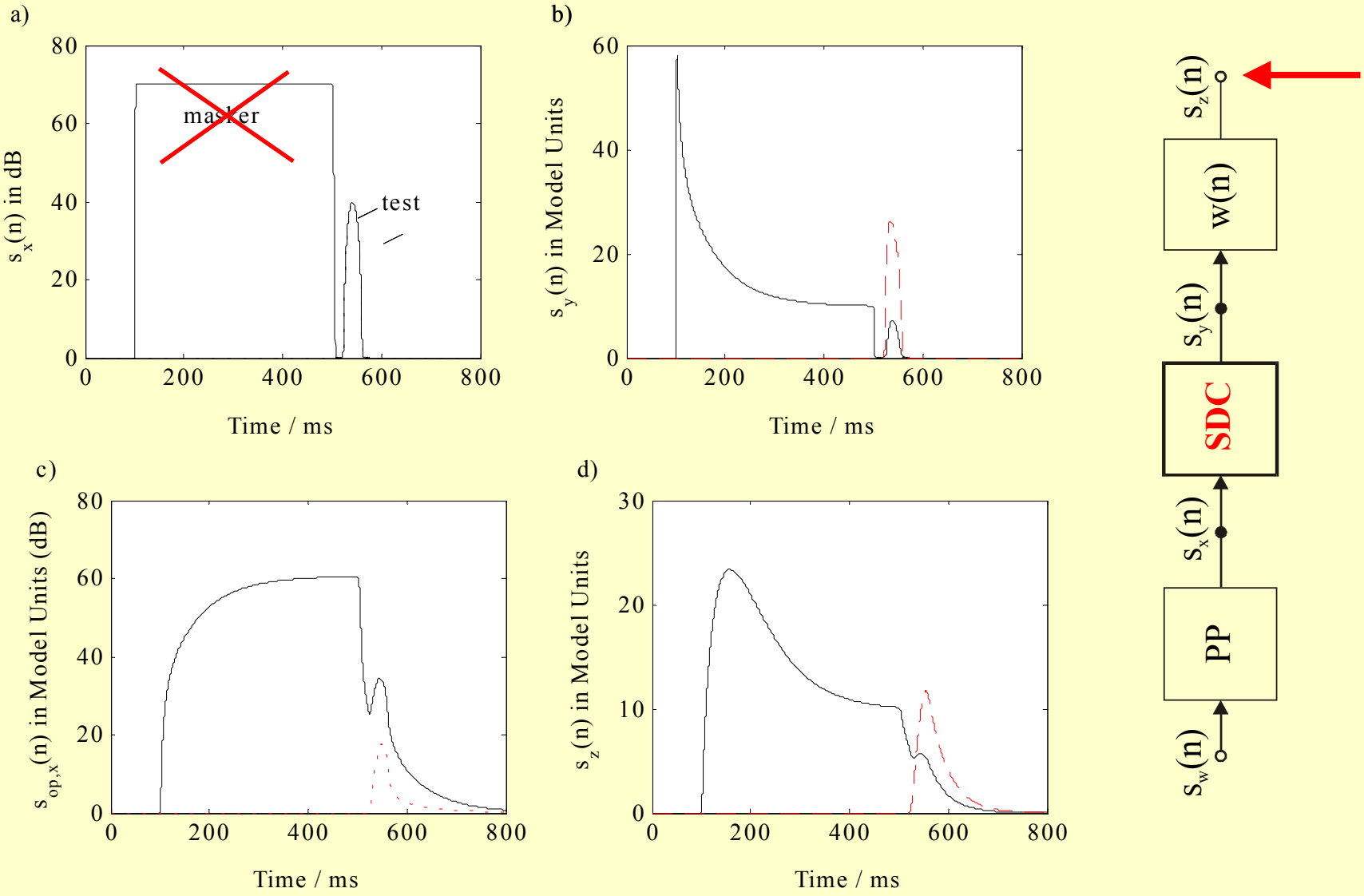


$$s_y(n) = \Psi\{s_x(n) + s_{op,x}(n) + n_x(n)\} - \Psi\{s_{op,x}(n)\}$$

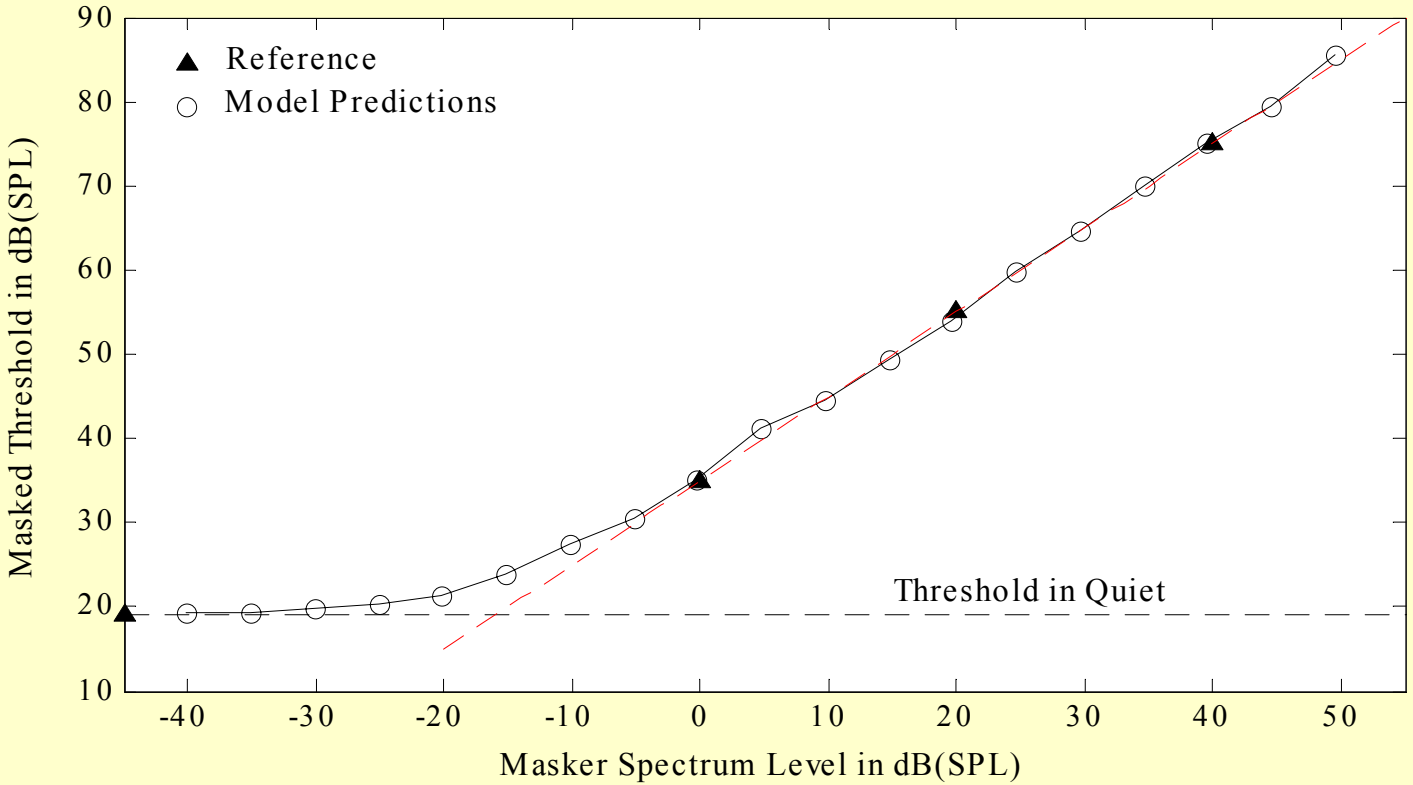
$$\Psi\{x\} = 10 \cdot \lg(x + 1)$$

$$h(n) \approx 1/n \qquad 3ms \cdot fa < n < 100ms \cdot fa$$

Signal Examples of the Computational Auditory Model



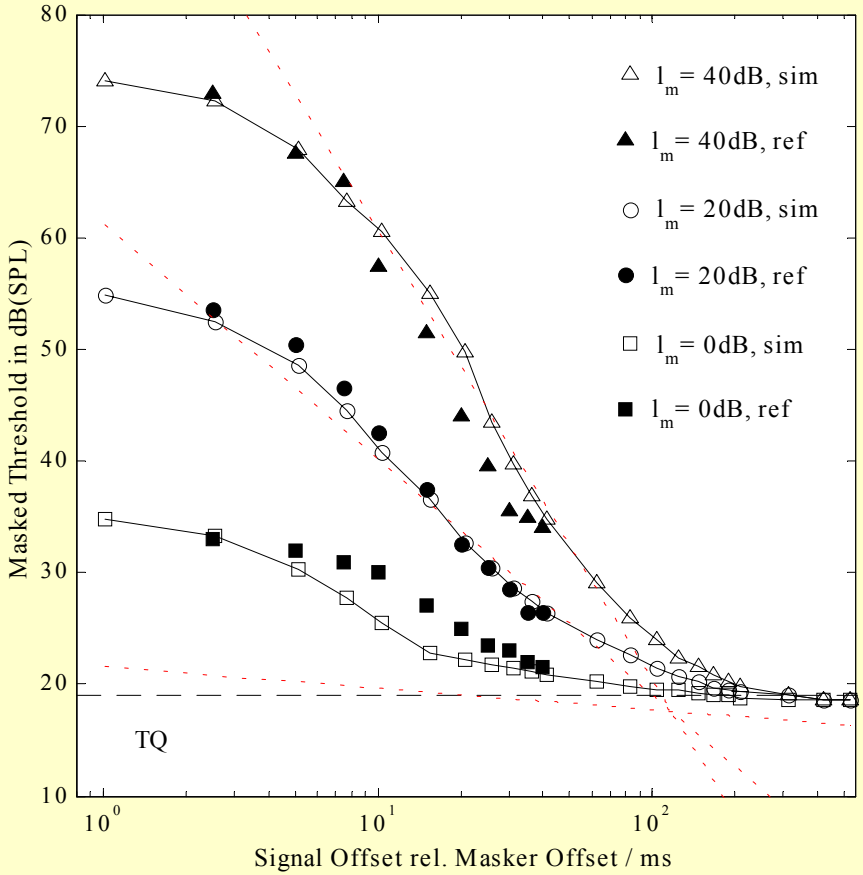
Simultaneous Masking (noise-on-tone): dependency on masker level



Webber‘s Law is satisfied!

$$\Phi_{SMT,dB} = L_m + b$$

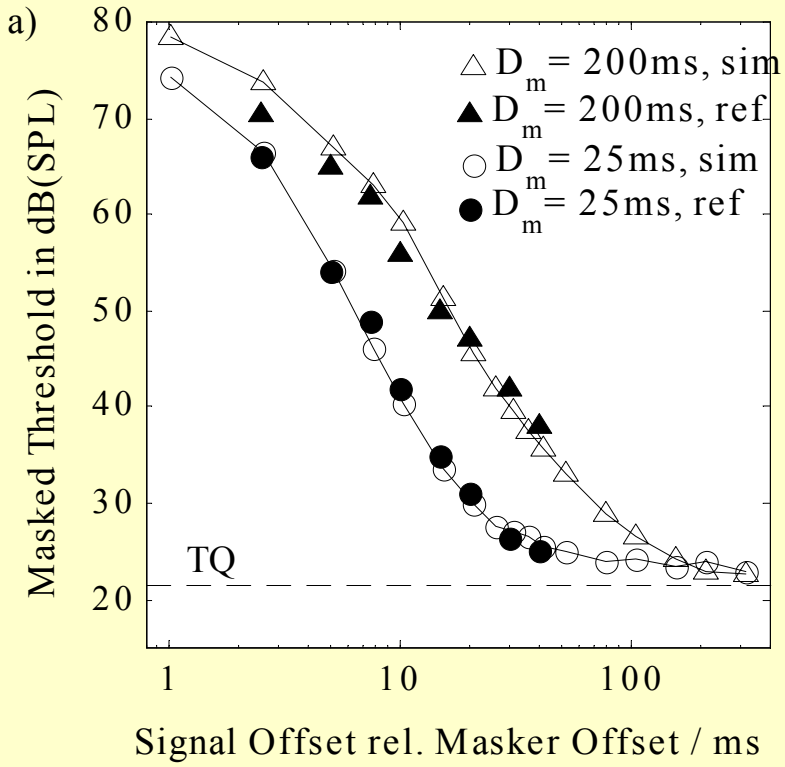
Forward Masking (noise-on-tone): dependency on masker level and test tone delay

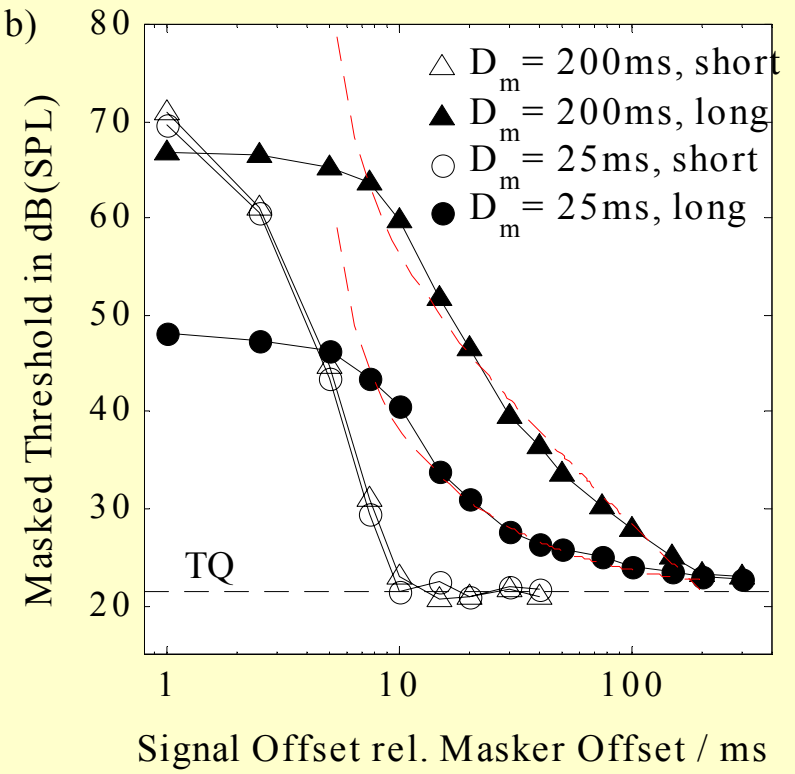


Approximation of the Function proposed by Jestead et al. (1982):

$$\Phi_{FMT,dB} = M_{TQ} + a \cdot [b - \lg(d_t)] \cdot [L_m - c^*]$$

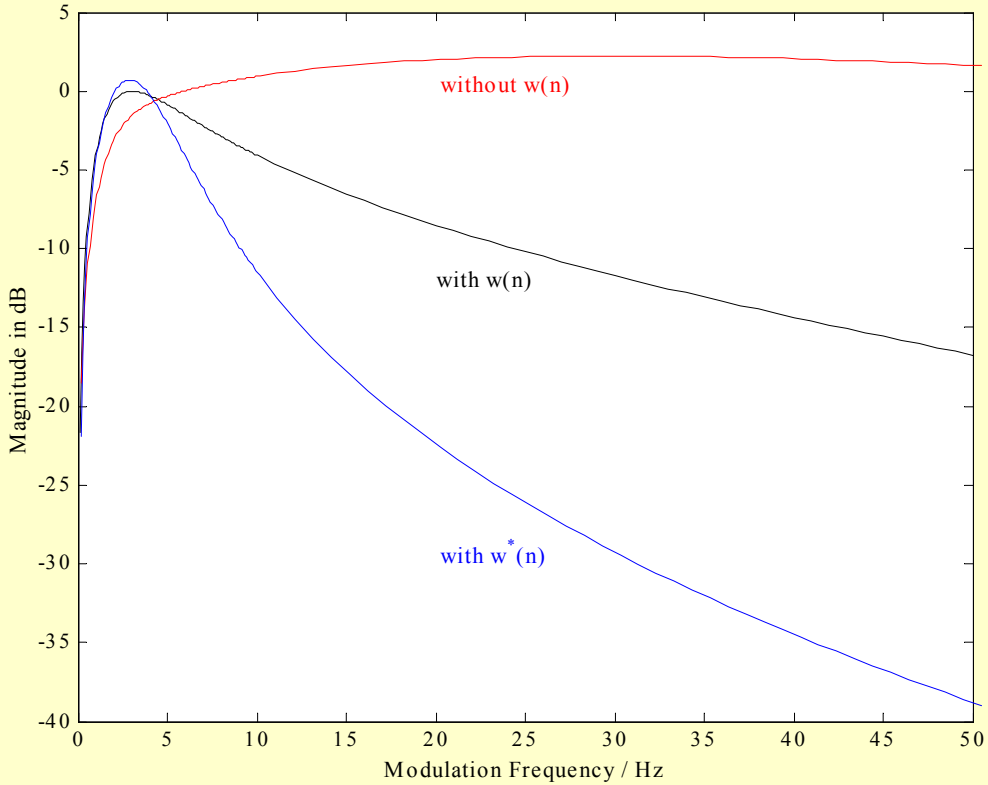
Forward Masking (noise-on-tone): dependency on masker duration

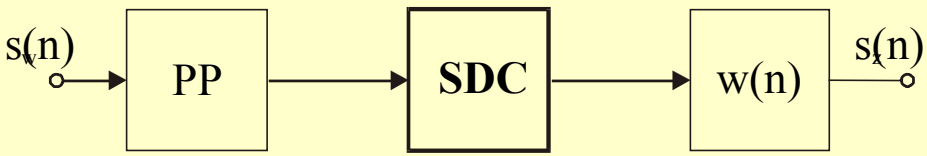




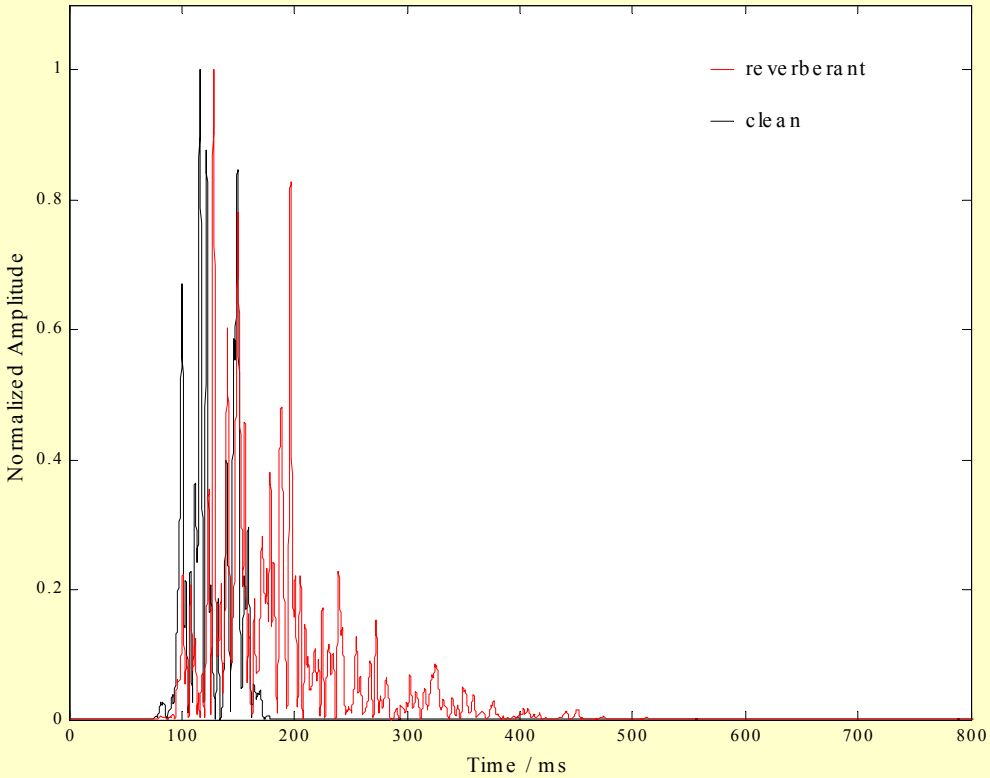
$$\Phi_{FMT,dB} = M_{TQ} + a \cdot [L_m - c^*] \cdot [\lg(D_m + d_t') - \lg(d_t')]$$

Modulation Transfer Function of the proposed Auditory Model

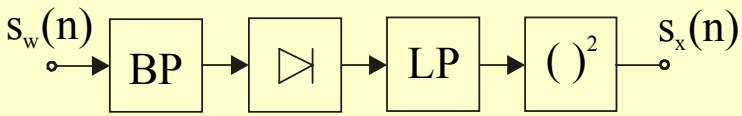




Signal processing example (broadband noise)
Static Compression



Preprocessing



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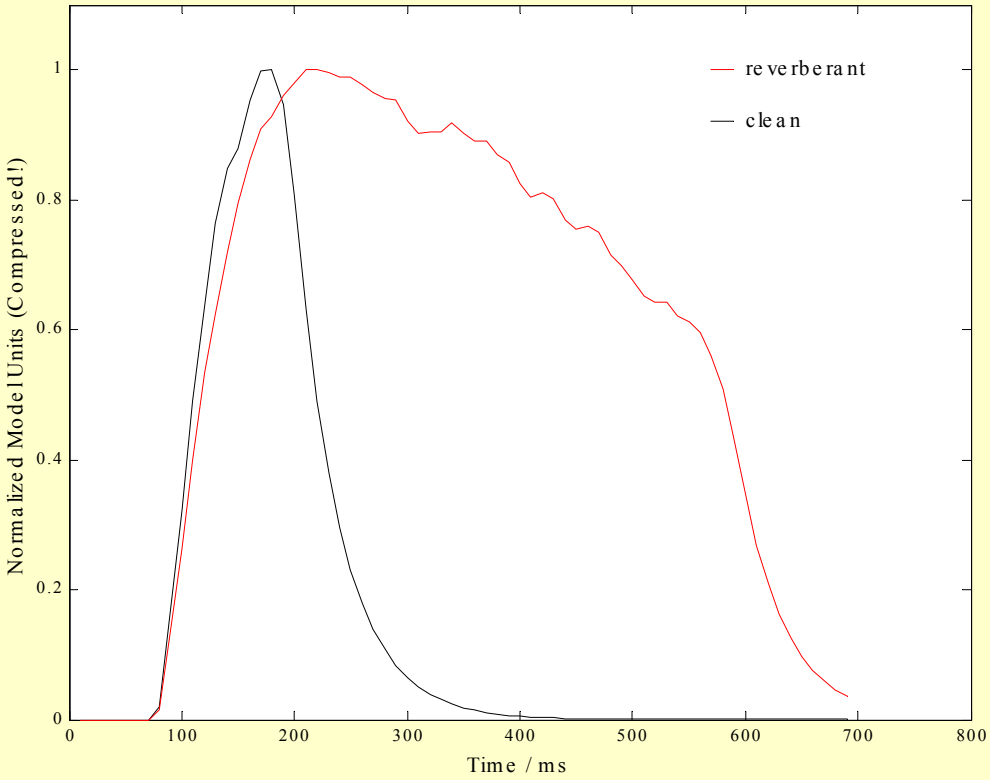
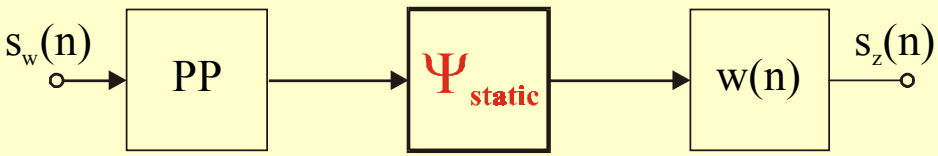
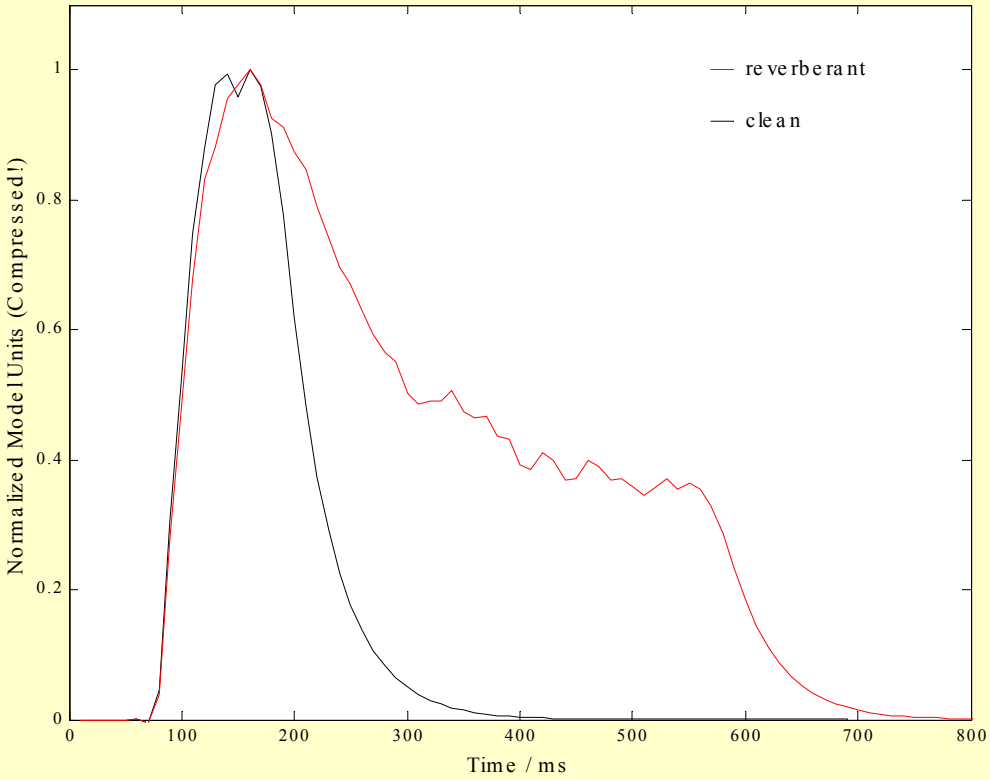
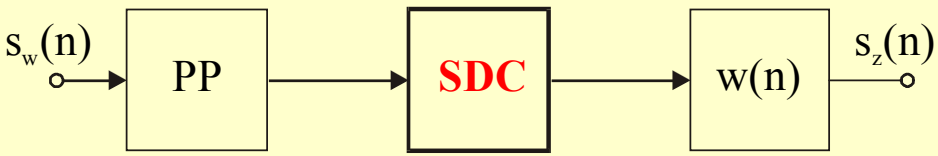
Static Compression



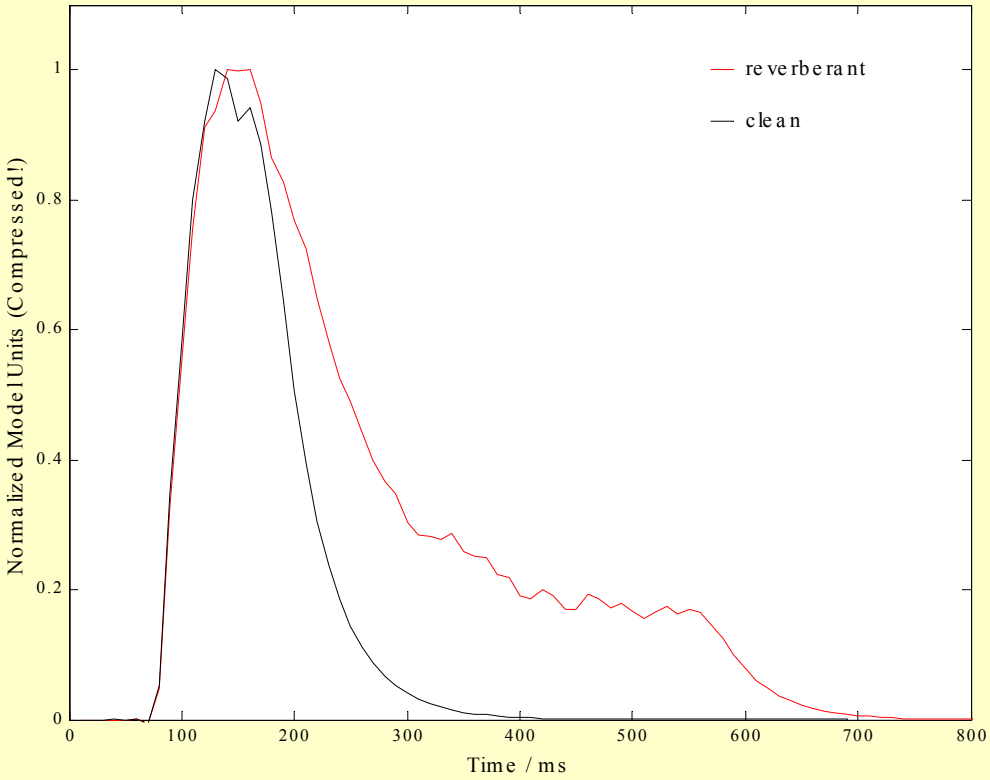


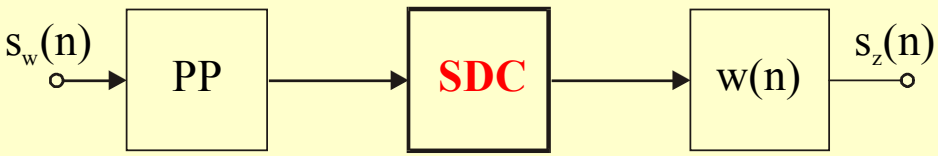
Signal processing examples (broadband noise)
SDC (g_i = 0,15 ; a = 0.985)



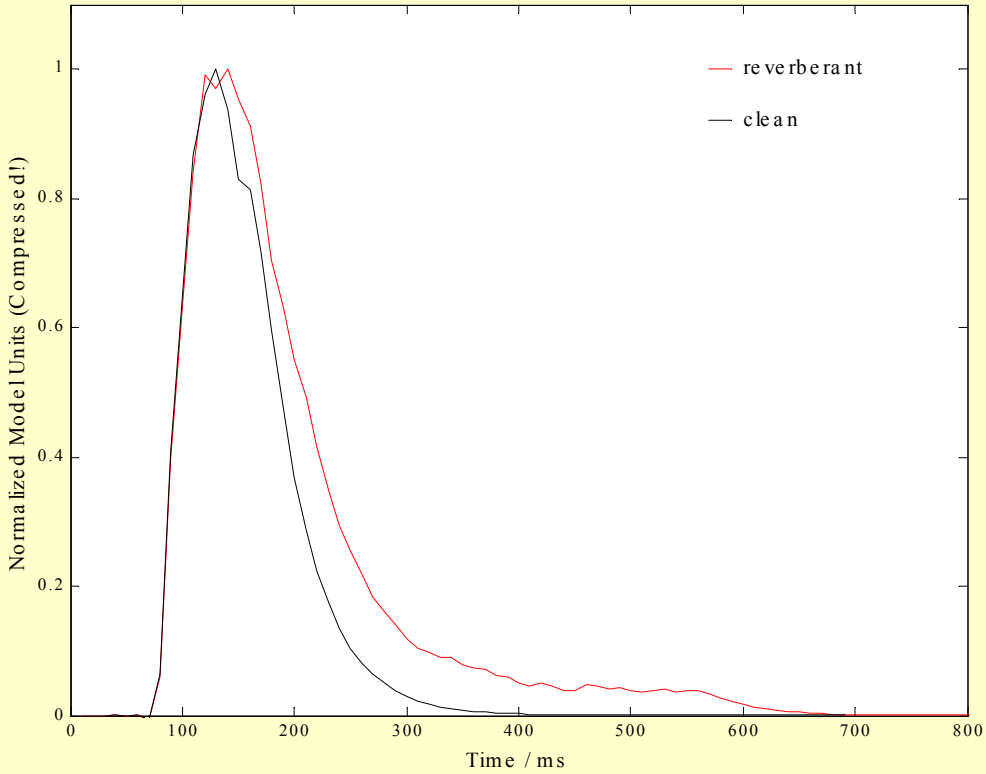


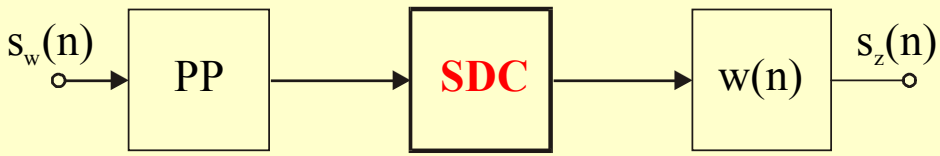
Signal processing examples (broadband noise)
SDC ($g_i = 1$; a = 0.985)





Signal processing examples (broadband noise)
SDC (g_i = 10 ; a = 0.985)





Summary (SDC properties)

- simulation of psychophysical masking
- simulation of auditory adaptation processes
- emphasizes on the modulation frequencies of Speech
- explicit utilization of the basilar-membrane non-linearity
- based on a mathematical concept
  → *small number of free parameters*
  → *analytical description of masking*
- computationally efficient
- clear feed-forward structure
  → *simple stability control*