

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

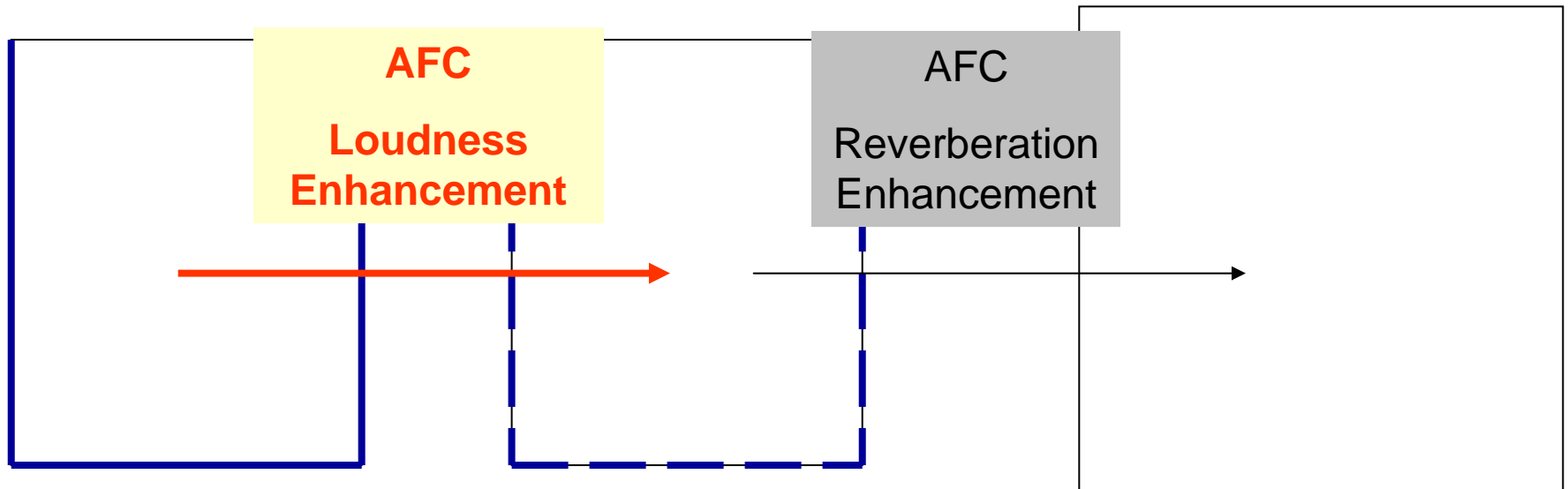
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Agenda

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

Introduction

Dead **Live**



Good for Amplified Music

Average absorption coefficient: High

Reverb: Very short

Good for Speech

Average absorption coefficient: Medium

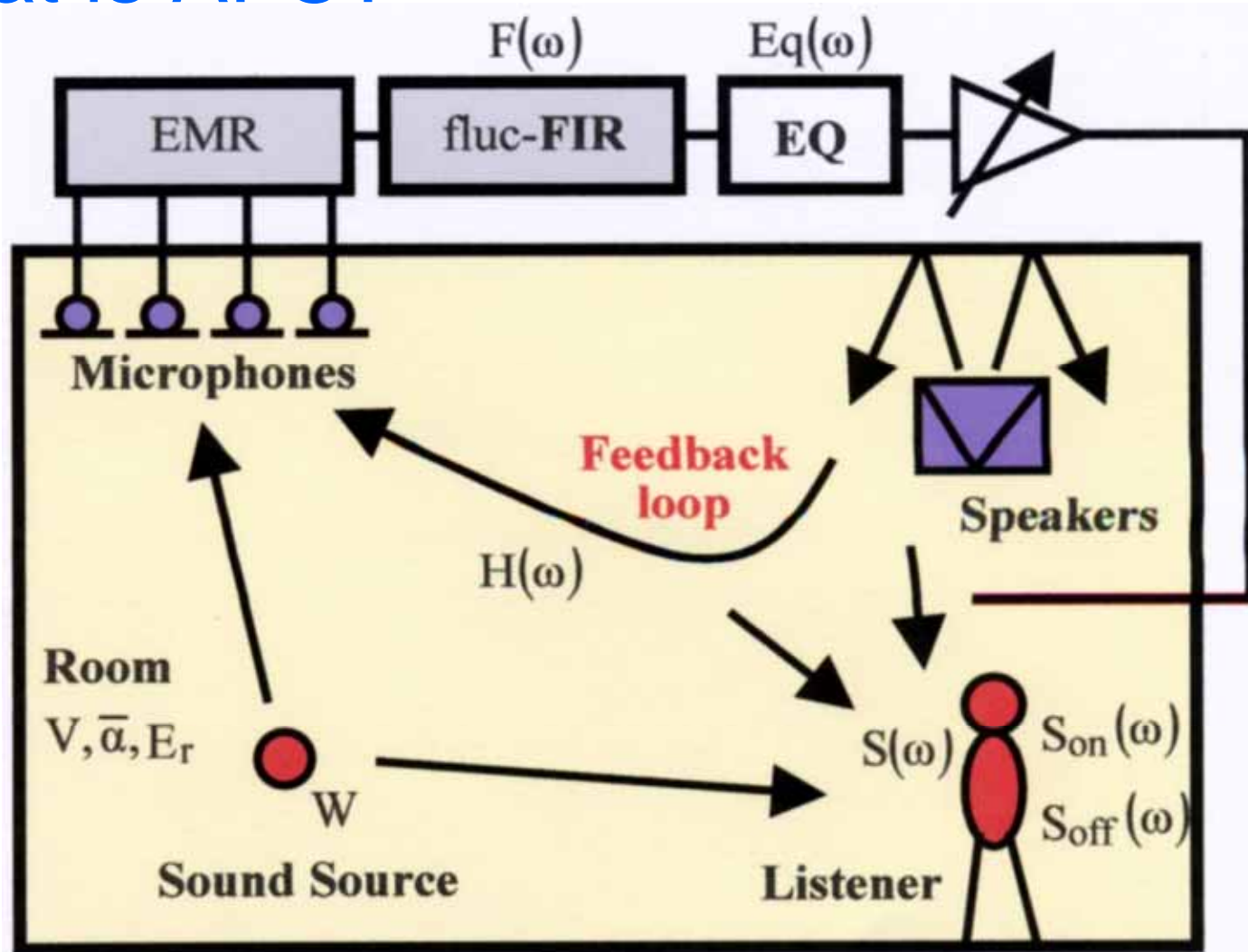
Reverb: Short

Good for Acoustic Music

Average absorption coefficient: Small

Reverb: Long

What is AFC?



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



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

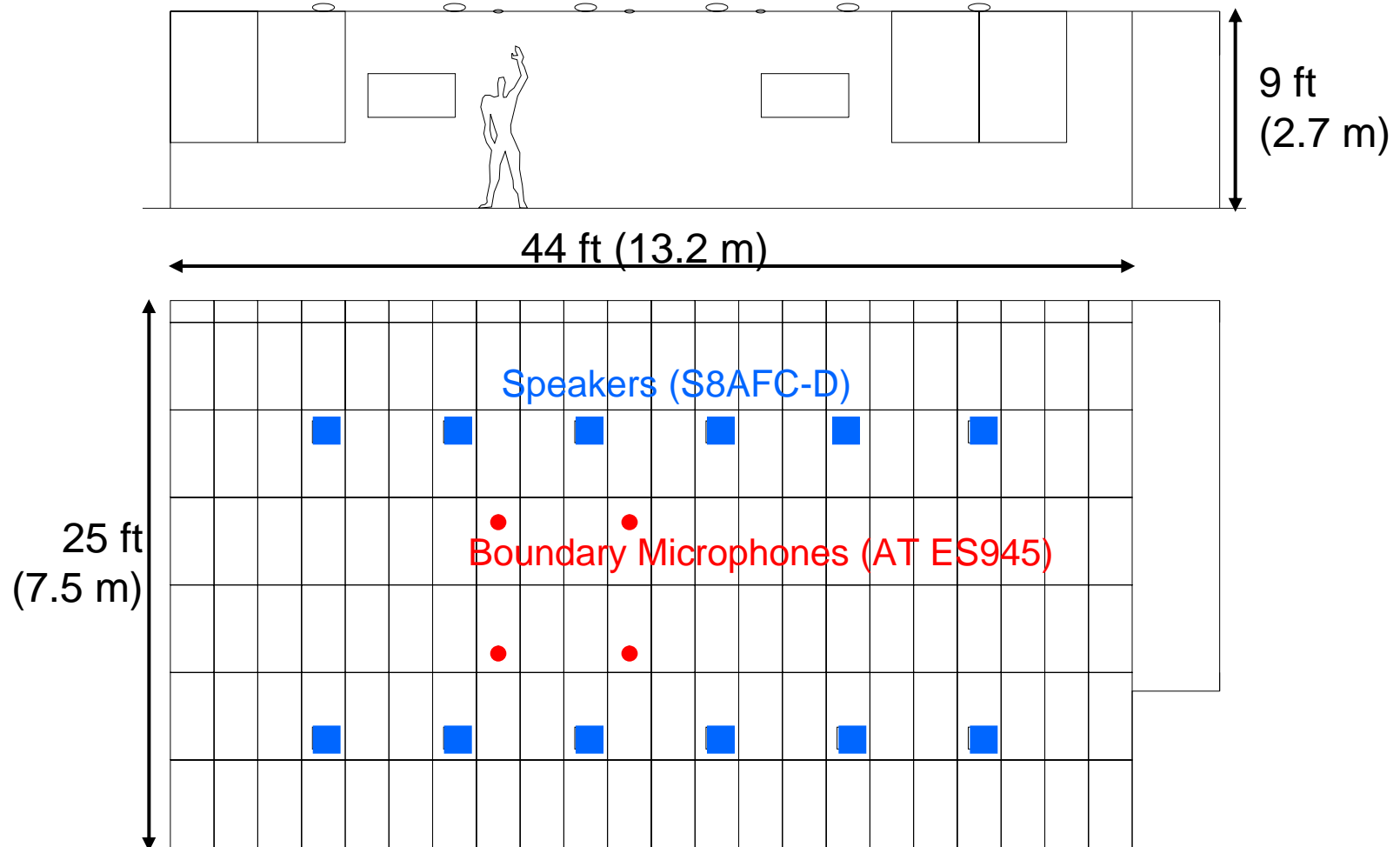


Conference room in Yamaha Office, CA

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 T_{60} , increasing a sound energy

||

Decreasing absorption A

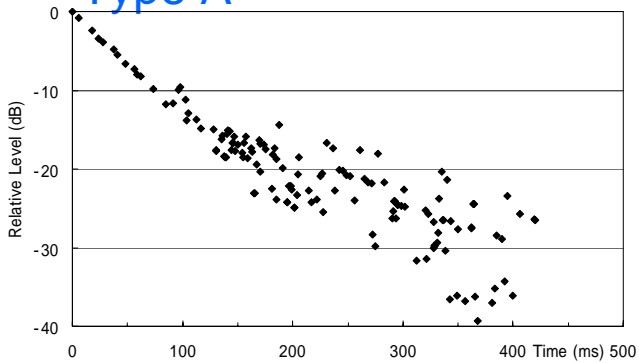
$$E_0 = \frac{4W}{cA} \quad (1)$$

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

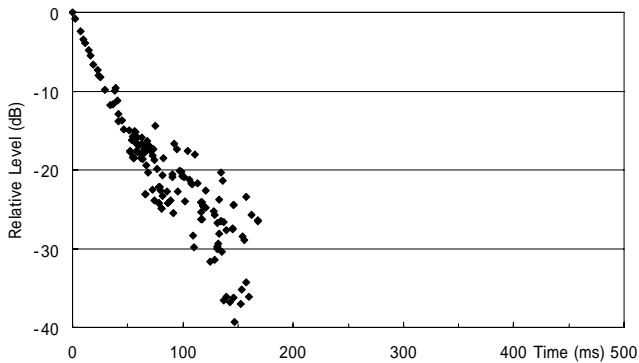
$$T_{60} = \frac{KV}{A} \quad (2)$$

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

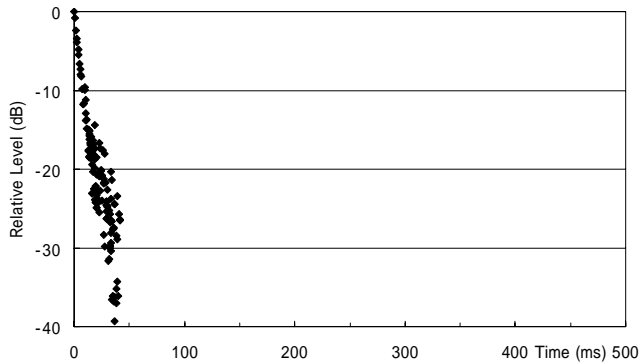
Type A



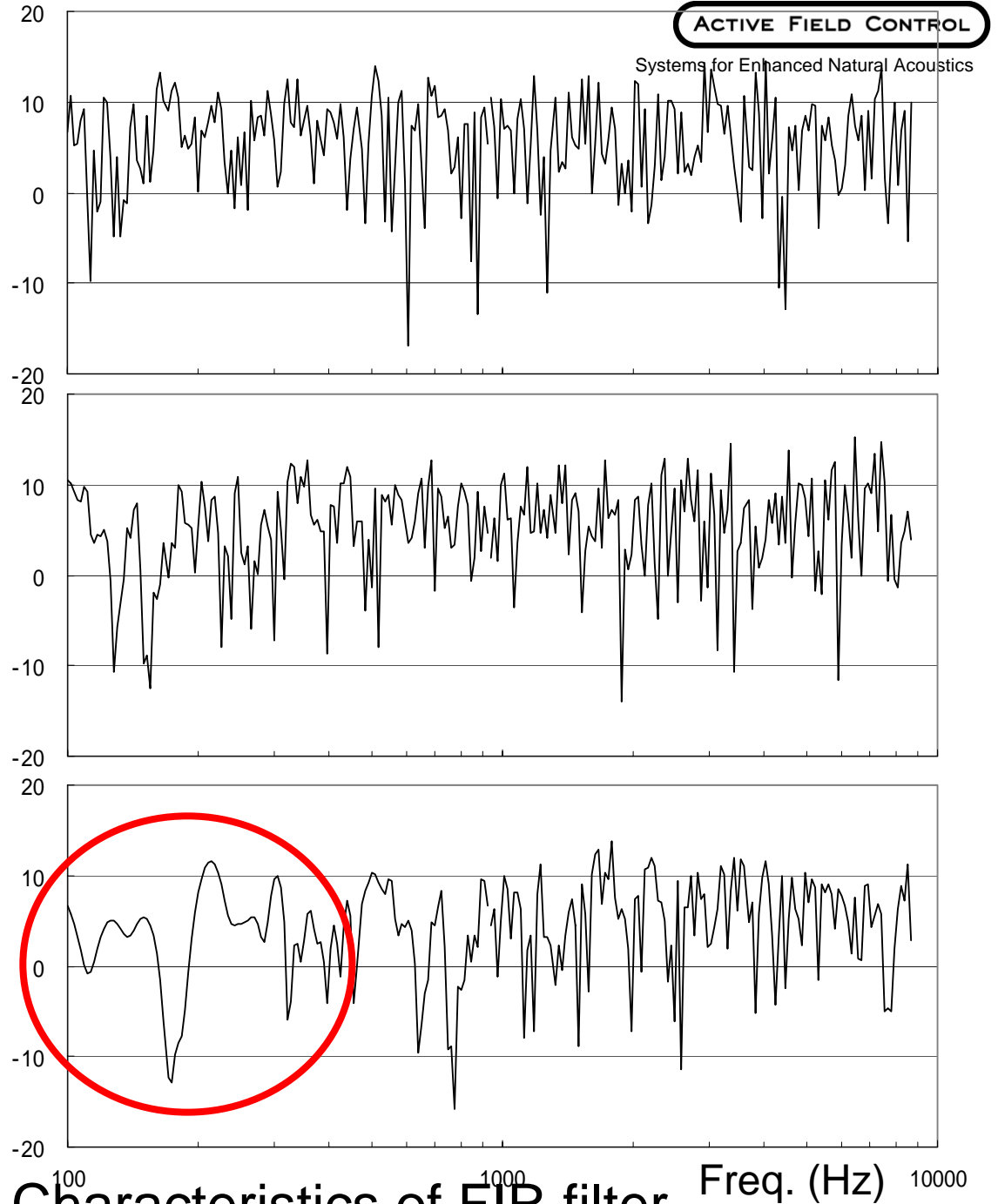
Type B



Type C

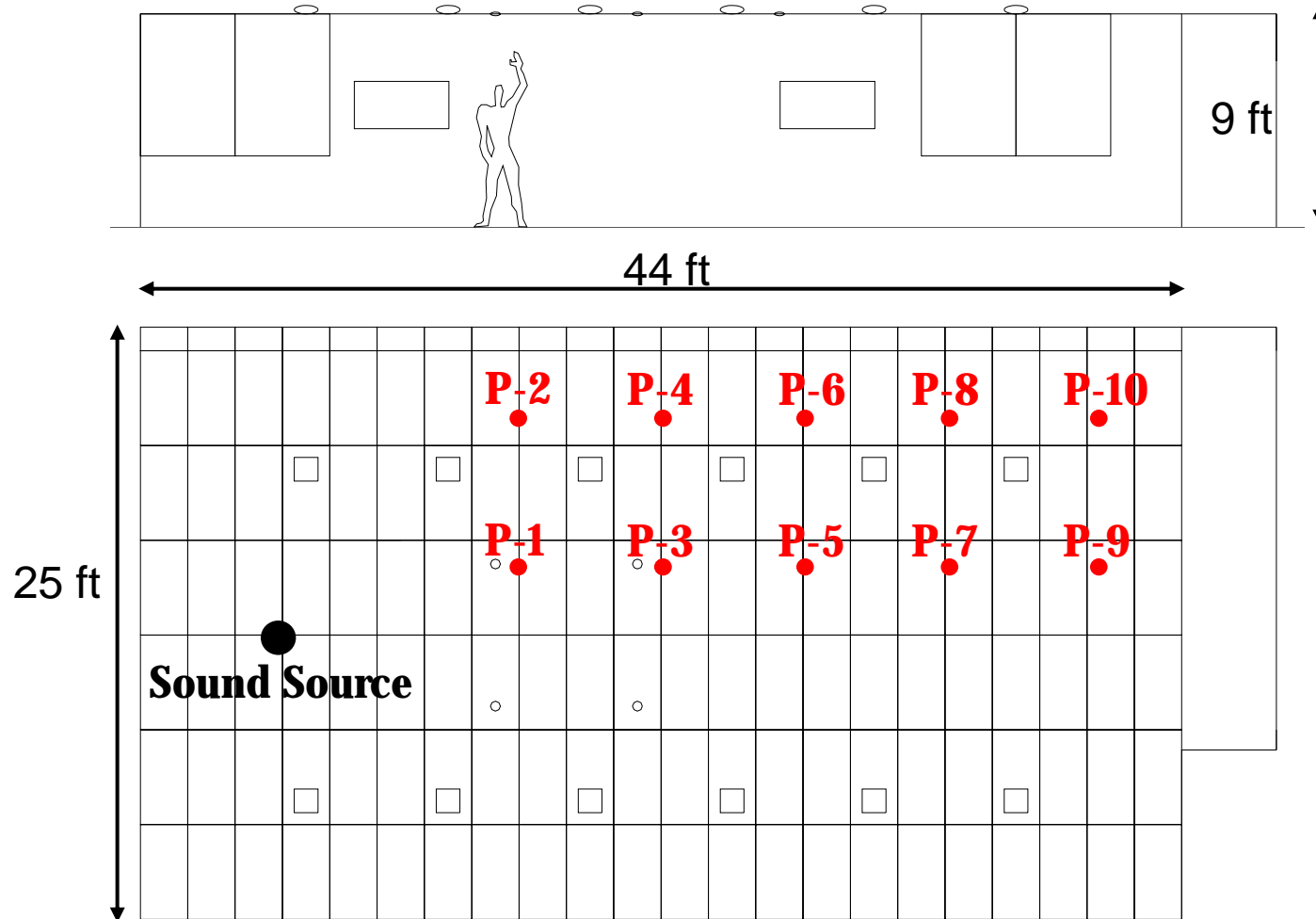


Relative level (dB)



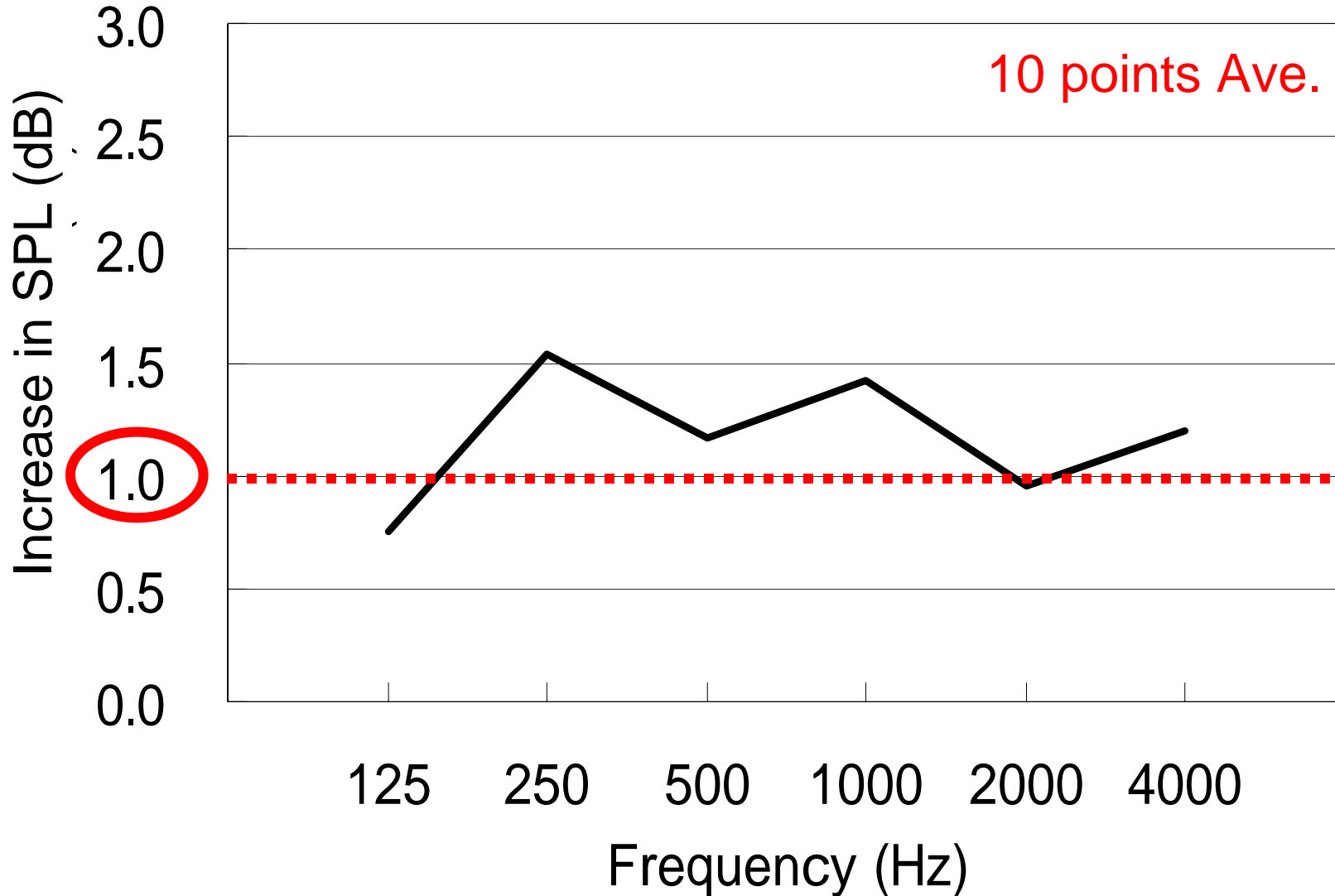
Example of Frequency Characteristics of FIR filter

Measurement Points

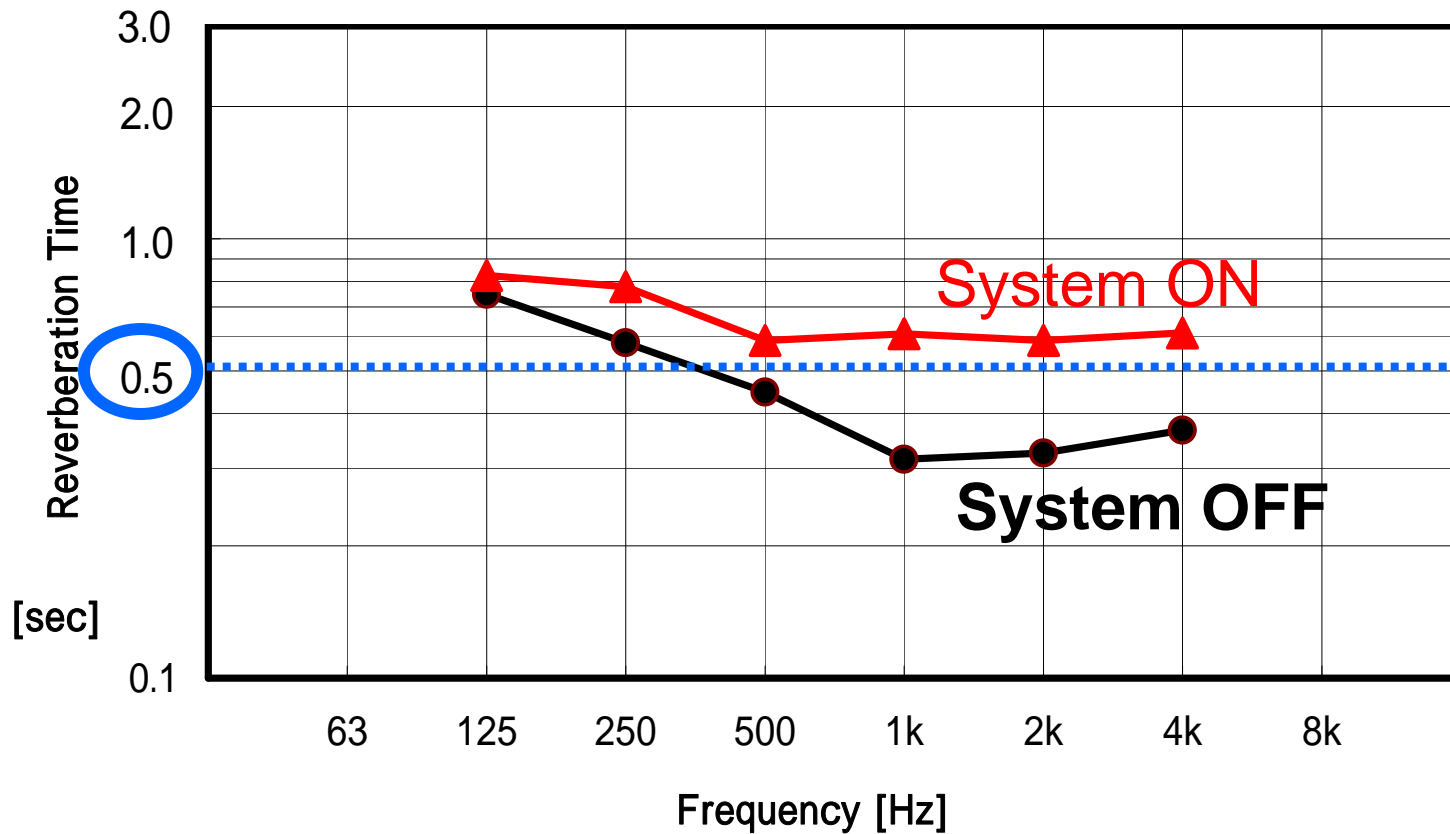




The measurement result of an increase in SPL with and without the AFC



Reverberation Time

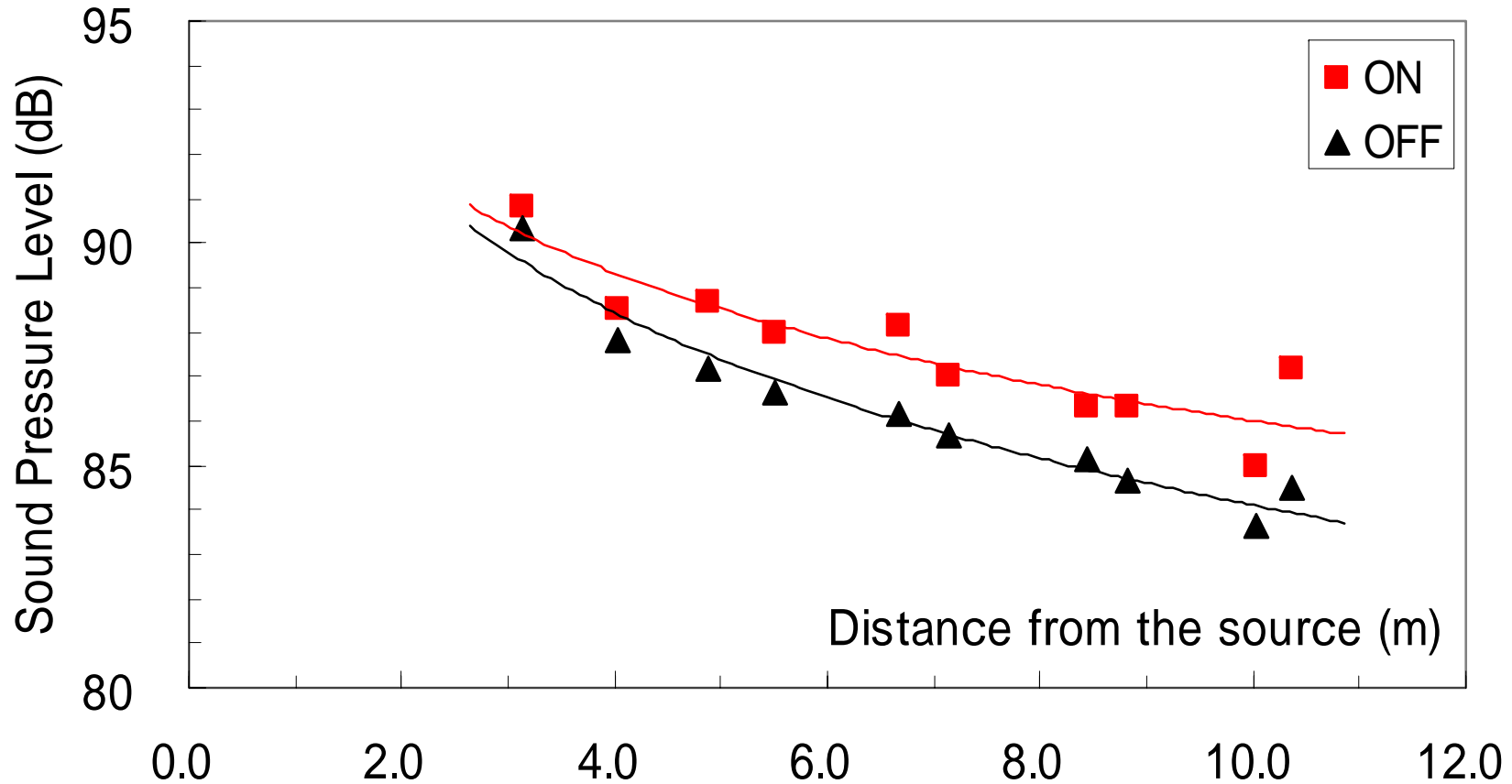


STI / System OFF : 0.88

System ON : 0.77

Distribution of SPL

1 kHz, 1/1 oct. band



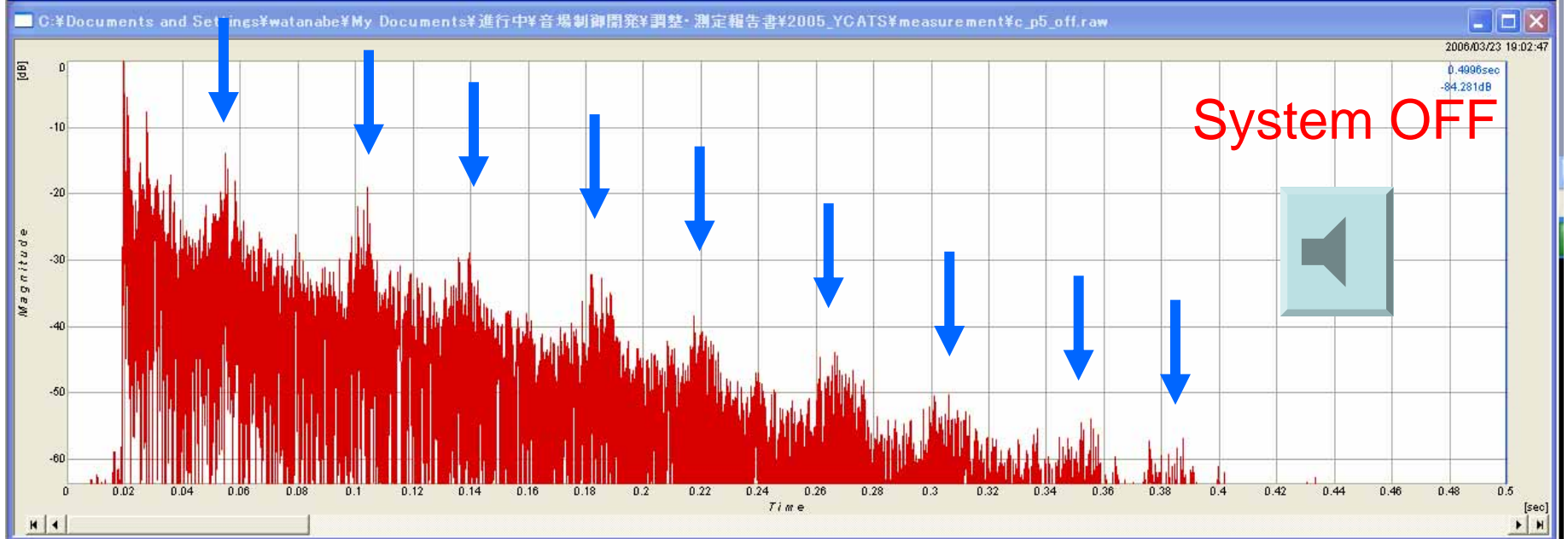
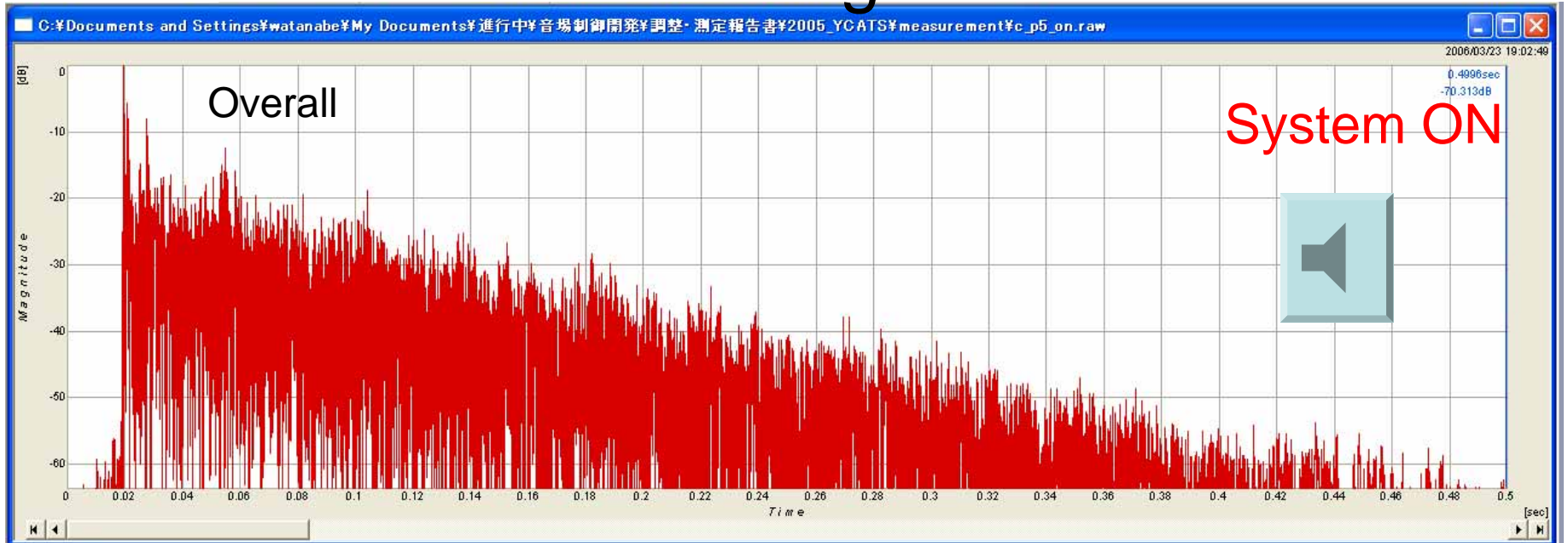
Absolute Deviation
System OFF 1.5 dB

$$\frac{1}{10} \sum |L - \bar{L}|$$

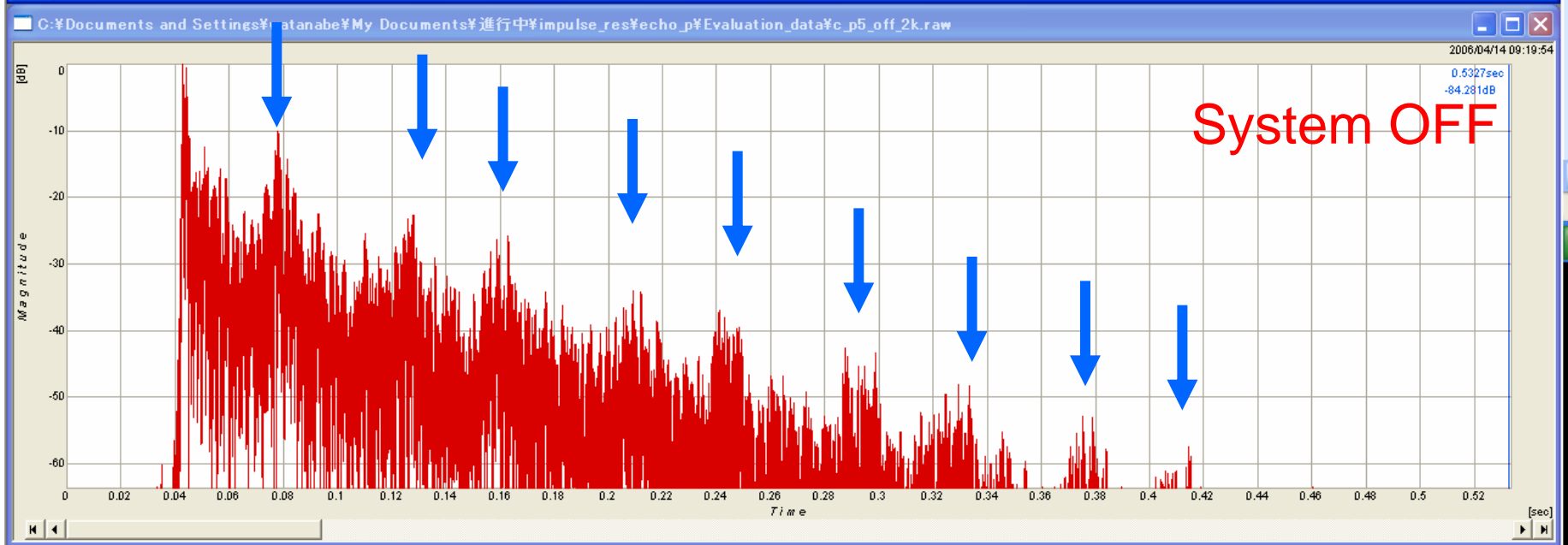
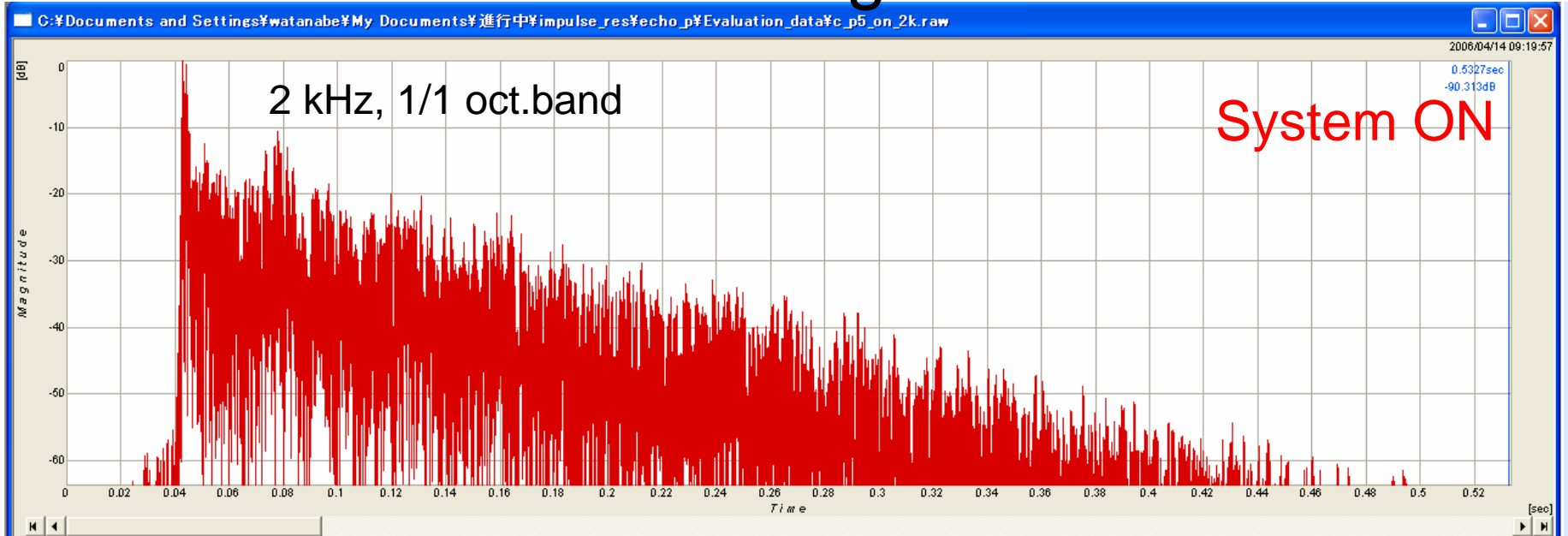
L: Sound Pressure Level at each point

System ON 1.2 dB (125-4 kHz average)

Echo Diagram

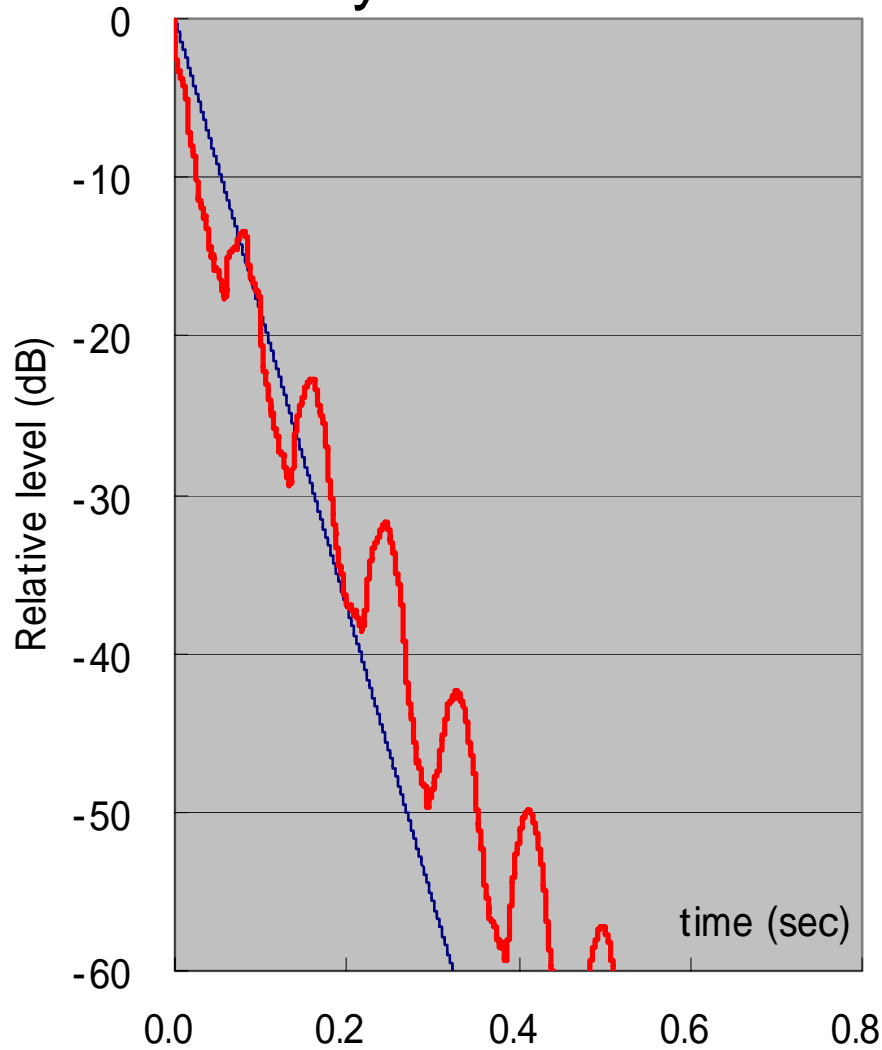


Echo Diagram

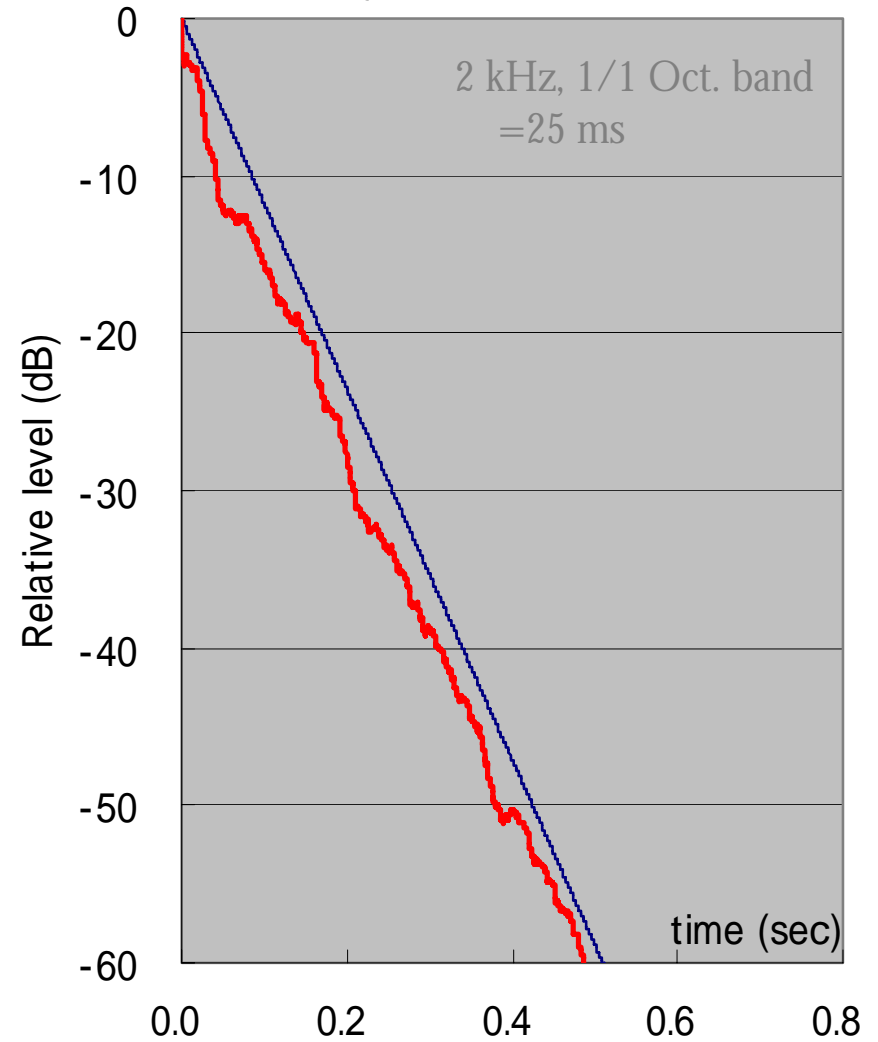


Comparison of RMS curve between real and ideal

System OFF



System ON



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.