

Vad vet vi om bullerreduktion i  
hörapparater?

Mätningar på 12 moderna  
hörapparater

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## Method

- Programming
  - default prescription
- Hearing aid
  - Mic, OMNI
  - MPO, MAXIMAL
  - Expansion, OFF
  - VC, OFF
  - Feedback reduction, OFF
  - Other sig. proc., OFF
- Equipment
  - Equinox HIT440, IA
  - TBS25 test box, IA
  - 711 coupler, GRAS
  - Mic (ref./meas.), GRAS
- Measurements
  - Pre-conditioning  
30 seconds
  - Long-term average  
30 seconds

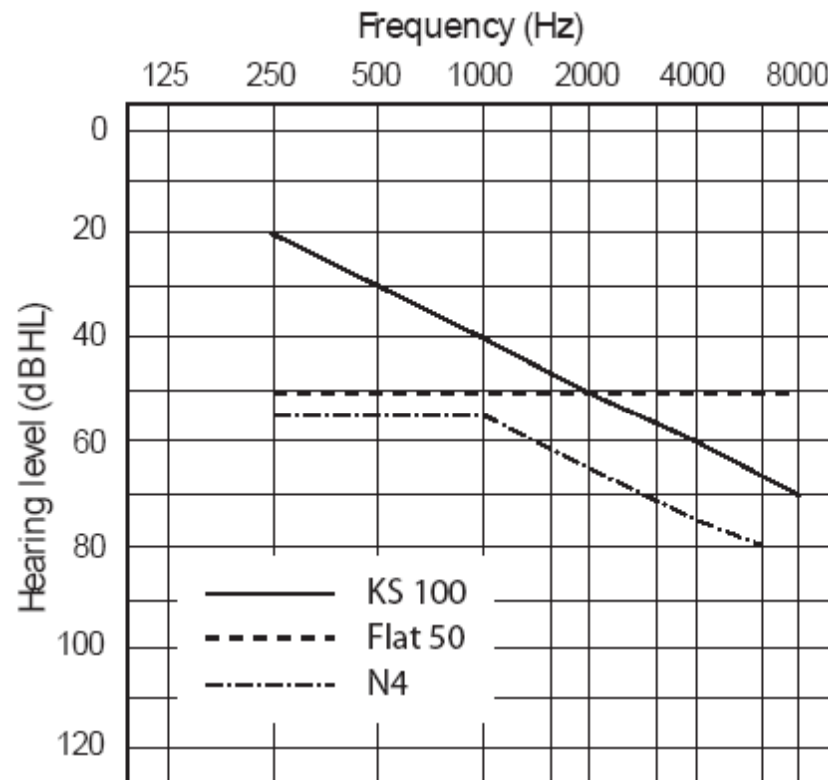
"Classification of steady state gain reduction produced by amplitude modulation based noise reduction in digital hearing aids" by Hoetink AE, Körössy L, and Dreschler WA. Int J Audiol, 48, 2009, 444-455.

## Method

- Measurement signals
  - ISTS (ISMADHA draft)
  - ICRA1 (stationary speech-weighted noise)
- Variables
  - SNR in the input signal (8 different)
    - "Speech", +6 dB, +3 dB, 0 dB, -3 dB, -6 dB, -9 dB, -12 dB
  - Sound pressure level (fixed speech level)
    - 62 and 75 dB SPL (ANSI S3.5)
  - Audiogram (3 different)
    - KS100, Flat50, N4



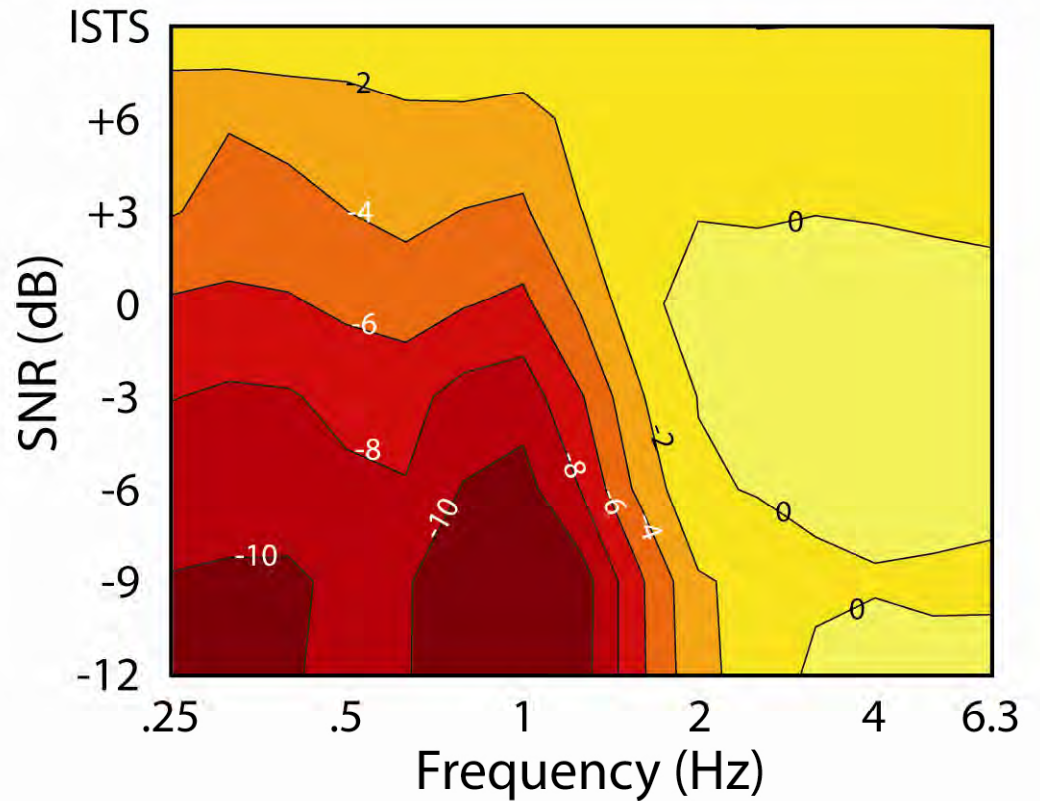
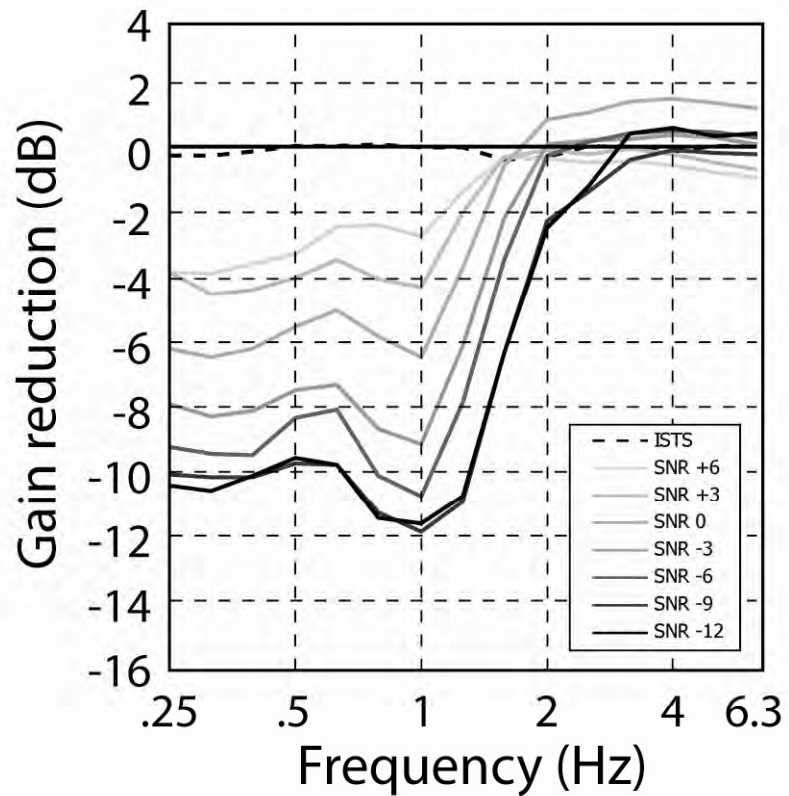
# Audiogram

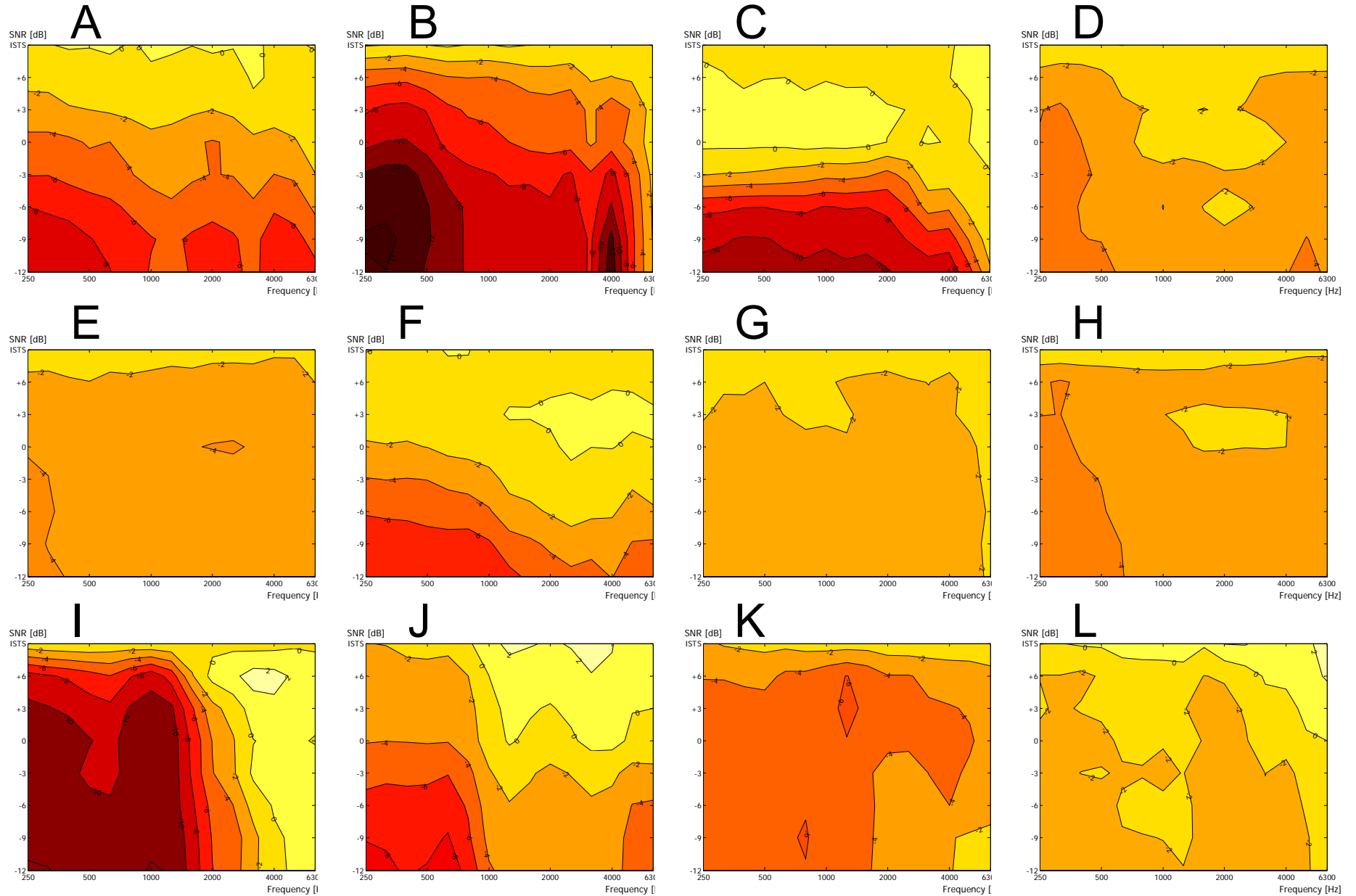


# Gain reduction

Gain reduction = ON - OFF

Reduction contours





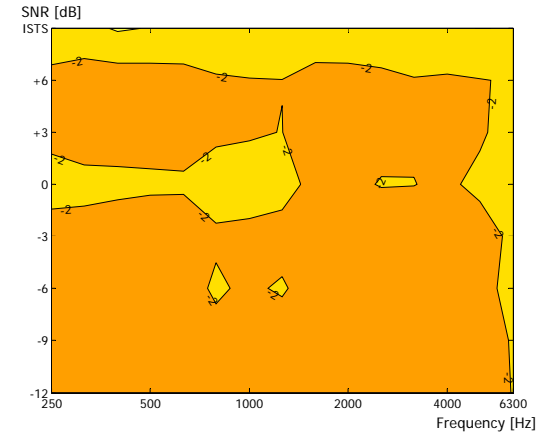
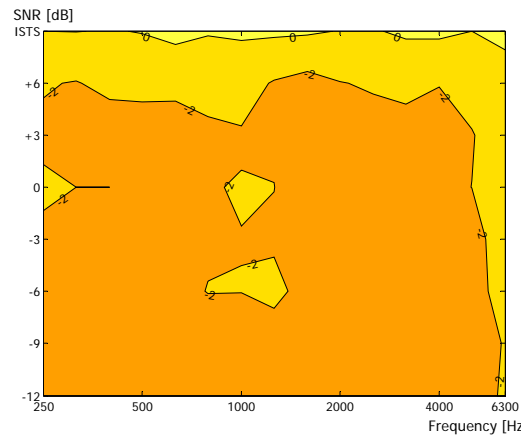
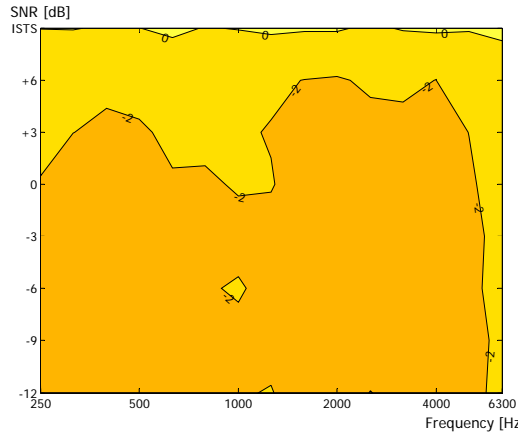
Least reduction and "least difference": G

## KS100

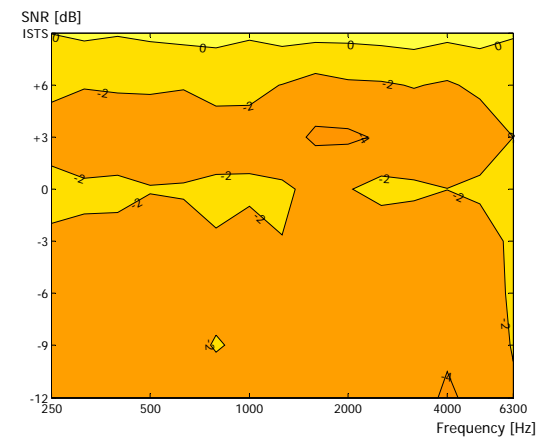
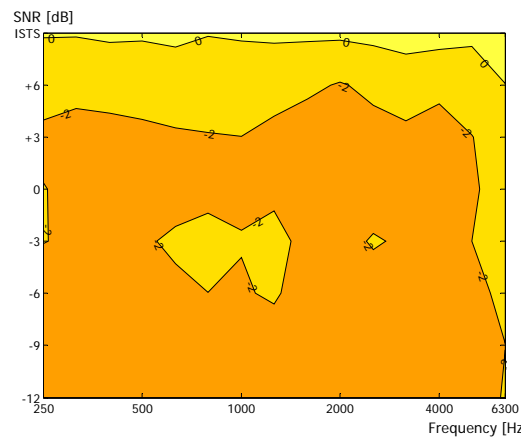
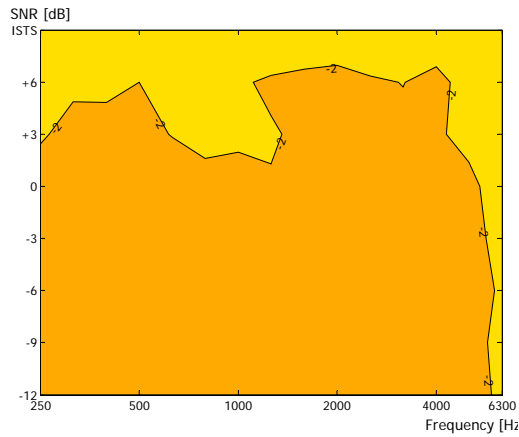
## Flat50

## N4

62 dB  
SPL



75 dB  
SPL



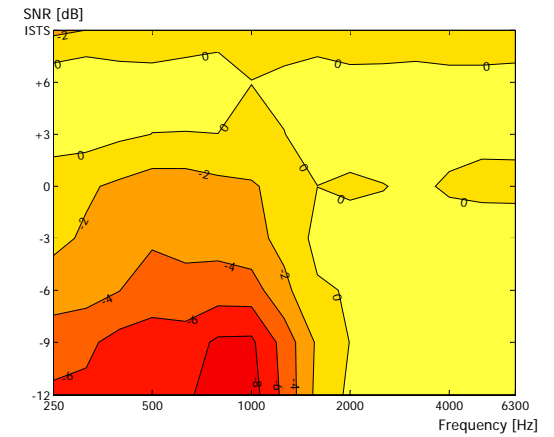
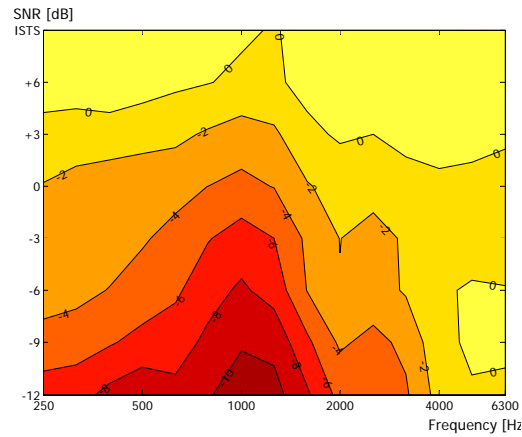
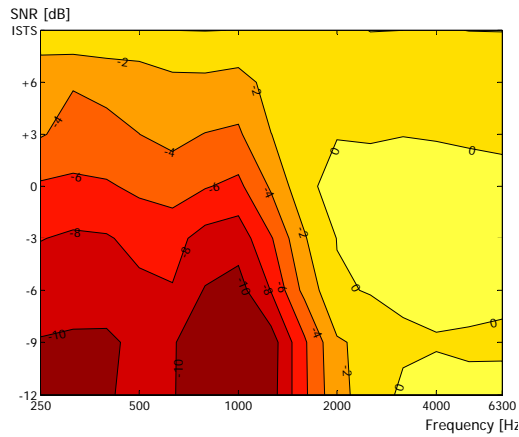
Largest reduction and  
"largest difference": I

## KS100

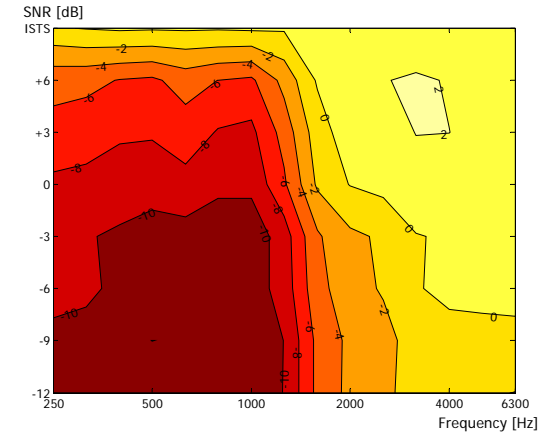
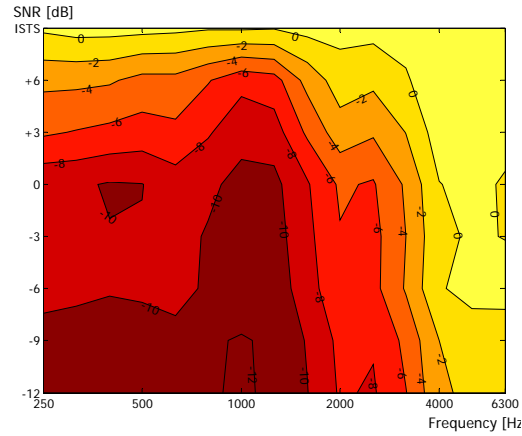
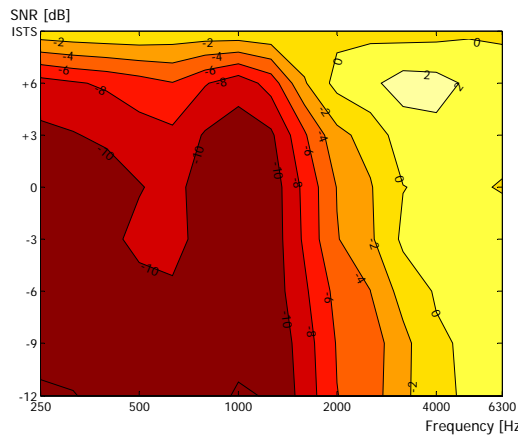
## Flat50

## N4

62 dB  
SPL



75 dB  
SPL



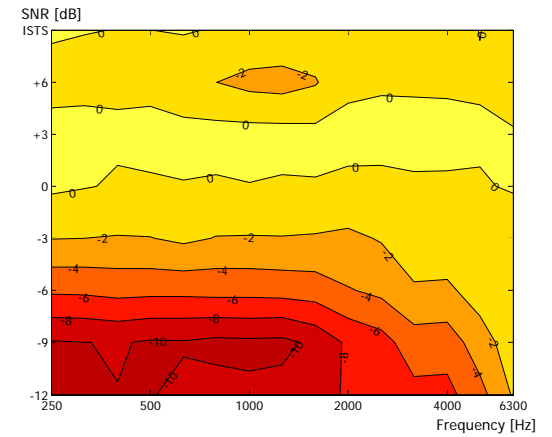
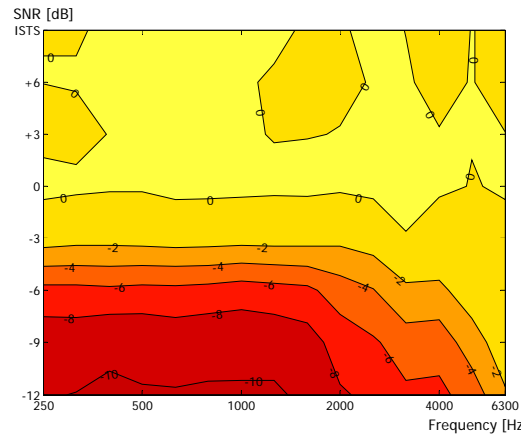
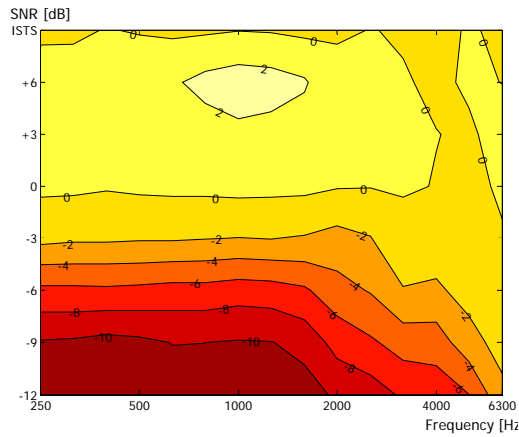
Large reduction and "small difference": C

## KS100

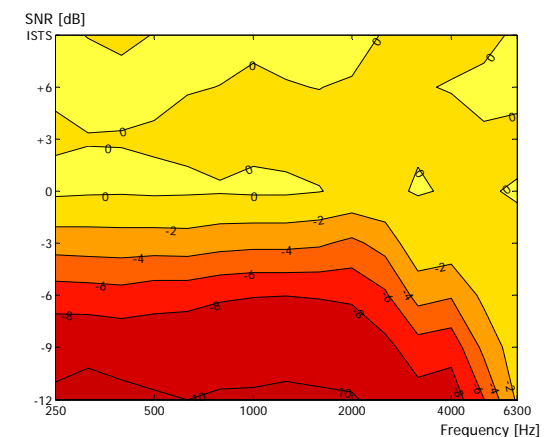
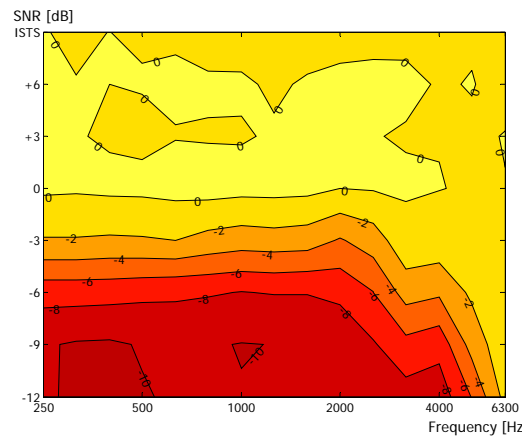
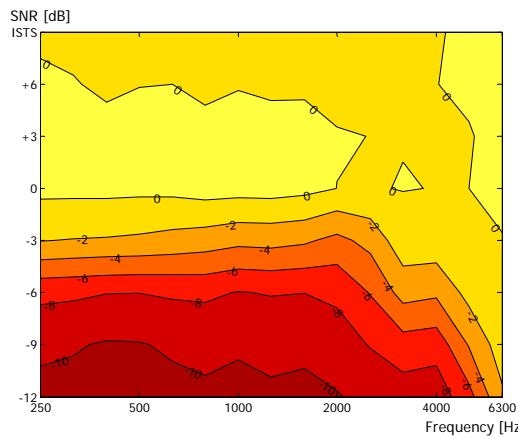
## Flat50

## N4

62 dB  
SPL



75 dB  
SPL

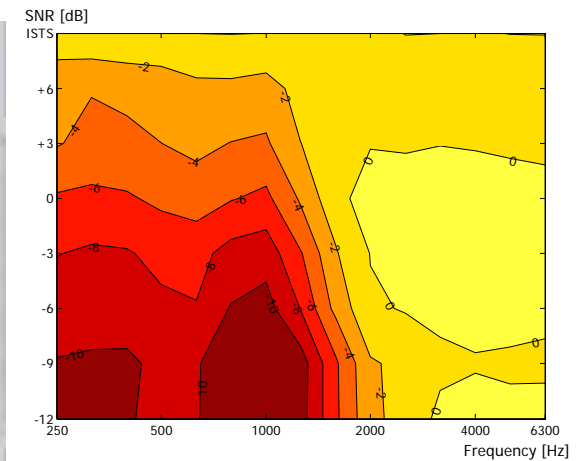
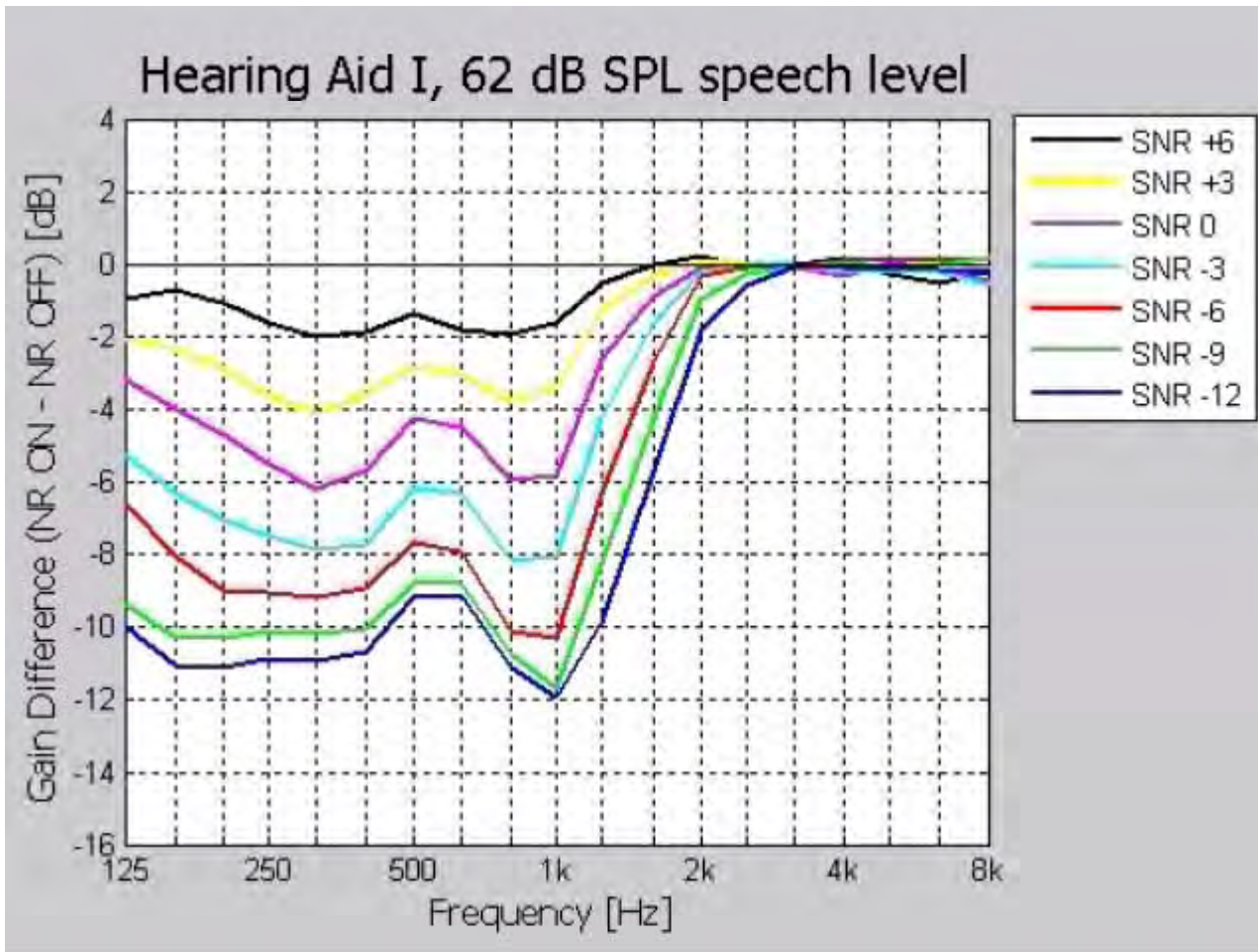


## Summary

- Large differences!
- Limitations
  - Long-term average reductions
  - We do not know how hearing-aid users perform with the various NR systems
- Next step: Short-term average reductions

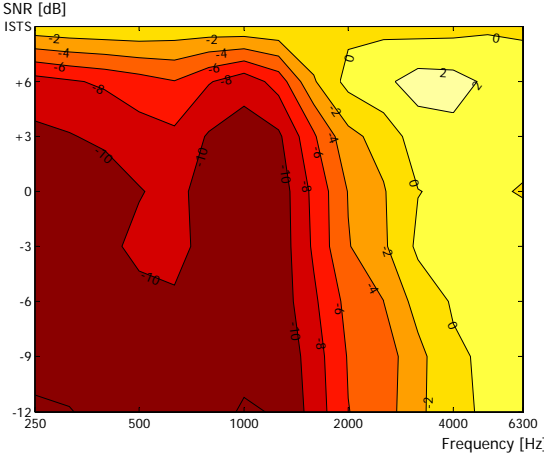
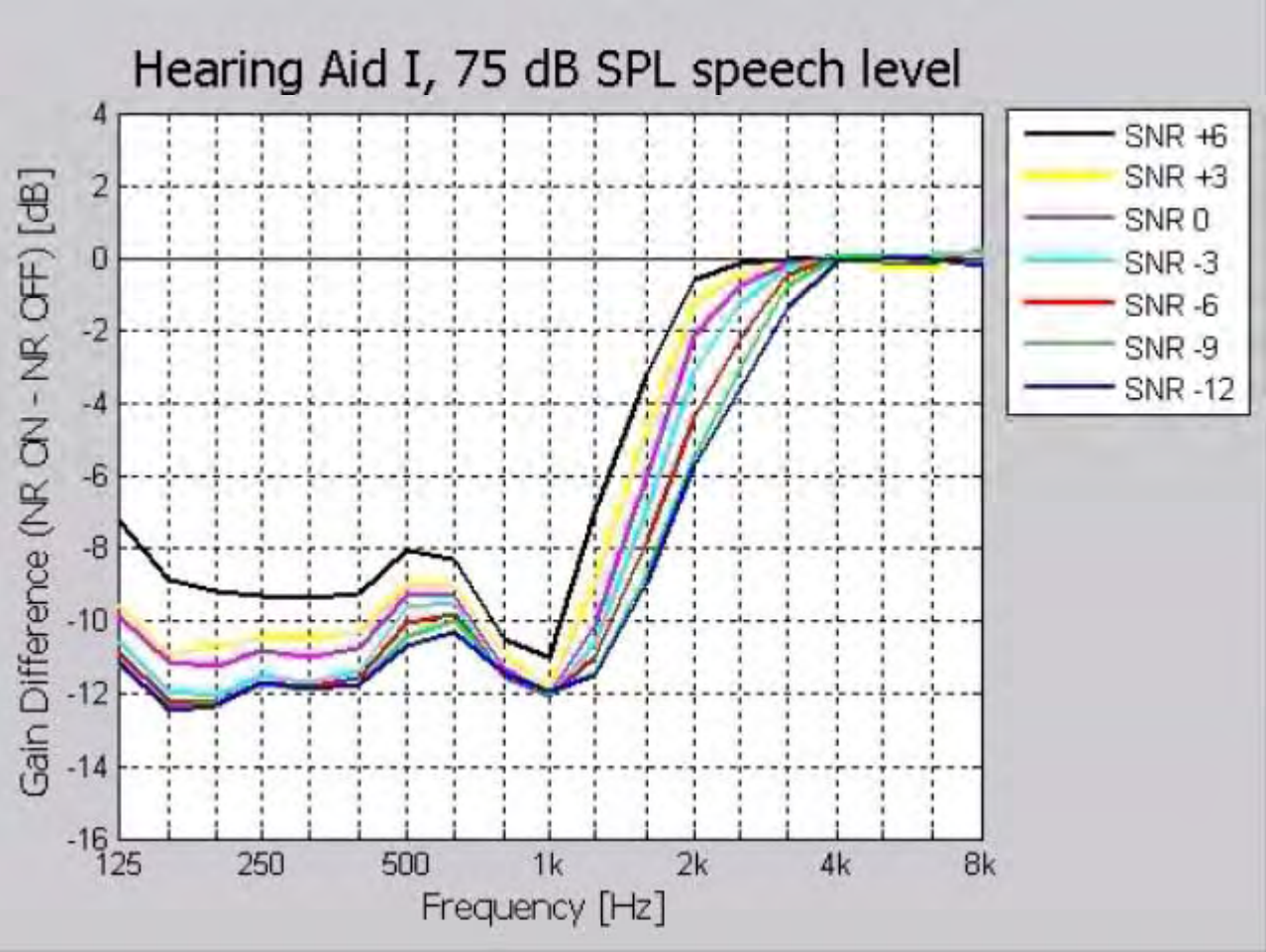
## Method

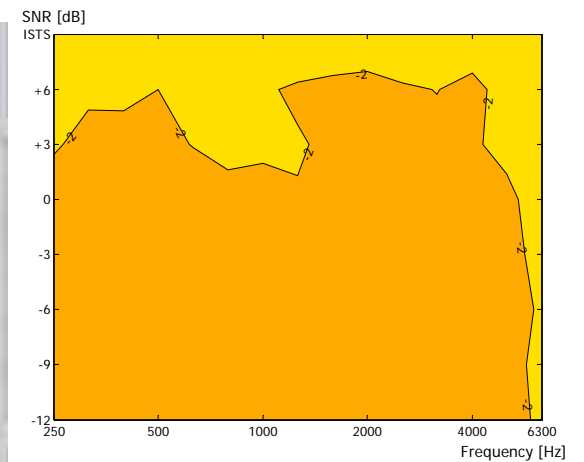
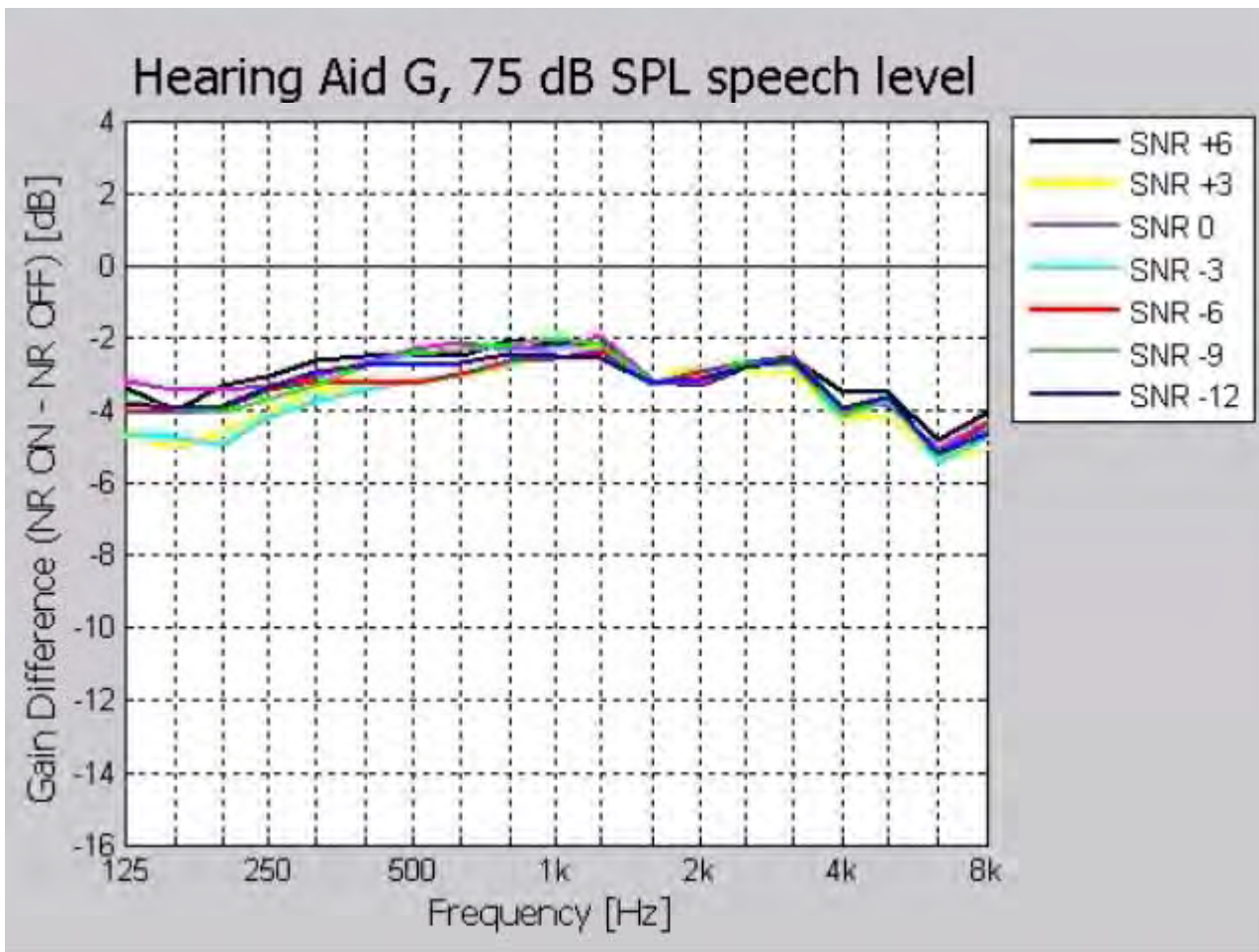
- Programming
    - default prescription
  - Hearing aid
    - Mic, OMNI
    - MPO, MAXIMAL
    - Expansion, OFF
    - VC, OFF
    - Feedback reduction, OFF
    - Other sig. proc., OFF
  - Equipment
    - Recordings sound card
- MATLAB processing
  - TBS25 mätbox, IA
  - 711 coupler, GRAS
  - Mic (ref./meas.), GRAS
- Measurements
  - Pre-conditioning: 30 s
  - Short-term average (1/3-oct): 125 ms
  - Updated every 40 ms
  - Hagerman sentences in ICRA1 noise
  - KS100 audiogram

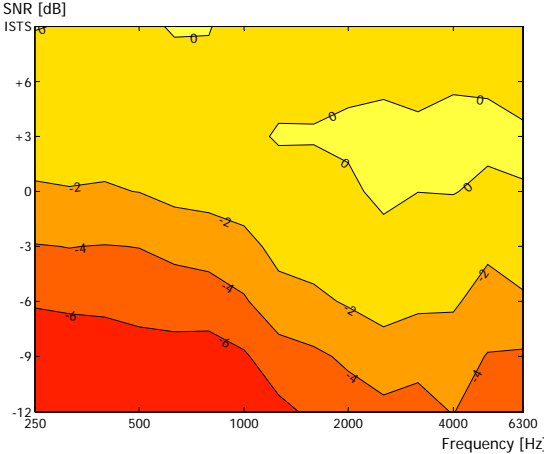
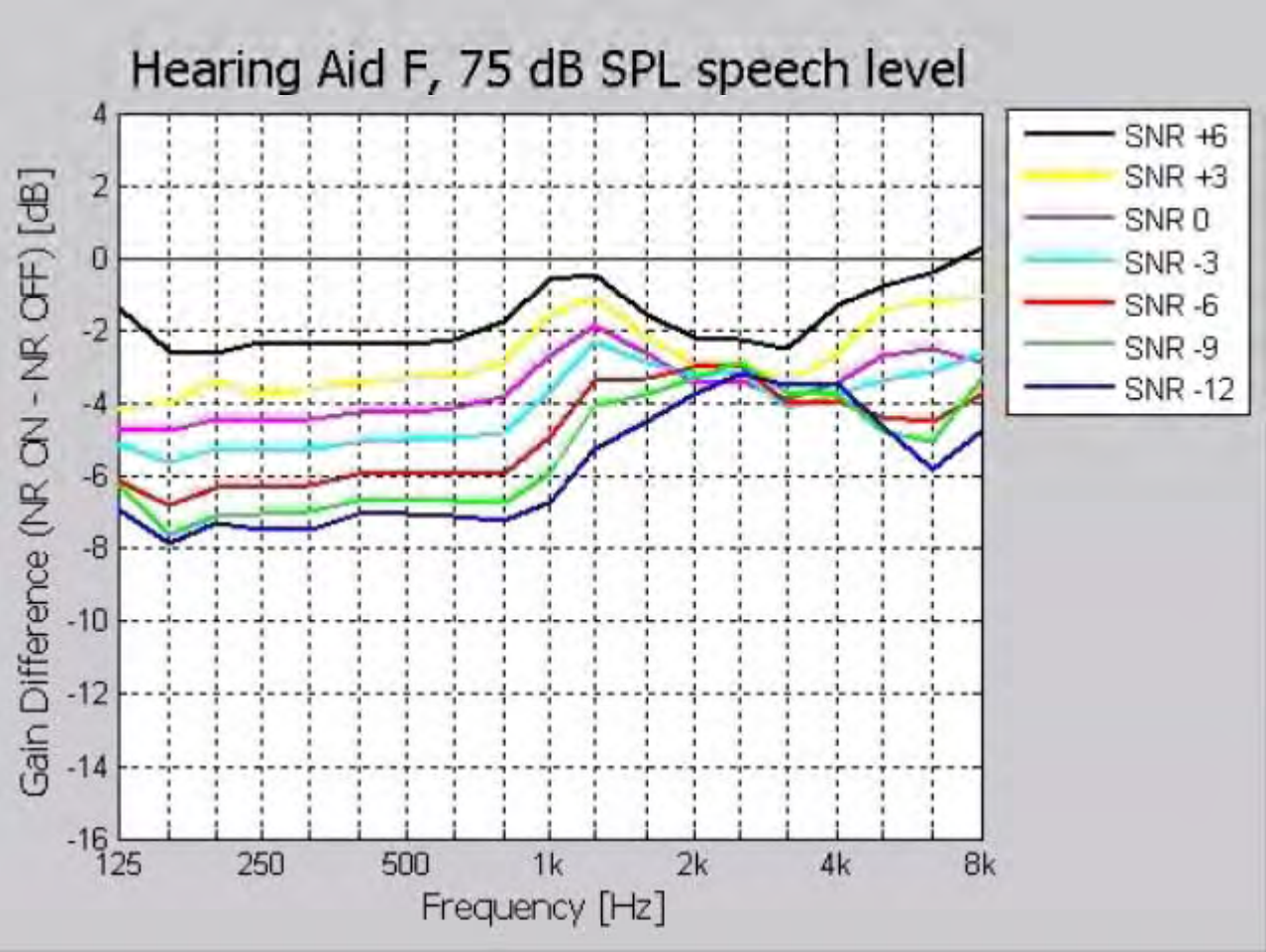


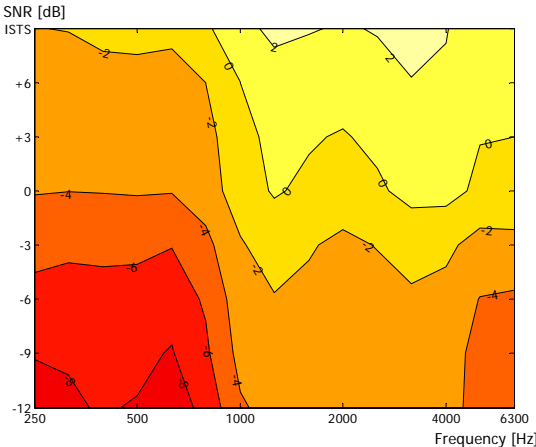
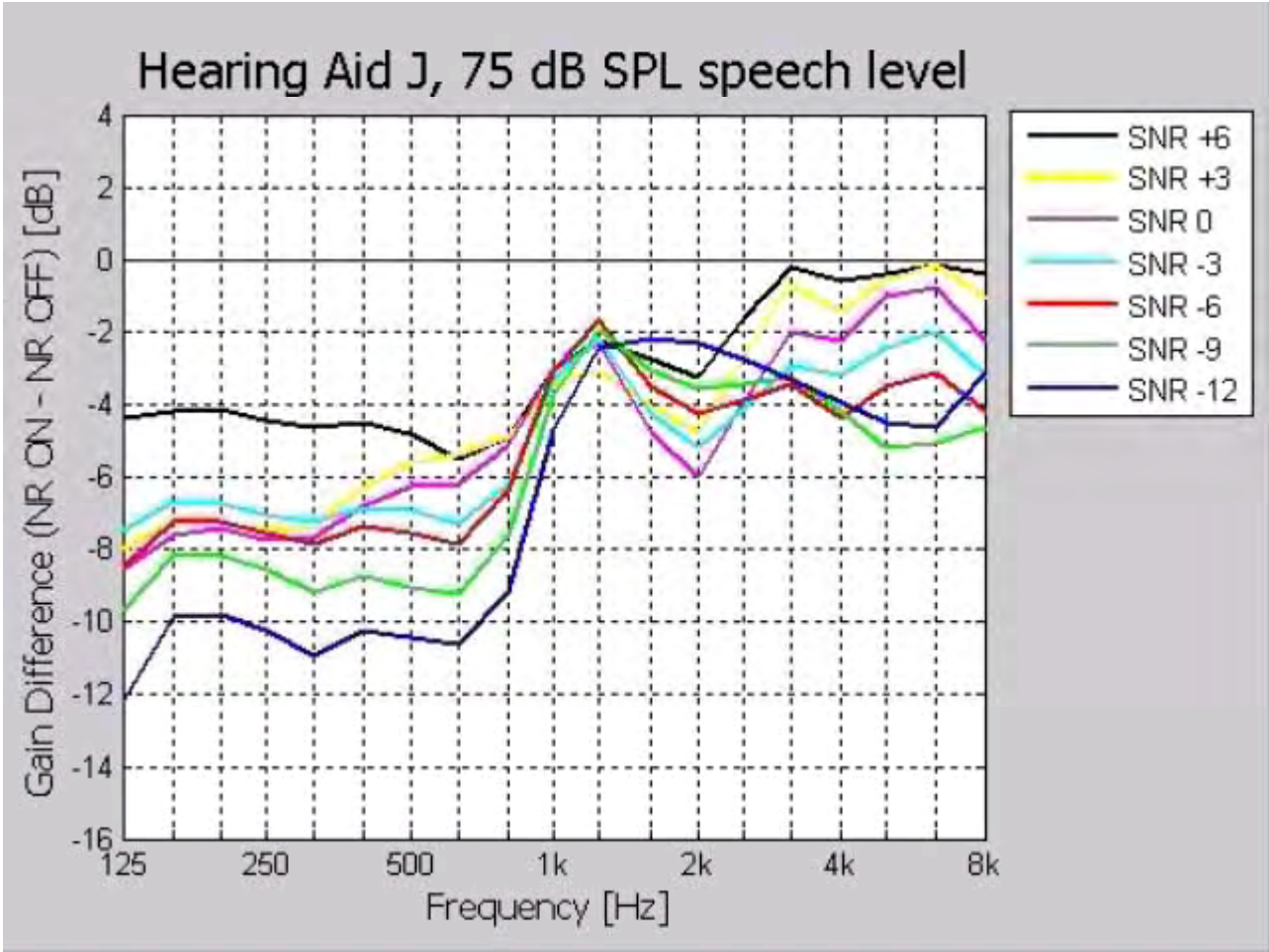
14 measurements  
(7 SNR, NR on/off)  
in the same figure.

We will listen to the  
speech signal  
without noise.









## Summary

- Large differences in how the various NR systems work!
- The short-term aspects are needed to describe the noise reduction systems (and they most likely have perceptual relevance)
- Clinical relevance?
- Future work
  - Evaluate the systems with hearing-impaired listeners...



Thank you for your attention!

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