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ACTIVE FIELD CONTROL
Systems for Enhanced Natural Acoustics

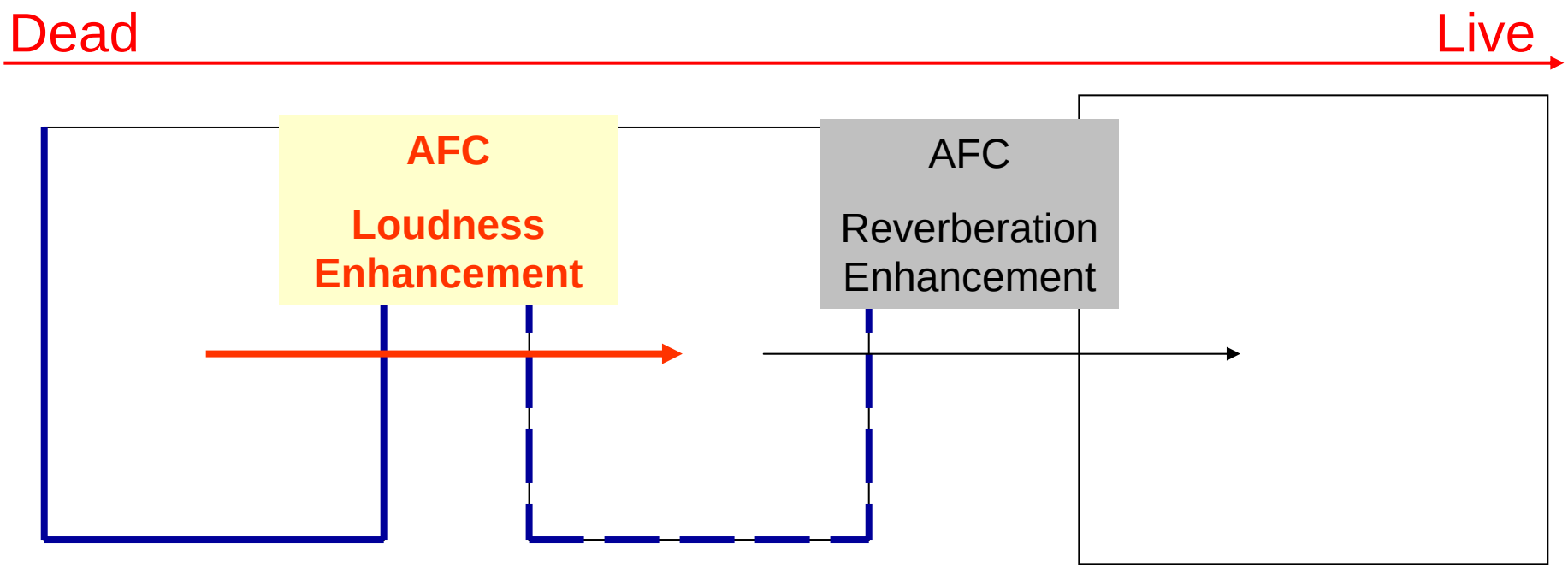
Case study for voice amplification in a highly absorptive conference room using negative absorption tuning by the YAMAHA Active Field Control system

Takayuki Watanabe
Yamaha Commercial Audio Systems, Inc.

Agenda

- Introduction
- What is Active Field Control (AFC)?
- The conference room specifications
- The AFC tuning for a negative absorption?
- The measurement results

Introduction



Good for Amplified Music

Average absorption coefficient: High

Reverb: Very short

Good for Speech

Average absorption coefficient: Medium

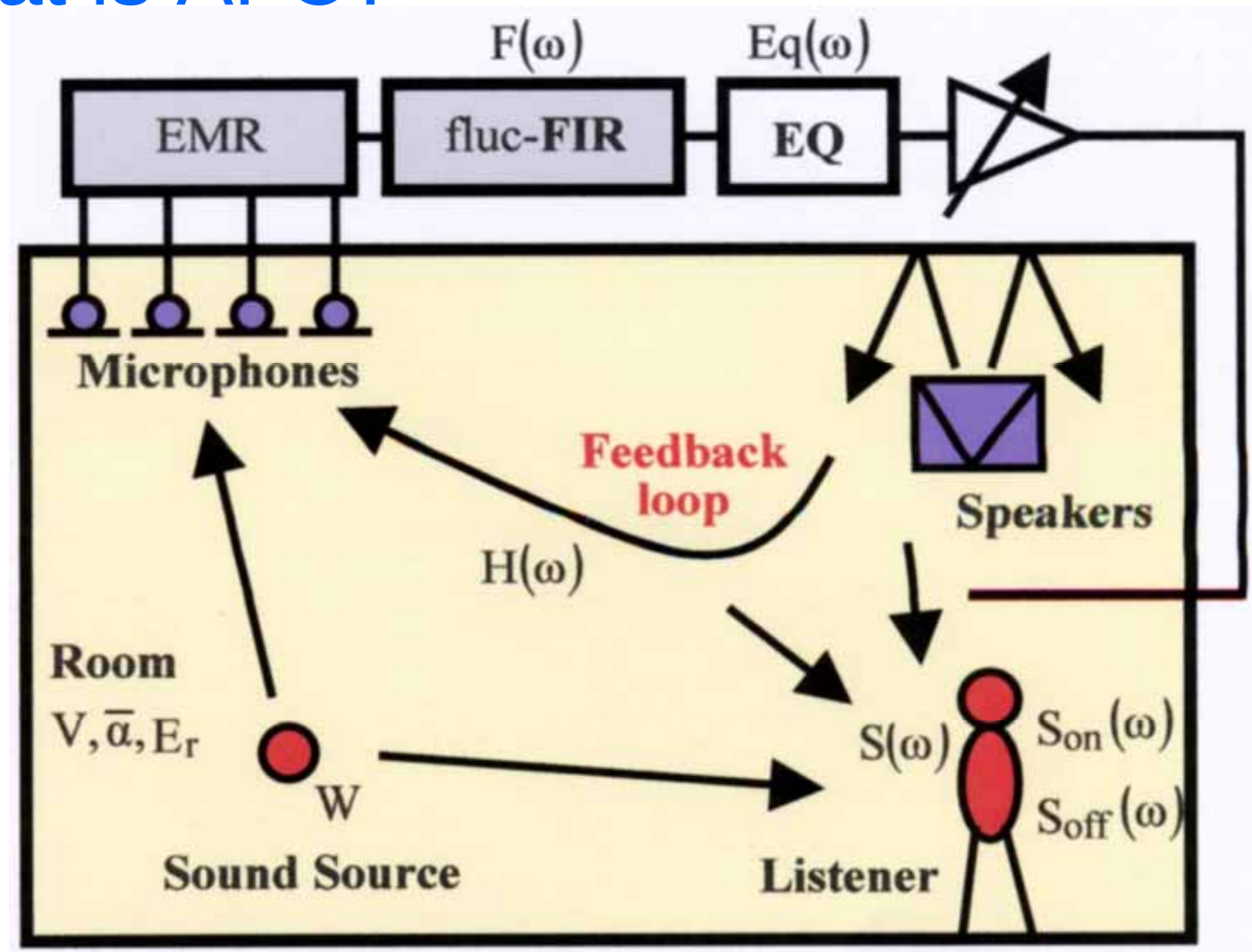
Reverb: Short

Good for Acoustic Music

Average absorption coefficient: Small

Reverb: Long

What is AFC?



$$E_r = (1-\bar{\alpha})WT_{60}/(13.8V)$$

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Application	Product evaluation, Product seminar
Capacity [N]	30
Volume [V]	9,900 ft^3 267 m^3
Floor	1,100 ft^2 99 m^2
V/N	330 ft^3 8.9 m^3
Reverberation time	0.4 sec (500 Hz)

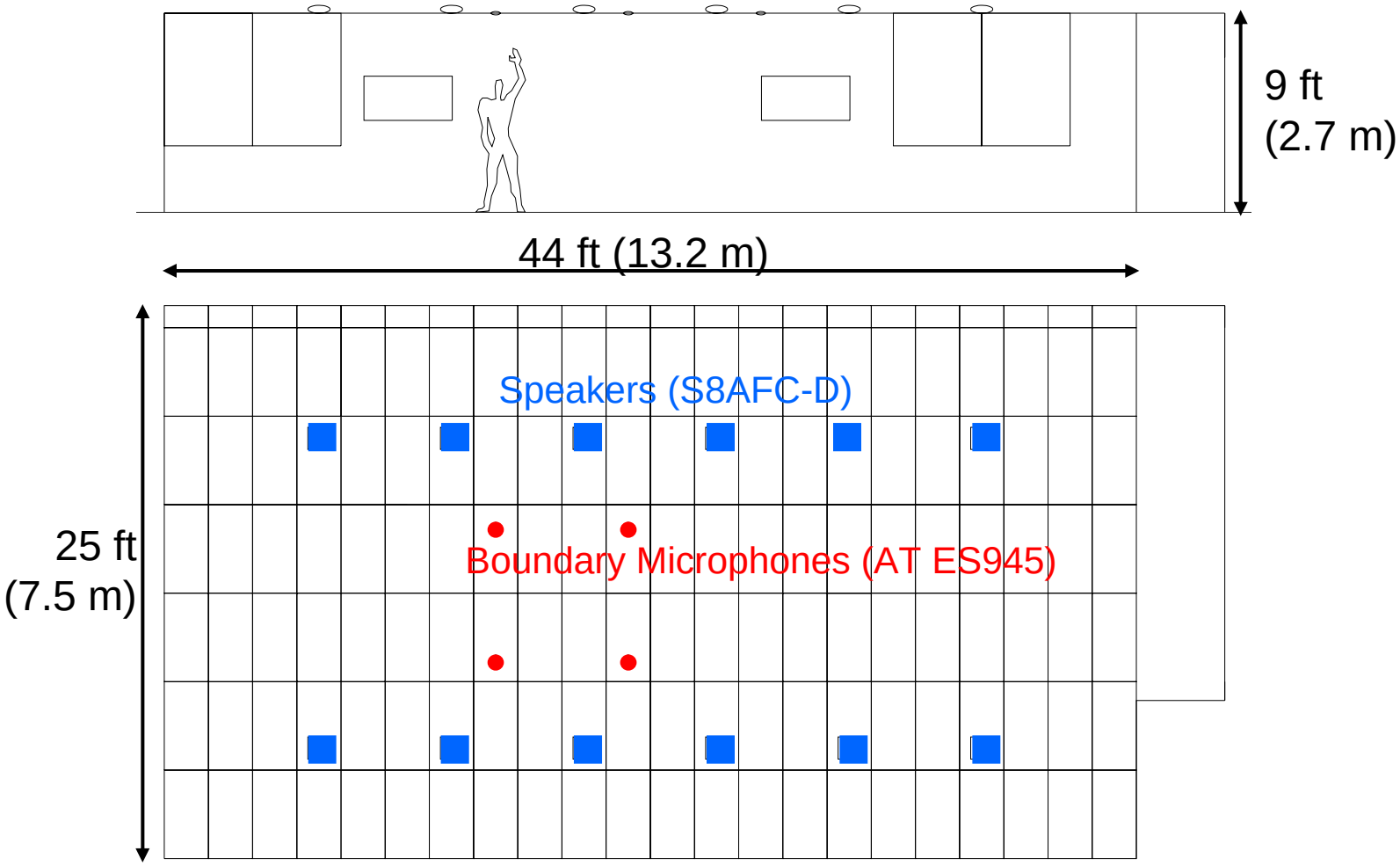
Conference room in Yamaha Office, CA

Conference room in Yamaha Office, CA

Demands by lecturers

- Too large, a little bit, in size for talks without using a PA.
  - Want to talk without using a PA system
- Difficult to talk and hear because of a highly absorption in the room
  - Fit to the acoustics of the room to the liveness for a comfortable speech communication

Speaker & Microphone Placement



The AFC tuning for a negative absorption?

“LIVENESS Control” using the AFC system

- Target level for listeners at a seminar
  - Calculate from the appropriate reverberation time, more than 1 dB
- Appropriate reverberation for a comfortable speech communication
  - The appropriate reverberation time for this room size is around 0.5 sec for speech auditorium.

LIVENESS Control

Adding energy with holding the system stable

↓

Extending *T60*, <u>increasing a sound energy</u>

||

Decreasing absorption *A*

$$E_0 = \frac{4W}{cA} \quad (1)$$

$$T_{60} = \frac{KV}{A} \quad (2)$$

$$T_{60} = \frac{KVcE_0}{4W}$$

E_0: Energy Density
W: Source Power
c: Velocity of sound
A: Absorption of the room
T_{60}: Reverberation time
K: constant

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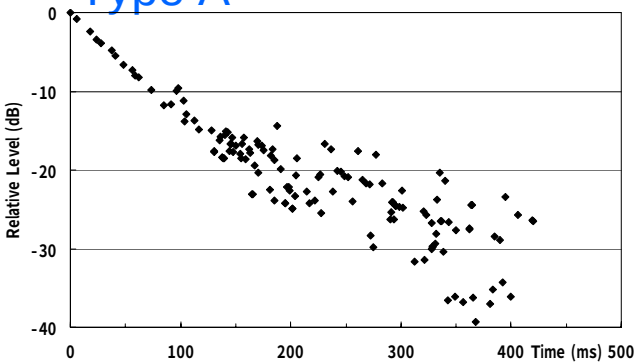
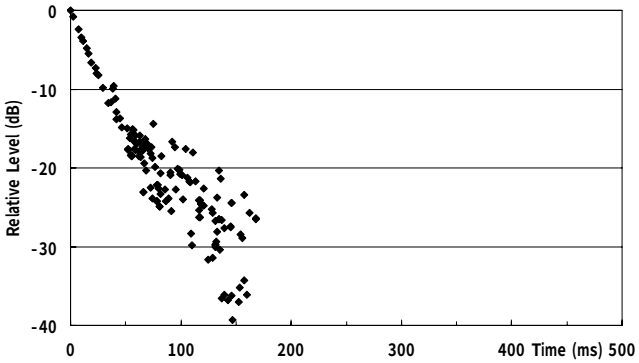
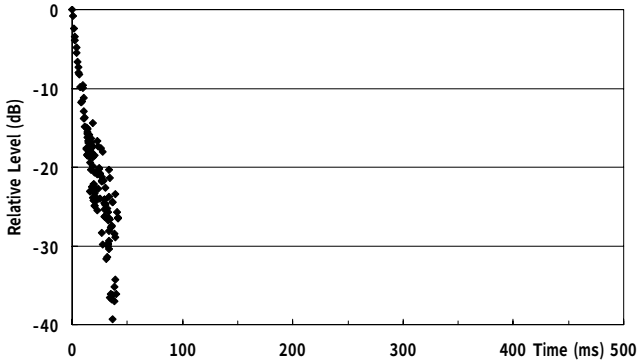
Type A

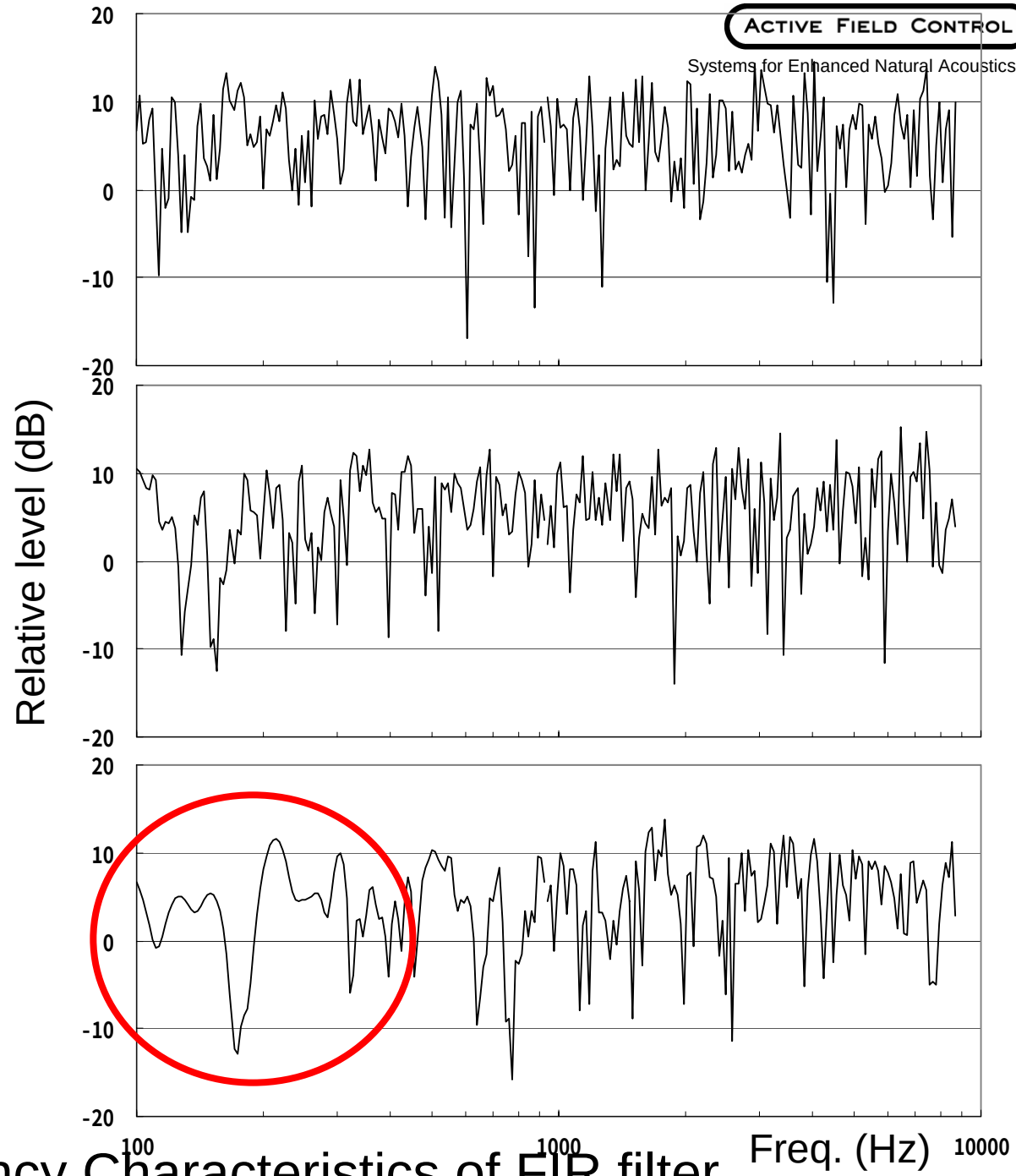


Type B



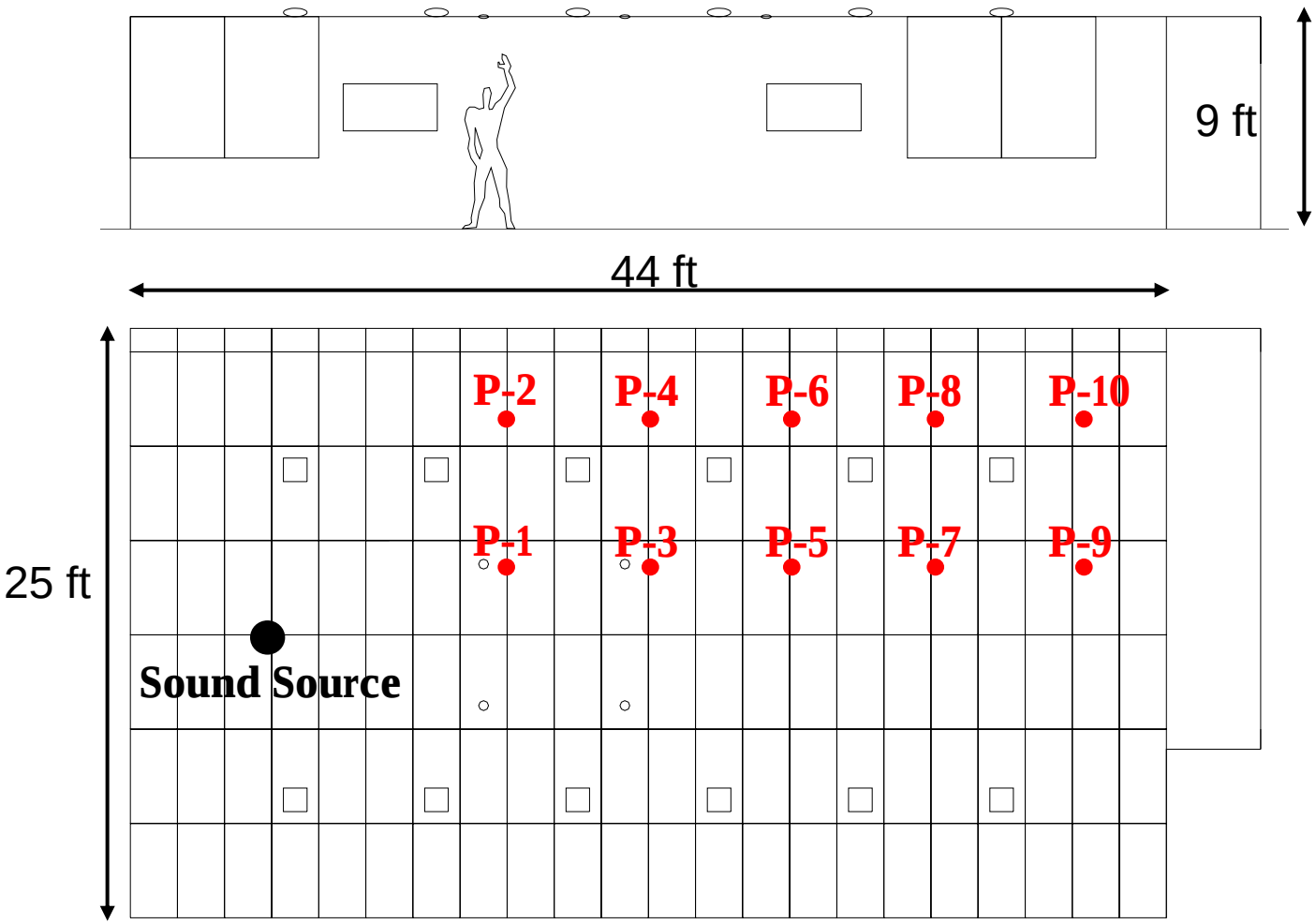
Type C





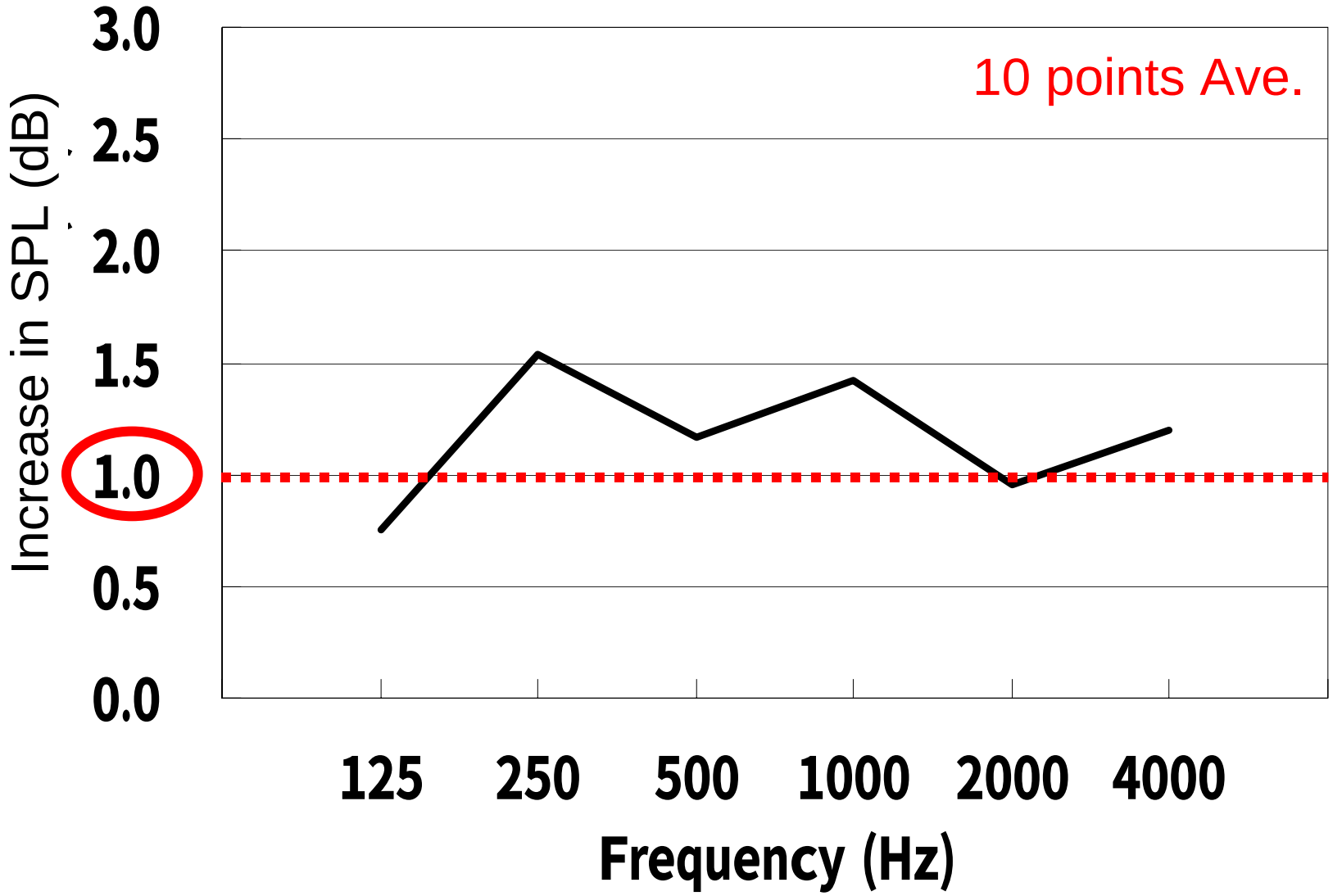
Example of Frequency Characteristics of FIR filter

Measurement Points

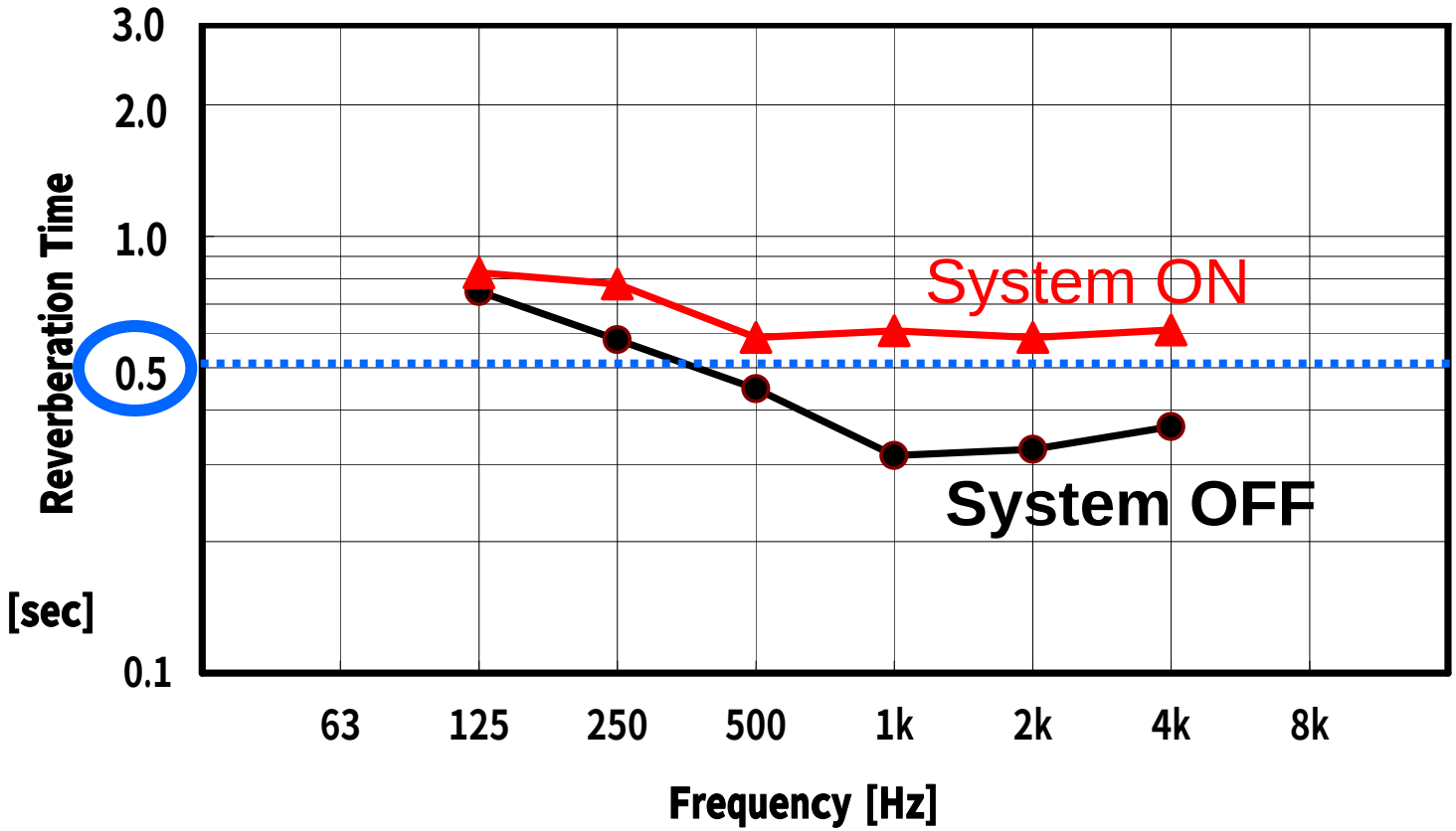


EXIT

The measurement result of an increase in SPL with and without the AFC



Reverberation Time



STI / System OFF : 0.88
System ON : 0.77

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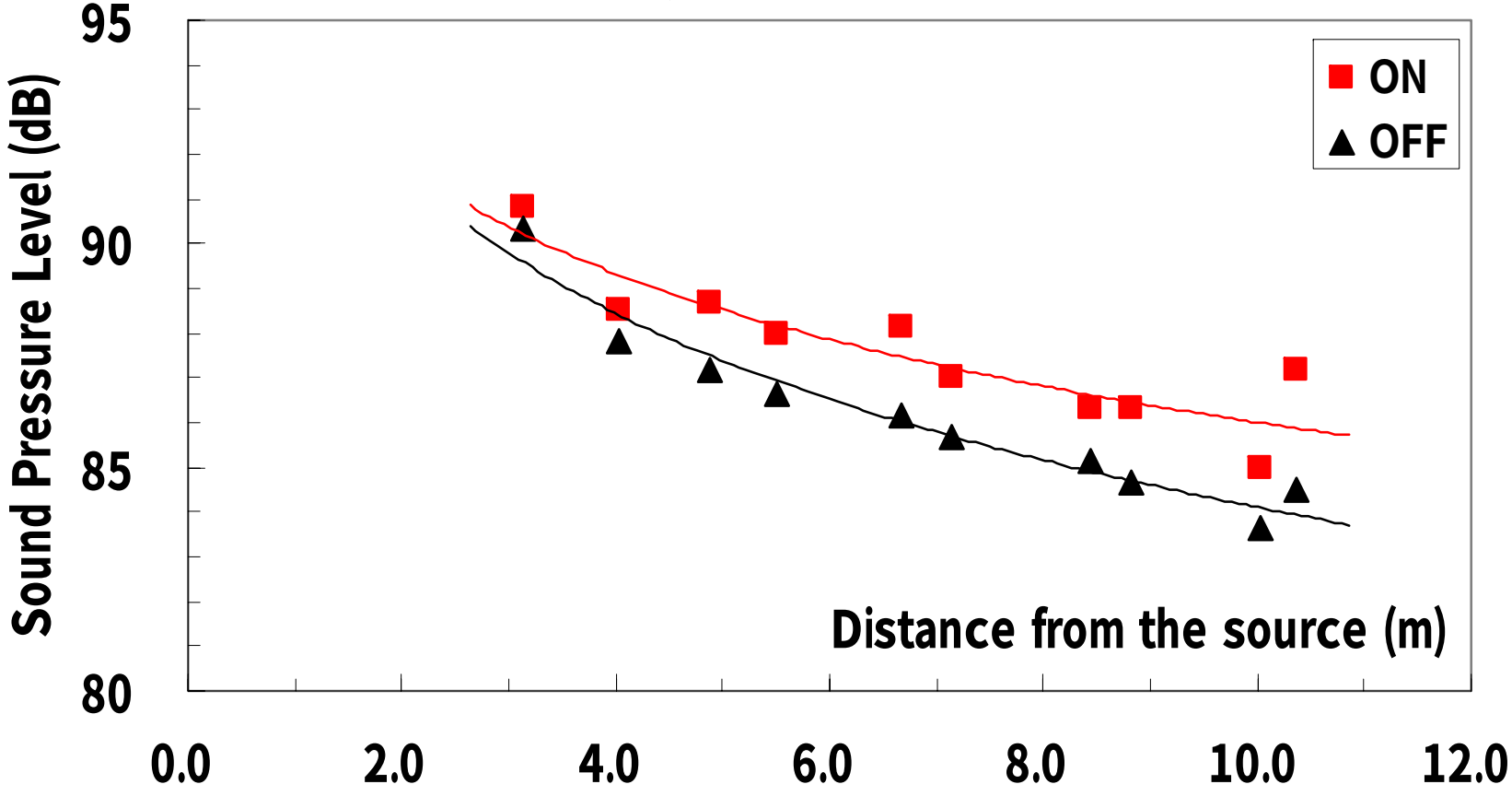
Distribution of SPL

1 kHz, 1/1 oct. band



Absolute Deviation $\frac{1}{10}\sum\left|L-\bar{L}\right|$

System OFF 1.5 dB

L: Sound Pressure Level at each point

System ON 1.2 dB (125-4 kHz average)

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Echo Diagram

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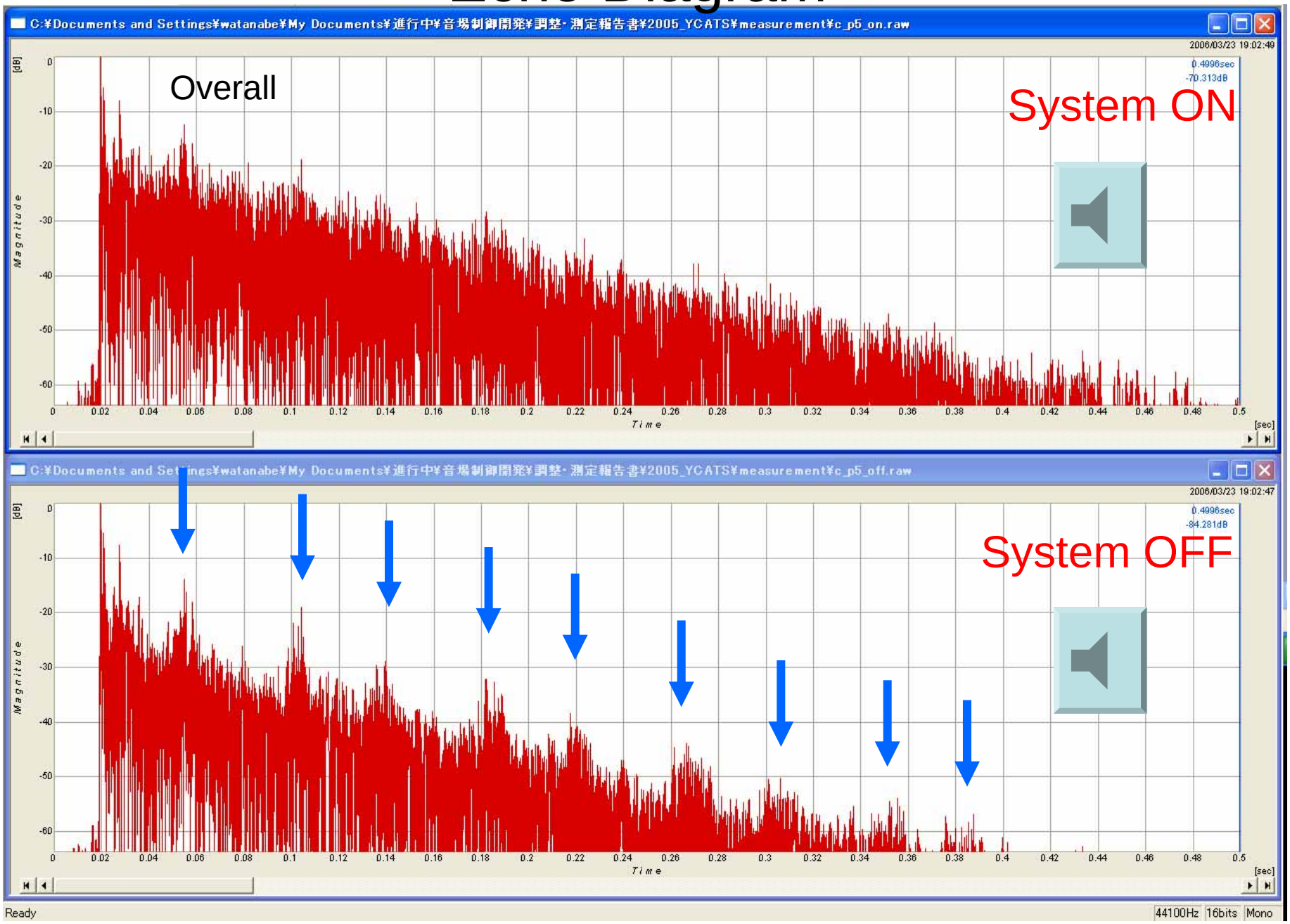

Echo Diagram

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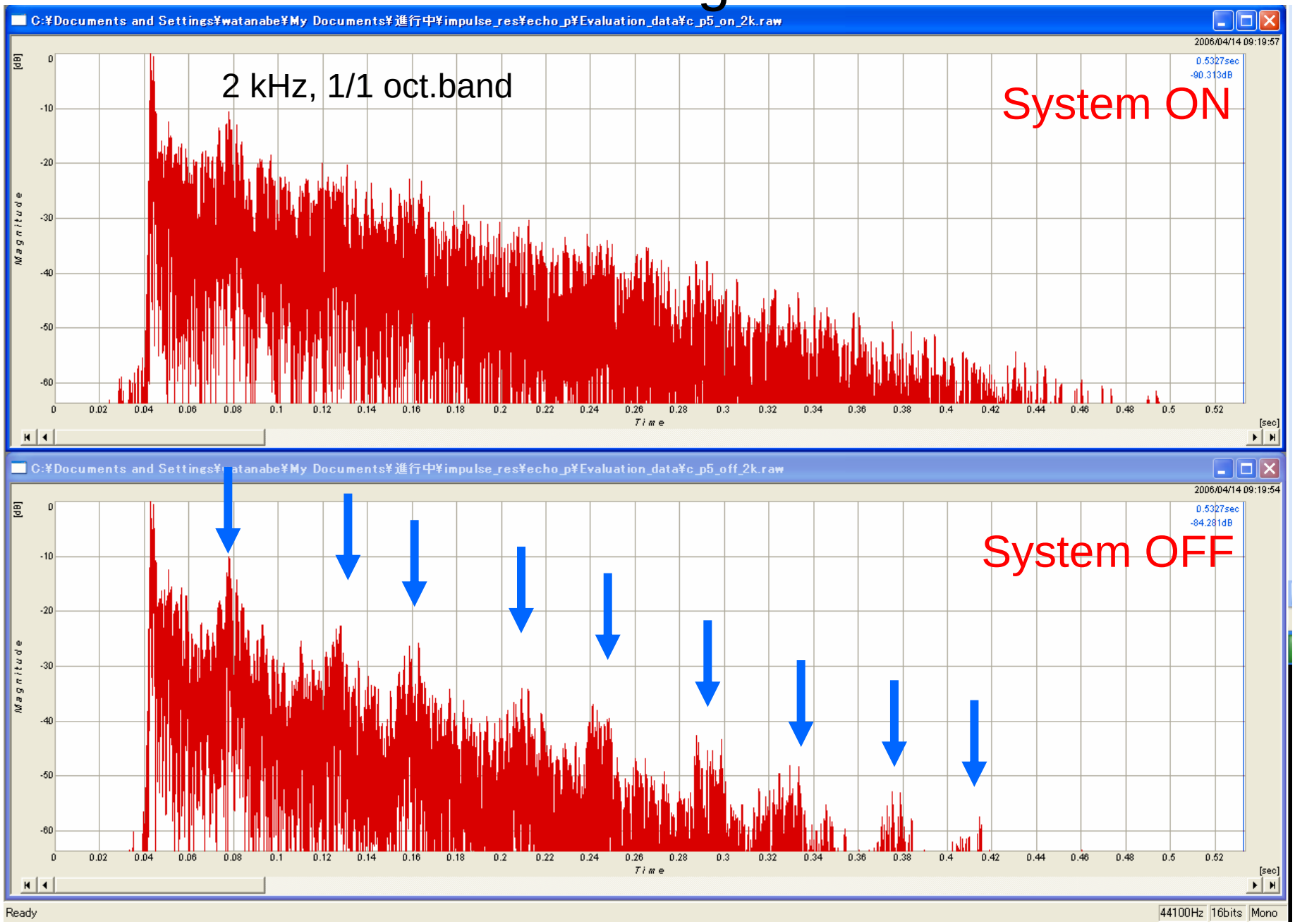
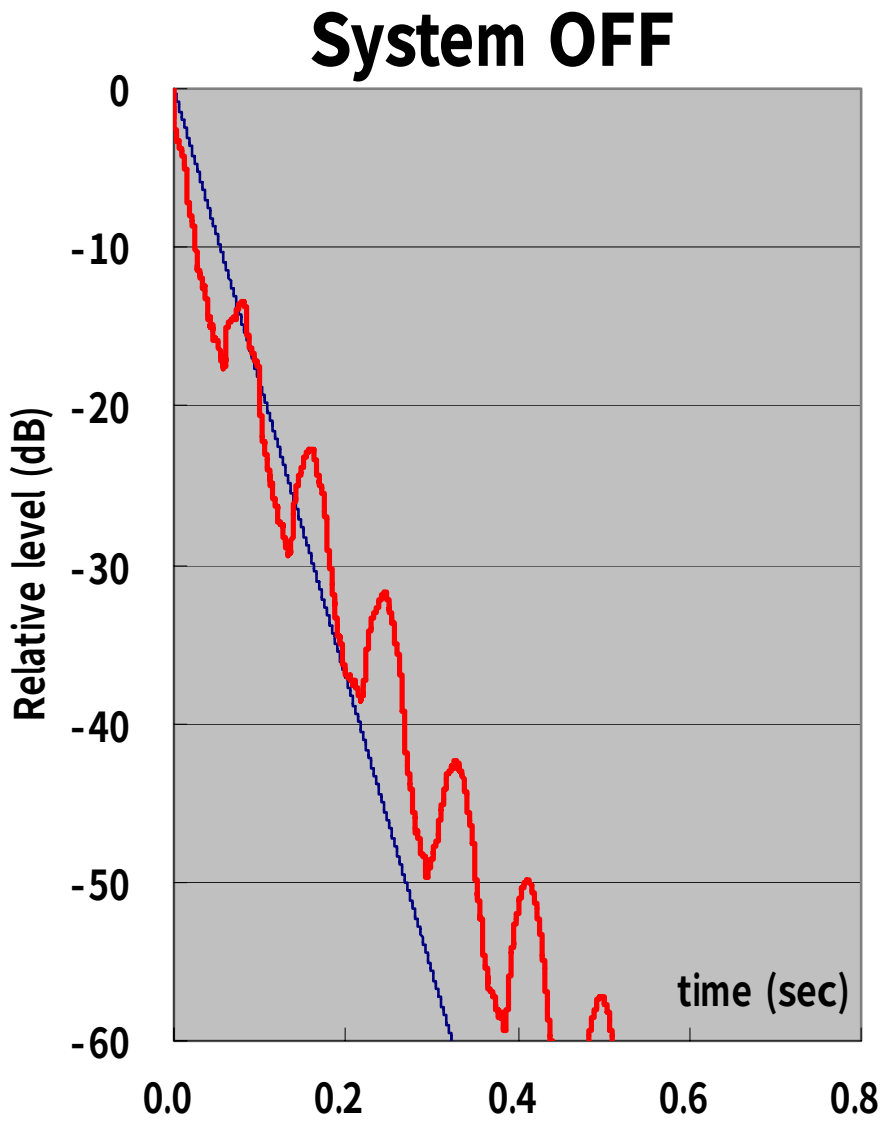
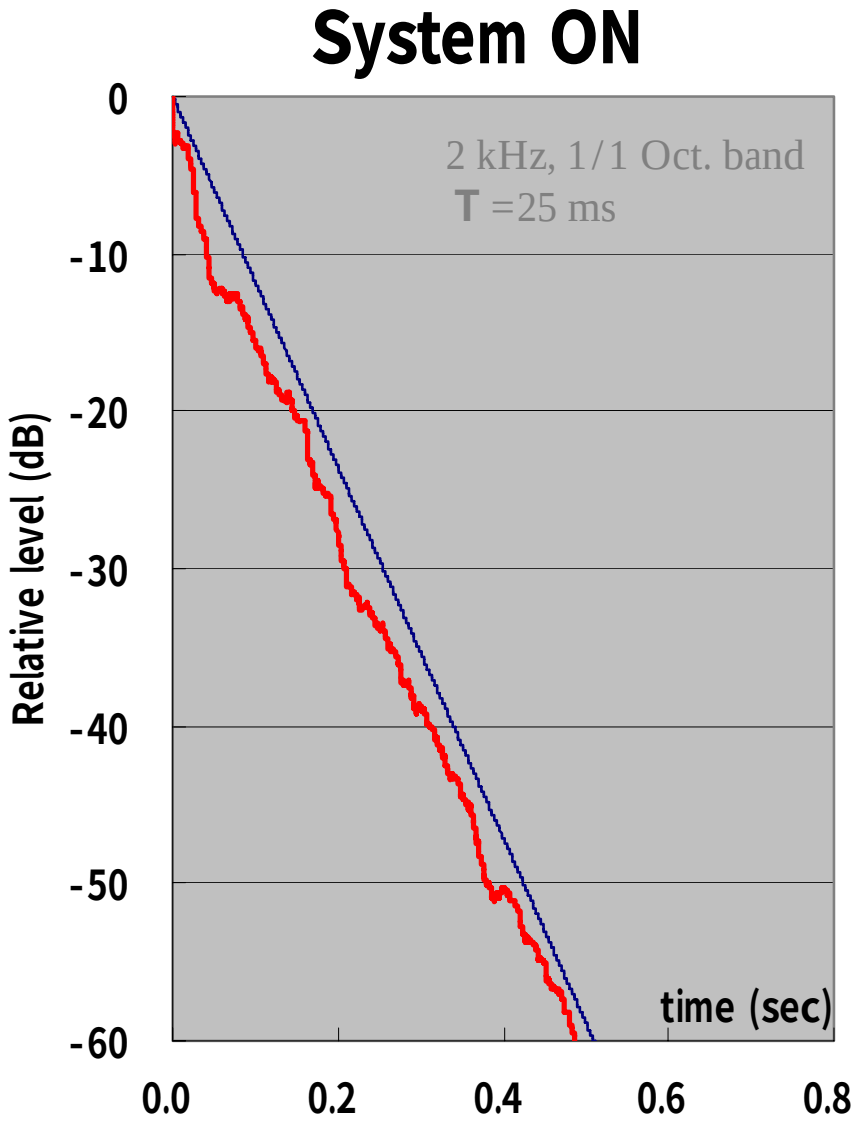


Comparison of RMS curve between real and ideal





Summary

1. We present a liveness control of the AFC system as a negative absorption.
2. The appropriate tuning allow the system to fit a voice amplification use at a middle-sized conference room with a relatively excessive absorption.
3. An appropriate increase in liveness is reached for a comfortable speech communication, and a sufficient increase in SPL for listeners is measured at a conference room.
4. Furthermore, it is also useful for an acoustical solution to eliminate a fluttering echo.