

Adaptive Noise Cancelling applied to OAE

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“Read the old papers”

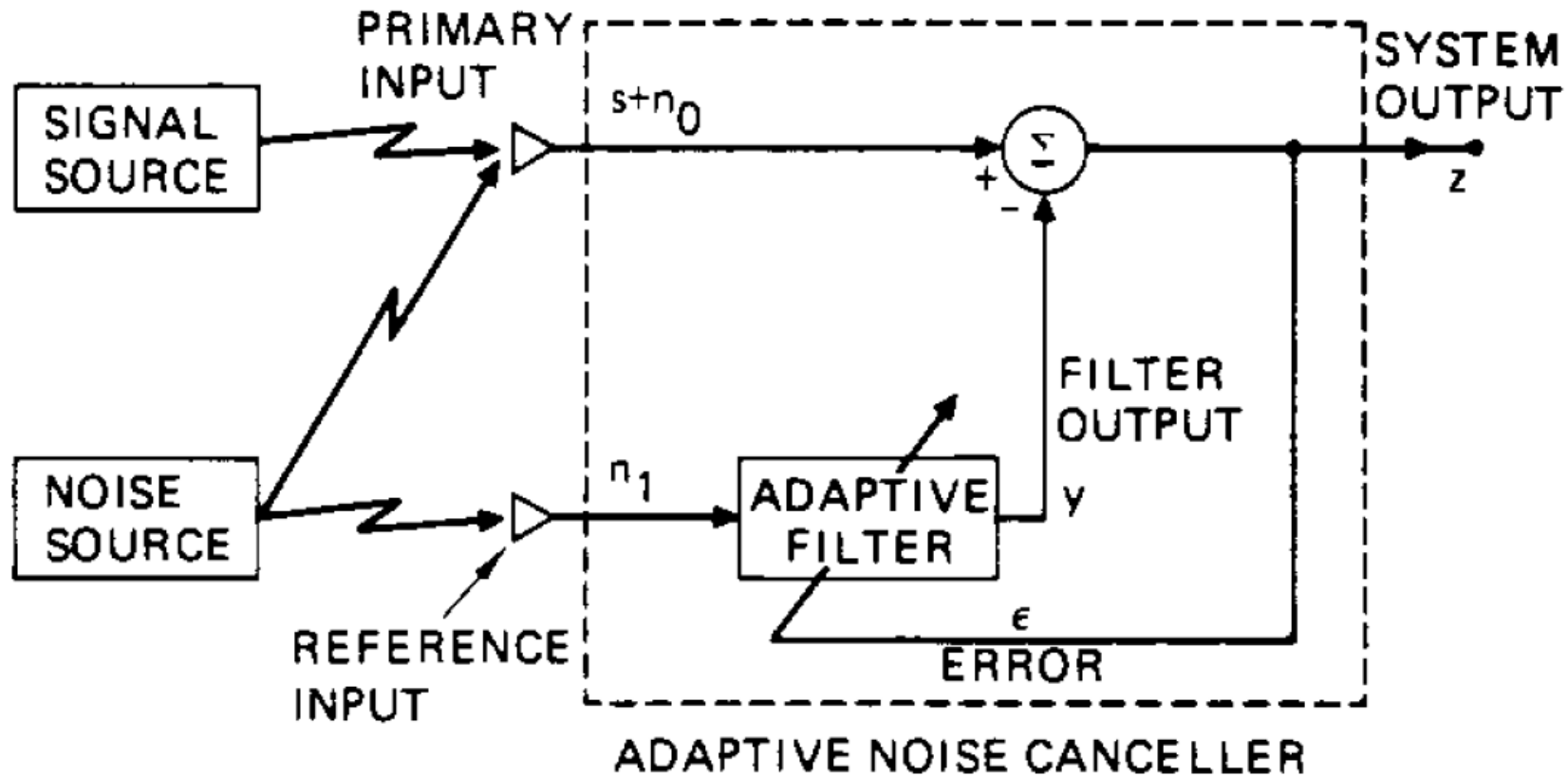


Fig. 1. The adaptive noise cancelling concept.

Applied to OAE

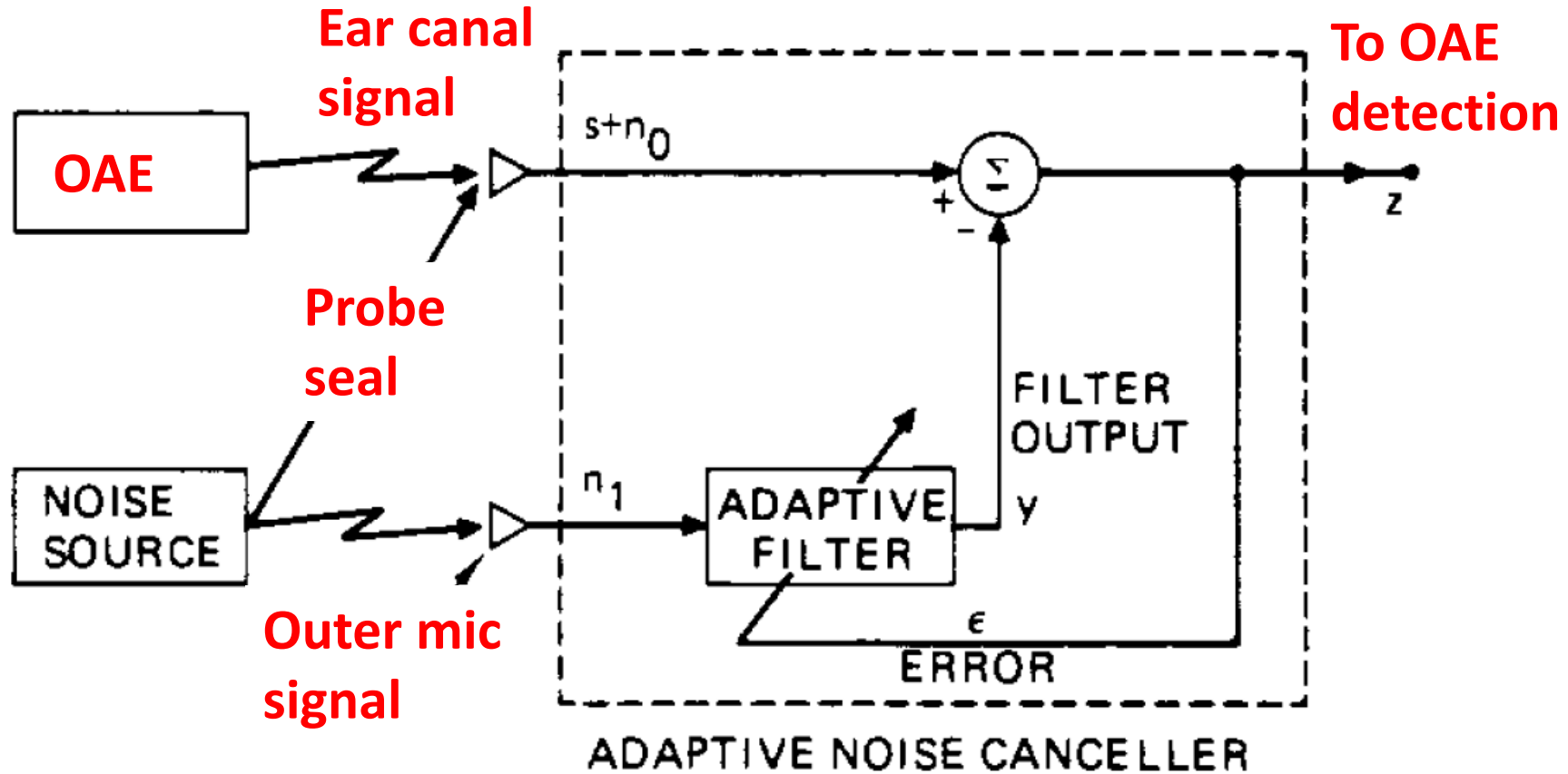
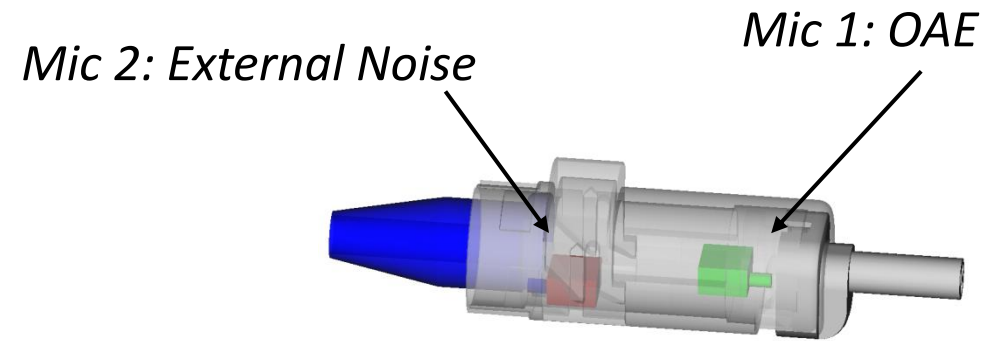


Fig. 1. The adaptive noise cancelling concept.

Adaptive Noise Cancelling: Probe



Hurdles

- Sound delay between microphones & diffuse sound field
 - Limits frequency range for noise reduction
 - Rough calculation: $\lambda/4 = 20\text{mm} \rightarrow f = 4.2\text{kHz}$
- Stimulus crosstalk to outer mic
 - Filter may adapt to suppress stimulus, not noise!
 - Need to suppress / filter stimulus from outer mic signal before adapting
- Will not handle internal noise (breath, sucking, ...)

ANC applied to OAE

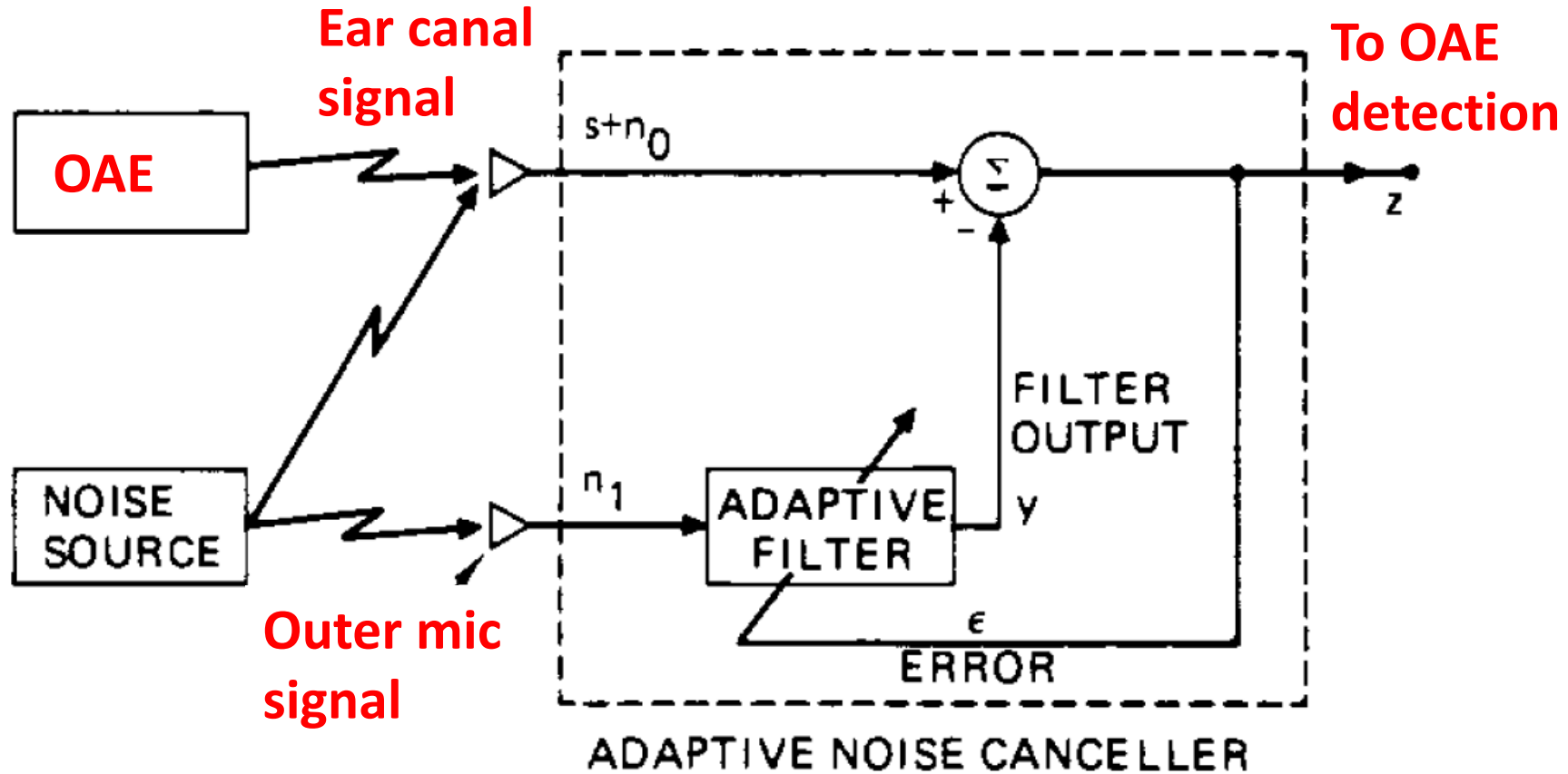


Fig. 1. The adaptive noise cancelling concept.

ANC applied to OAE

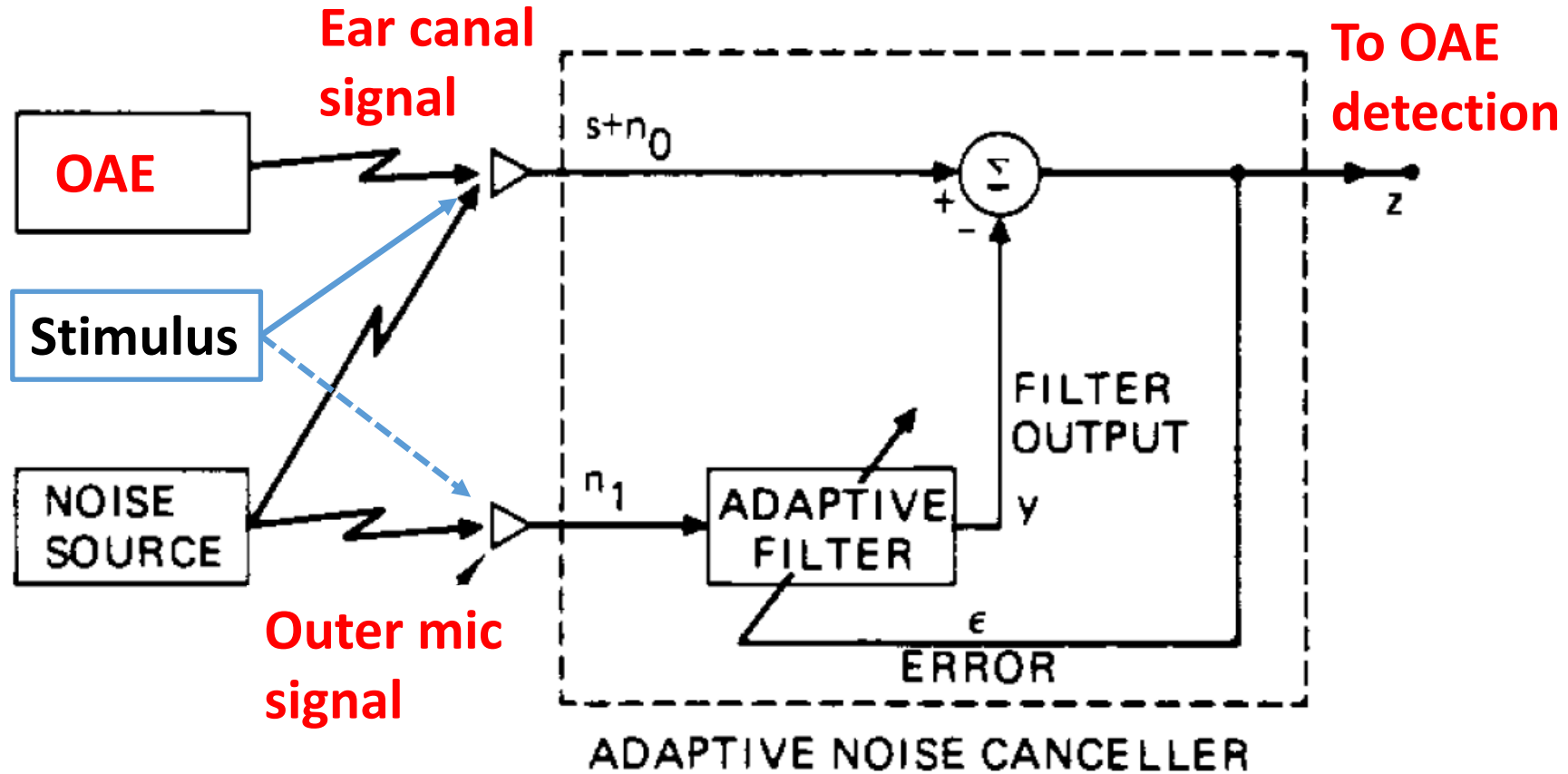
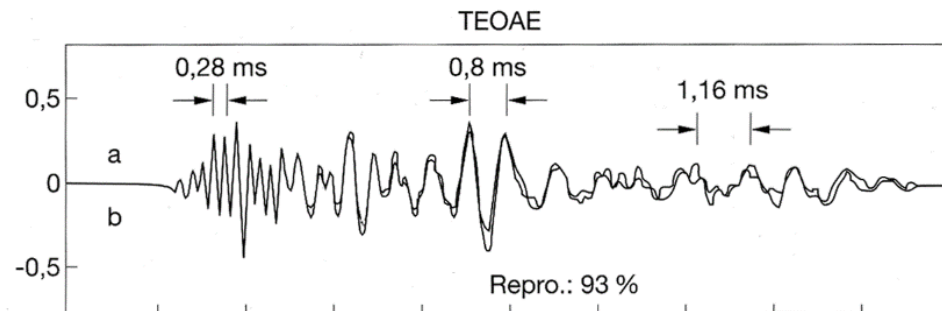
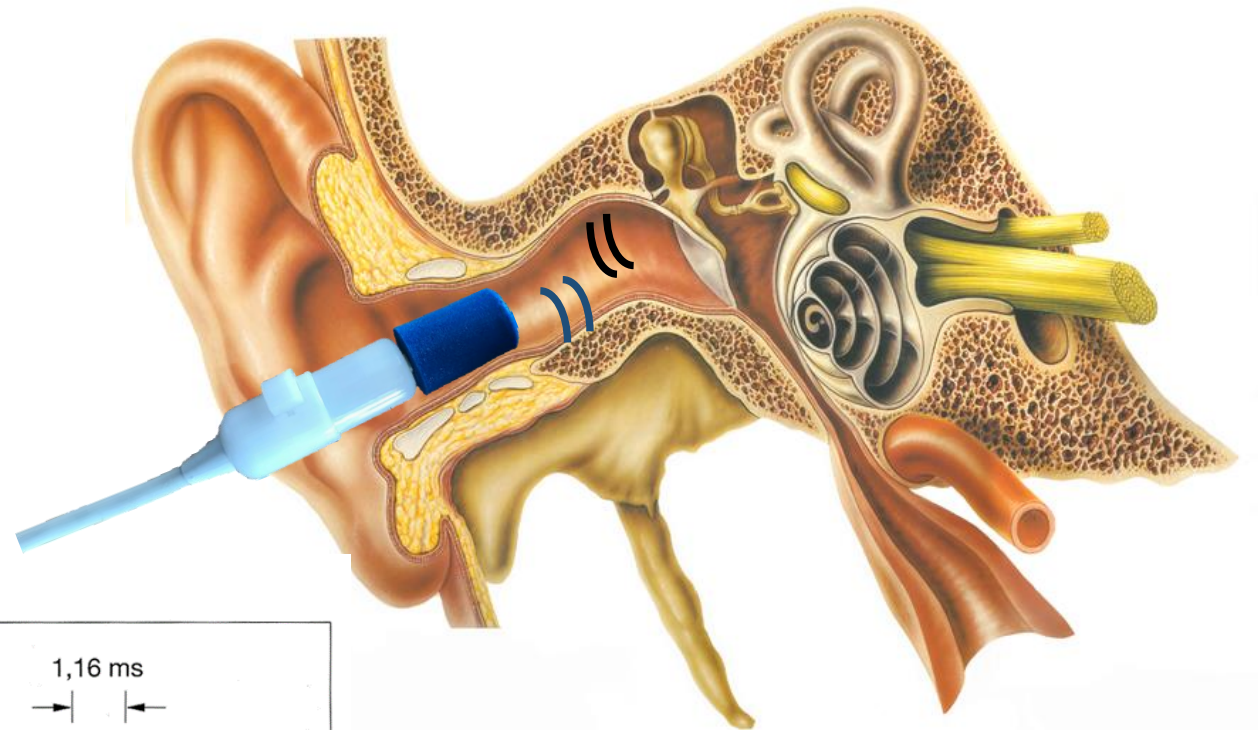
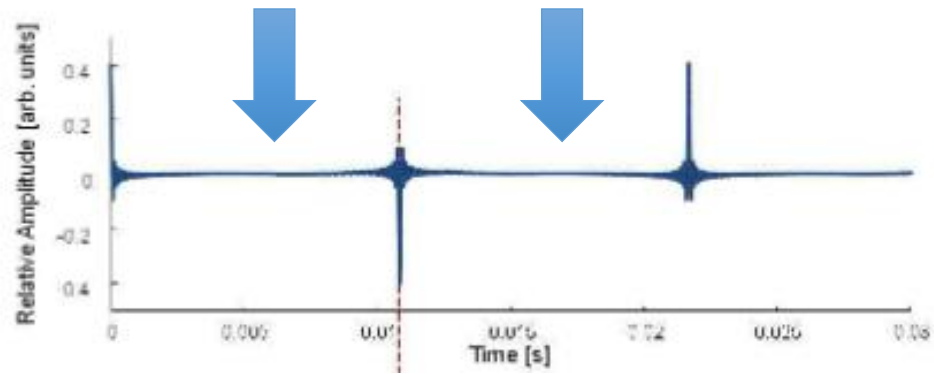


Fig. 1. The adaptive noise cancelling concept.

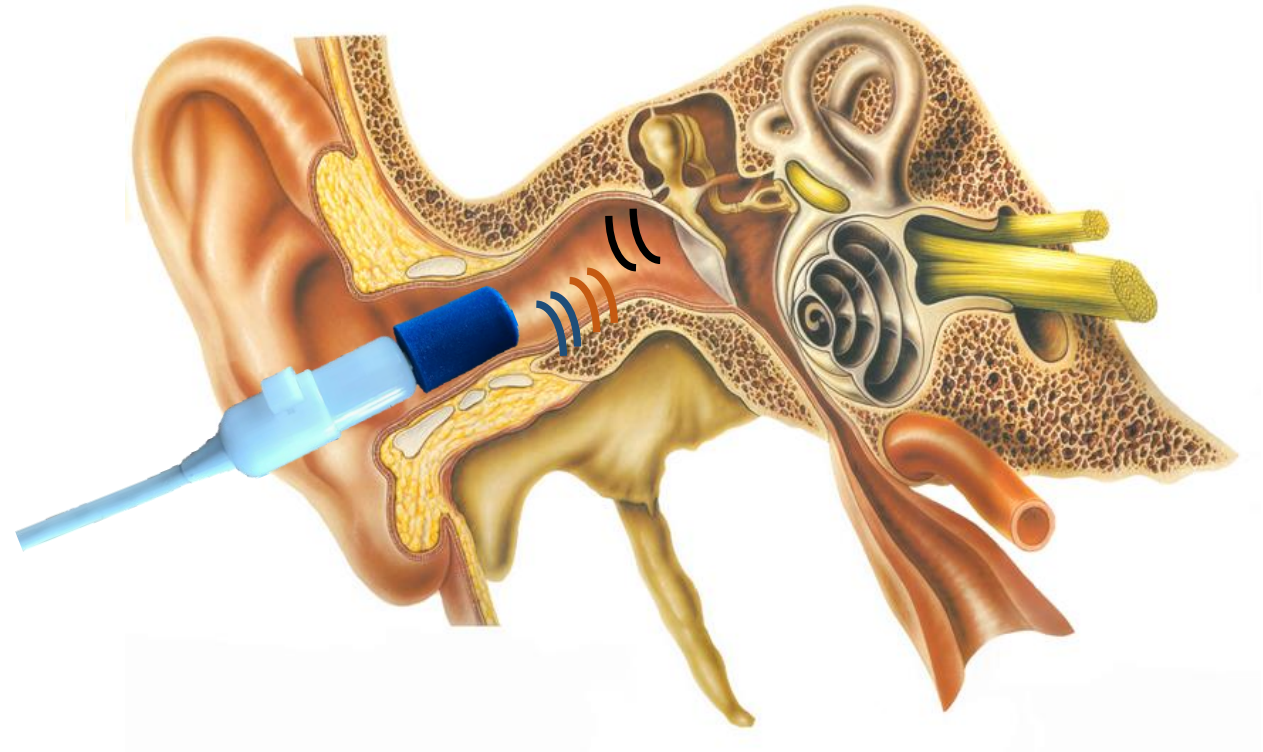
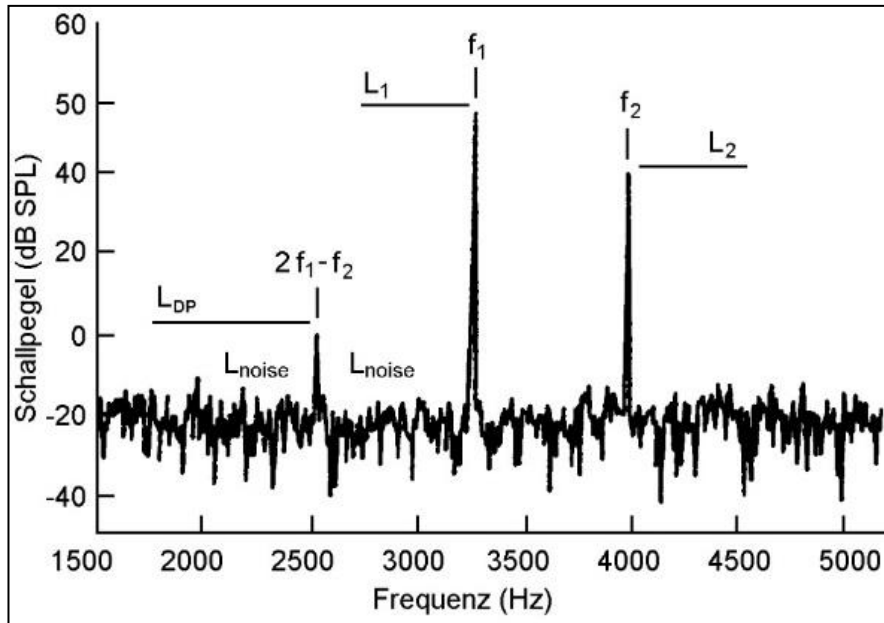
Transient Evoked Otoacoustic Emissions (TEOAE)

Exclude from adaptation:
Stimulus: Click sequence



Distortion Product Otoacoustic Emissions (DPOAE)

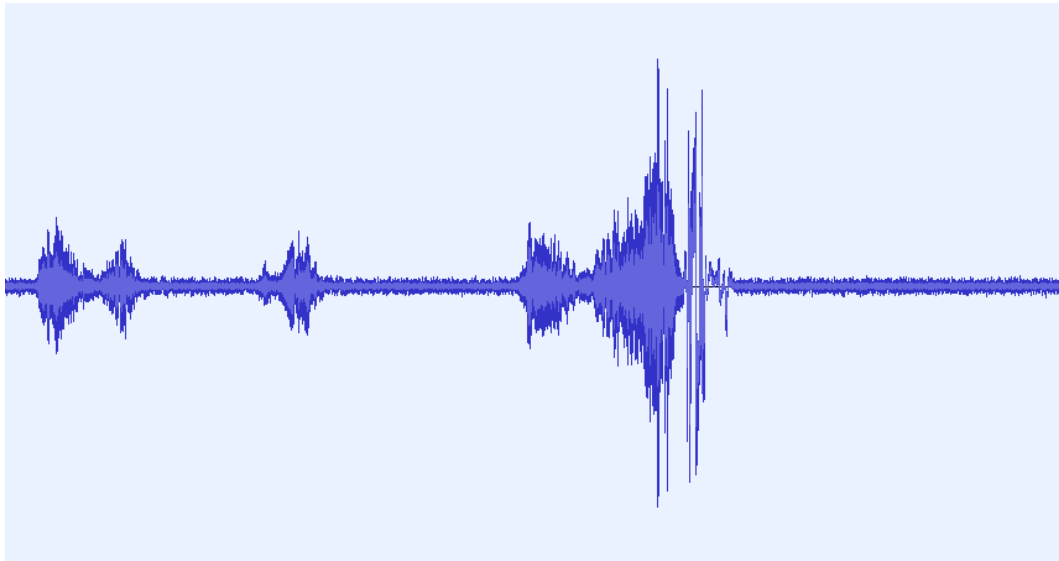
Exclude from adaptation:
Stimulus: Pure tones f_1 and f_2
(DPOAE @ $2f_1 - f_2$)



Typical noise

Transients:

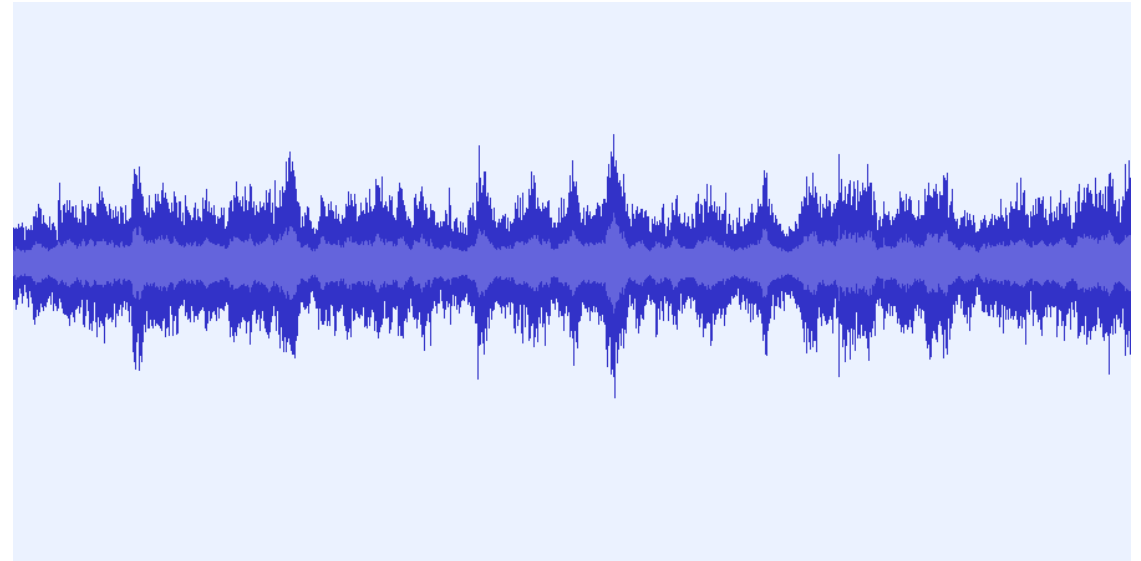
Talking, Doors, touch probe cable



- Relatively obvious to users
- can be handled by artifact management

Noise floor:

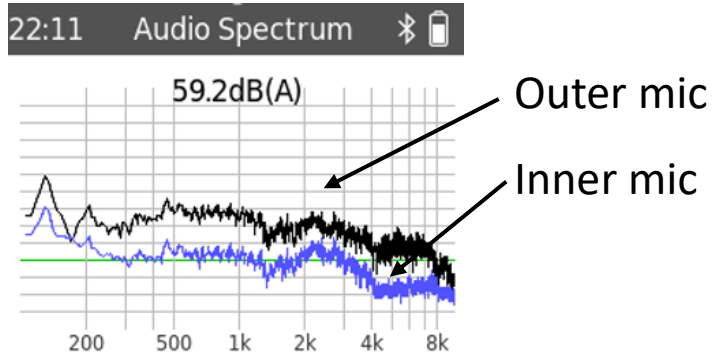
Air condition, street noise



- users are often unaware of
- cannot be handled by artifact management

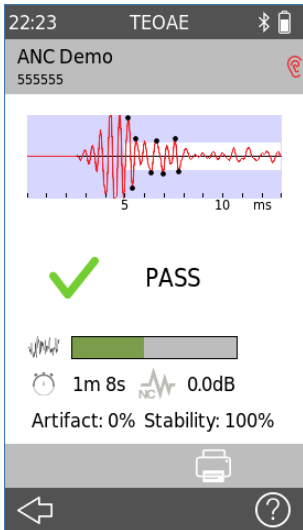
Probe fit

good

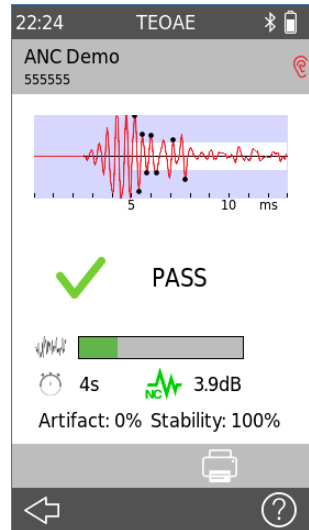


ANC OFF

ANC ON

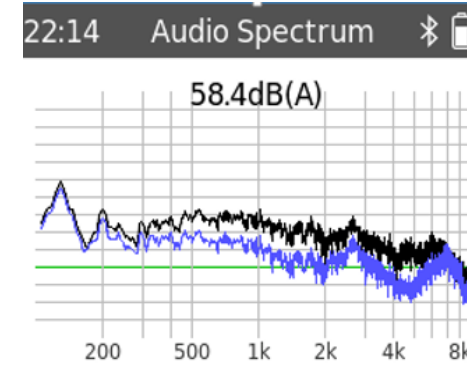


1m8s



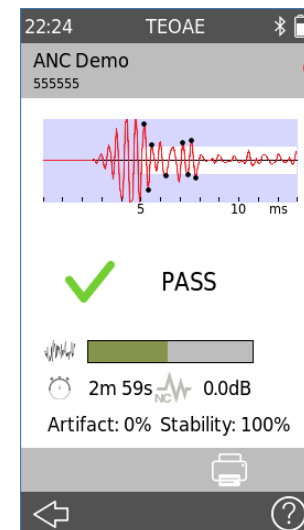
4s

leaky

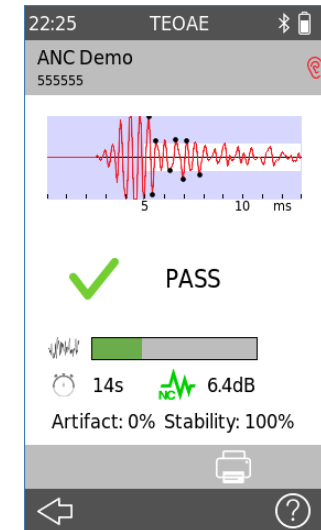


ANC OFF

ANC ON



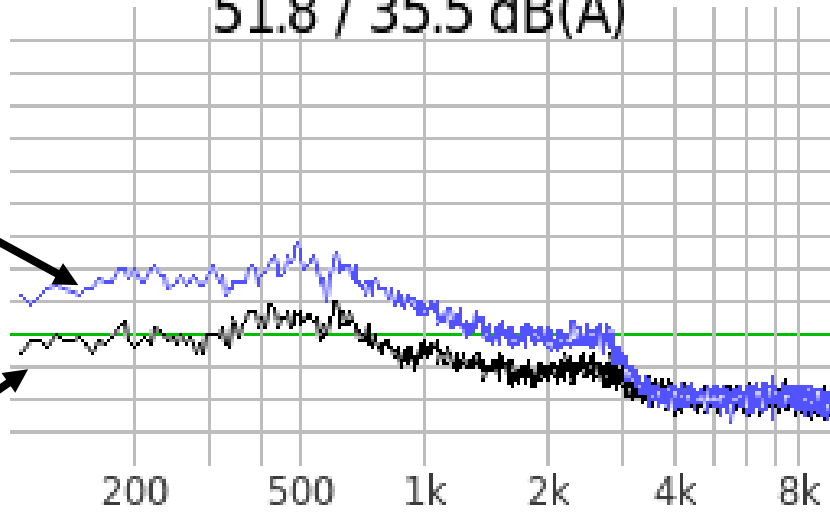
2m59s



14s

Test bench performance

51.8 / 35.5 dB(A)

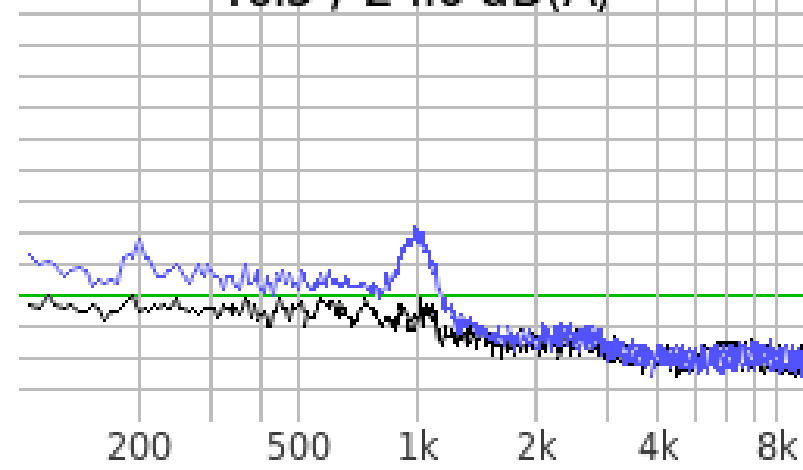


Pre-ANC

Post-ANC

Pink noise

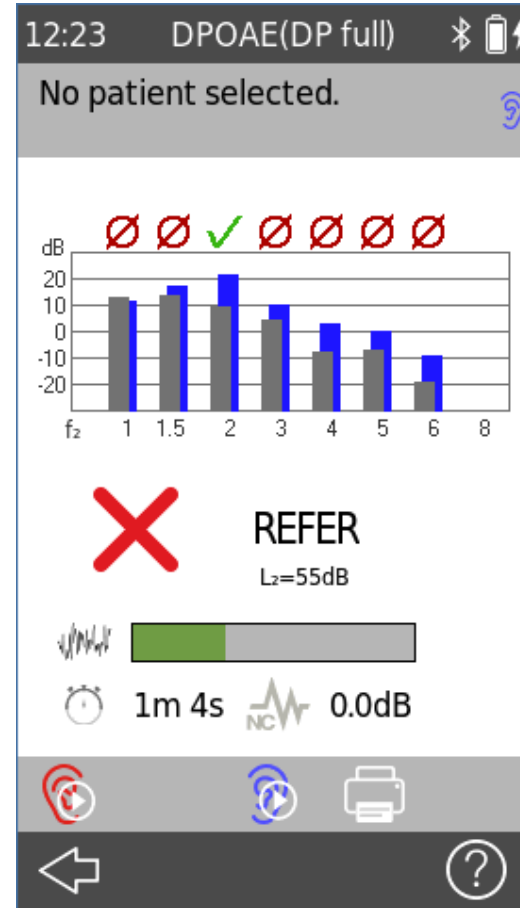
40.5 / 24.6 dB(A)



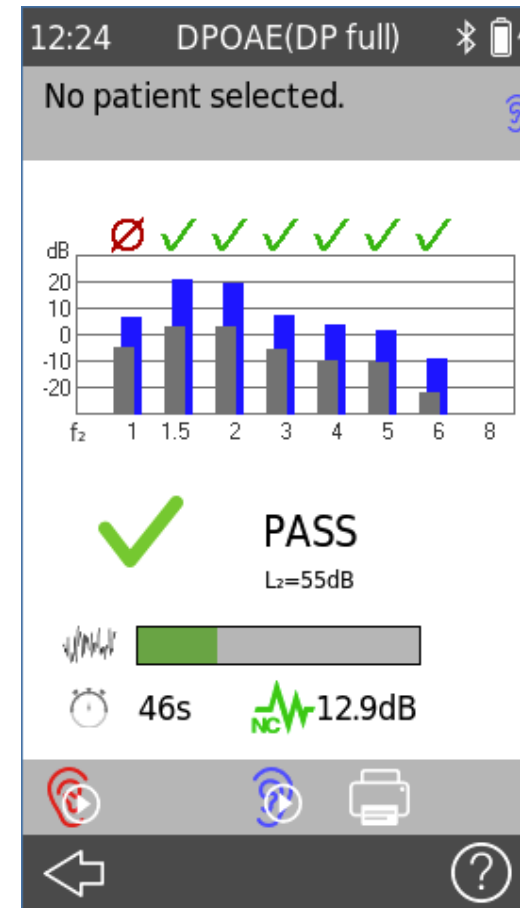
Pink noise, peak @ 1kHz

DPOAE

ANC off



ANC on



$$f_{\text{DPOAE}} = 0.64 f_2$$

Summary

- Artifact management, such as weighted averaging, does not help much in constant background noise conditions
- ANC subtracts filtered outside noise from microphone signal
- NO “Antisound” generated -> no audible effect
- SNR gain up to 10 dB, equivalent 10x test time(!)
- Best effect @ < 3kHz
DPOAE: $f_{\text{DPOAE}} = 0.64 f_2$ -> Best effect @ $f_2 < 4.5\text{kHz}$
- Can reduce false-positiv-rate (increase specificity)

