Welcome to aural demonstration using sound field simulator!

SAKAMOTO LAB.

[Mathematics and physics for leading edge acoustics]

Advanced Mobility Research Center

http://www.acoust.iis.u-tokyo.ac.jp

Applied Acoustic Engineering

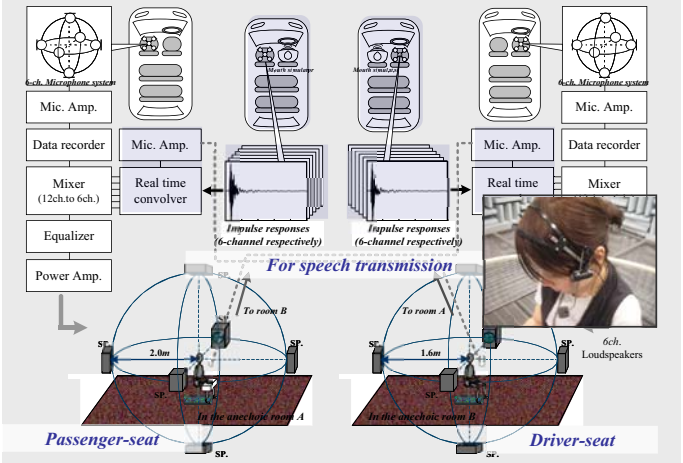
Department of Architecture,
Graduate school of Engineering

-Toward a better sound environment-
Mathematics and physics for leading edge acoustics

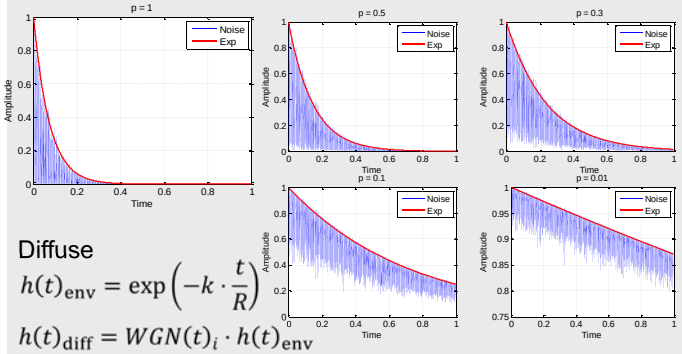
"Sound" is important for *our quality of life*. Our laboratory is making acoustic researches through prediction/measurement of physical aspects of sound and evaluation of psychological/ physiological effects of sound on man, in order to contribute to creation of safe and comfortable acoustic environment.

- ◆**Development of prediction methods**：Numerical analysis, Scale model experiment
- ◆**Room acoustic design**：Auditoria, Open-type classrooms
- ◆**Acoustic measurement**：Sound propagation, Sound insulation and absorption
- ◆**Development of sound field simulation**：6 channel recording-reproduction system
- ◆**Subjective evaluation**：Concert halls, Living environments, Public spaces, other small spaces such as a car cabin

Sound field evaluation in a car cabin



Unified representation of room acoustic parameters



Diffuse

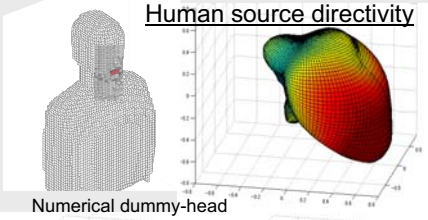
$$h(t)_{\mathrm{env}} = \exp\left(-k \cdot \frac{t}{R}\right)$$

$$h(t)_{\mathrm{diff}} = WGN(t)_i \cdot h(t)_{\mathrm{env}}$$

Non-diffuse $h(t)_{\mathrm{ndiff}} = \delta_a(t-R) = \lim_{a\to 0} \frac{1}{a\sqrt{\pi}} e^{-\frac{(t-R)^2}{a^2}}$

Numerical simulation of "Directivity"

Human source directivity

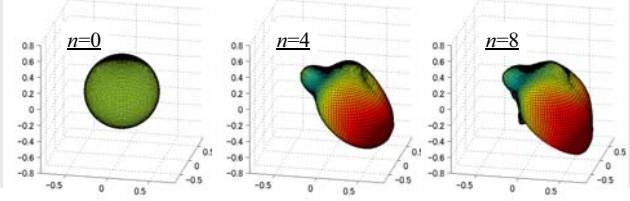


Numerical dummy-head

Expression of directivity using spherical harmonic expansion

$$Y_n^m(\theta,\phi) \equiv \sqrt{\frac{2n+1}{4\pi}\frac{(n-m)!}{(n+m)!}} P_n^m(\cos\theta) e^{im\phi}$$

$$g(\theta,\phi) = \sum_{n=0}^{\infty}\sum_{m=-n}^{n} A_{nm} Y_n^m(\theta,\phi)$$



Hearing directivity

Prediction of Head-Related Transfer-Function