Master OAM – Project proposal

INPHYNI
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Can we hear the shape of a room ?

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General context– To understand the acoustic quality of a room, in particular at low frequency, a mode-based approach is suitable. Those modes are resonances whose central frequencies have large enough spacing so that their broadening due to damping does not prevent to resolve them individually. Thus, at low frequency, the transmission of a single-frequency pure sound between two points can be significantly reduced if this frequency lies between two resonance frequencies of the room. For high frequencies, where the modal density increases, resonances are ovelapping and can no longer be resolved : one enters a regime where a statistical approach becomes more appropriate than a modal approach (see figure).

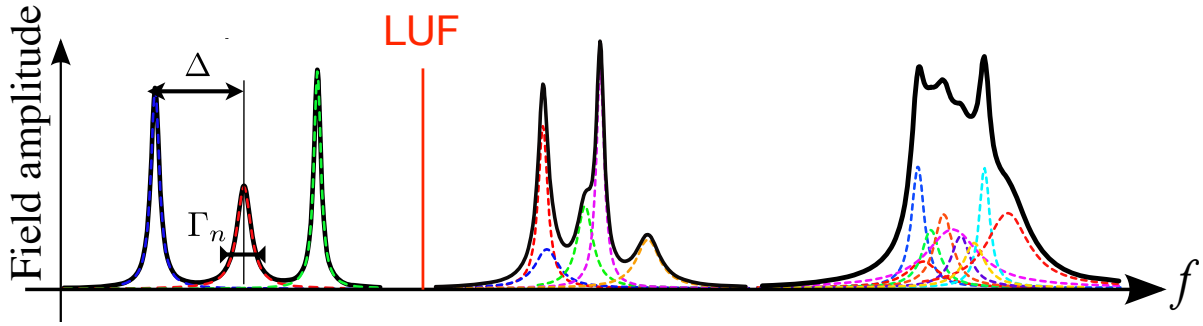

Figure : Schematic view of the response vs frequency f in a cavity in the presence of loss mechanisms (i.e. absorption at the walls). The red vertical bar (LUF) lies between a *low-frequency* regime of resolved resonances and a *higher-frequency* regime where resonances are overlapping in such a way they cannot be distinguished individually.

Objectives – During this project, the resonances of a reduced scale model of a room will be studied both analytically and experimentally in a rectangular closed space. Room dimensions are at the metric scale (V=1,00× 0,77× 0,62 = 0,451 m^3) and the expected losses due to absorption on walls and inserted objects will be evaluated. The geometry of the cavity will be modified by inserting objects in the volume and/or more or less absorbing elements on the walls.
By the analysis of sound signals recorded via a microphone, several techniques will be used to recover central frequencies and widths of the resonances : impulse response, response to a single frequency, response to a noise. The global quality factor of the resonances in a given frequency interval will be evaluated and related to the reverberation time, which is a key concept for the acoustic quality of a room.

Références

[1] Heinrich Kuttruff, *Room Acoustics: Fifth Edition*, New York: Spon Press, 2009
[2] M. Wright, R. Weaver: *New Directions in Linear Acoustics and Vibration.* University Press Cambridge, 2010