



Investigation on Quiet Zones created by remote impedance control

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Summary

- Introduction
- Principle
- Parameters influence
- Experimental validation
- Conclusions

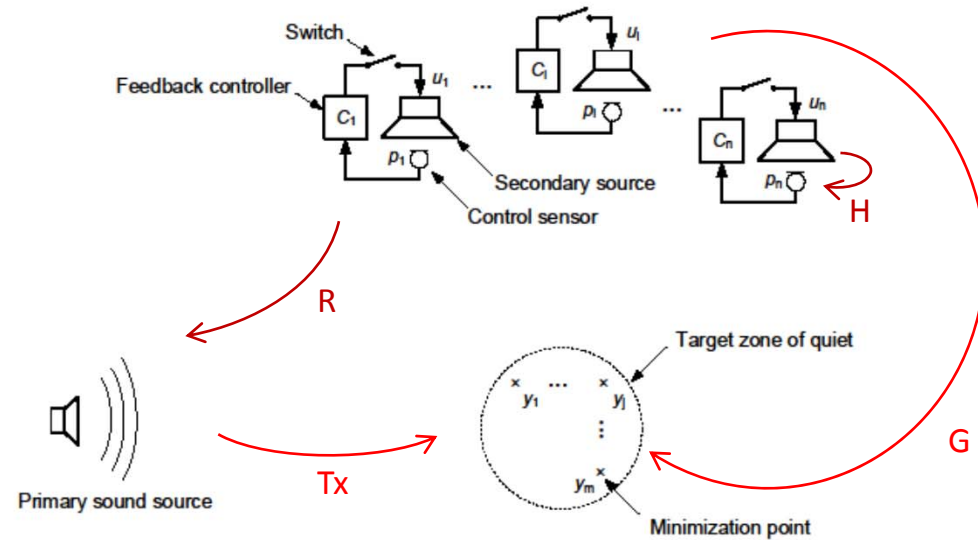
Introduction

- Low Frequency Noise (train stations, offices...)
 - No global control → Local “Quiet Zone”
 - Spot-Type sound reducer
 - Similar to an Impedance Control
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- **Paper : R. Boulandet, T. Laurence, H. Lissek, “Design of remote quiet zones using spot-type sound reducers”, Acta Acustica, vol. 103 (2017)**

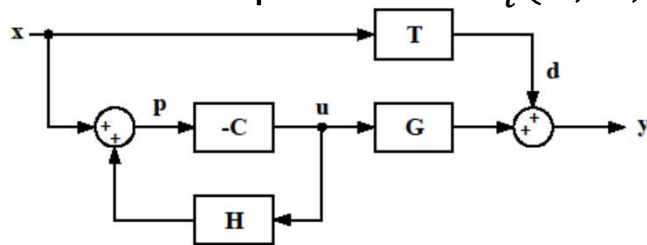


Principle

- $y = Gu + Tx$
- $J = y^H y + \beta u^H u$
- $p = Hu + x$ and $u = -Cp$
- $x = Rr$
- $C_i(j\omega) = -\frac{u_{opt_i}(G,H,T,R)}{p_i(G,H,T,R)}$



- Feedback expression : $C_i(G, H, T, R)$



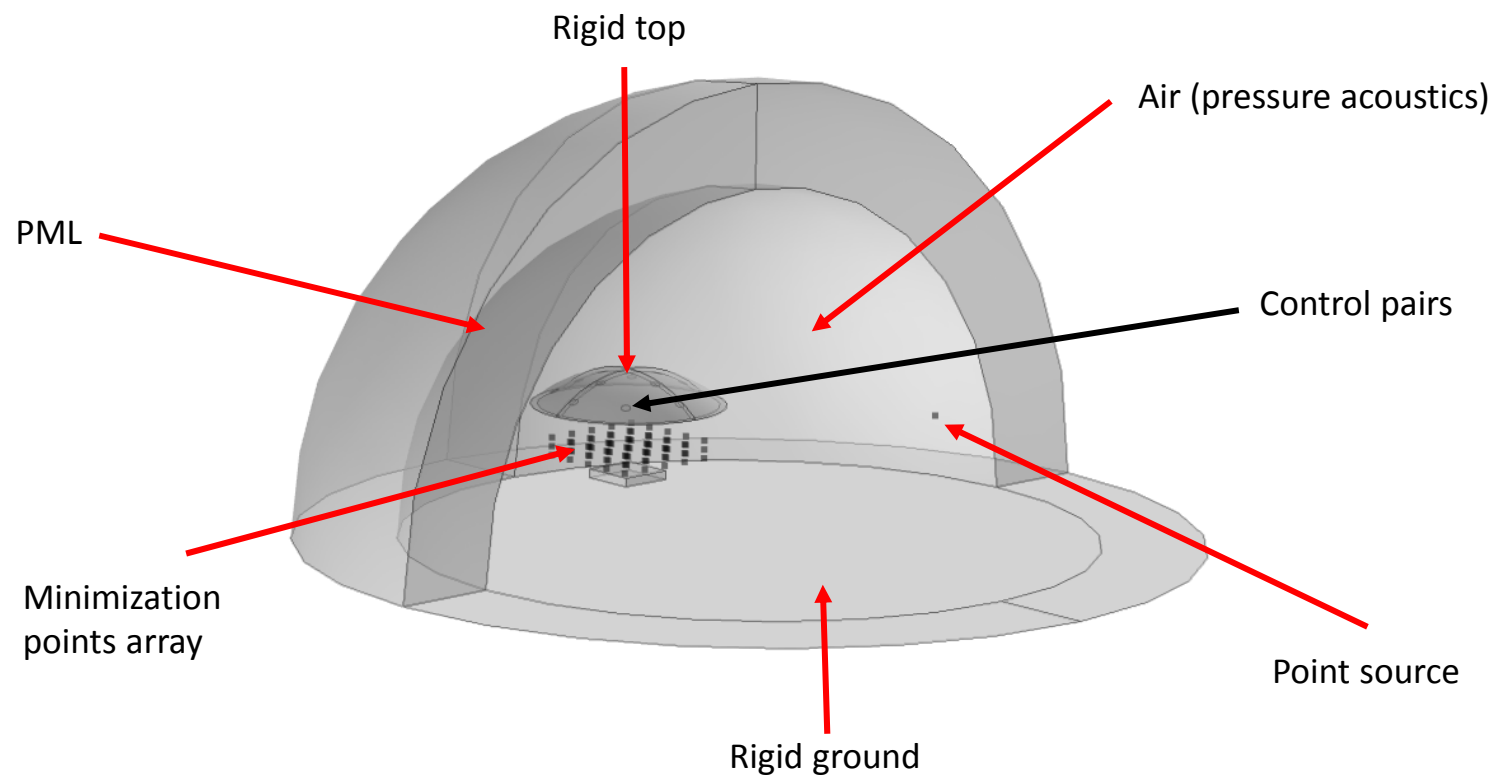
Parameters influence

- Potential parameters :
 - Number of control pairs
 - Presence of a rigid top
 - Shape of the minimization target

- ➔ COMSOL simulation of the variation of different parameters



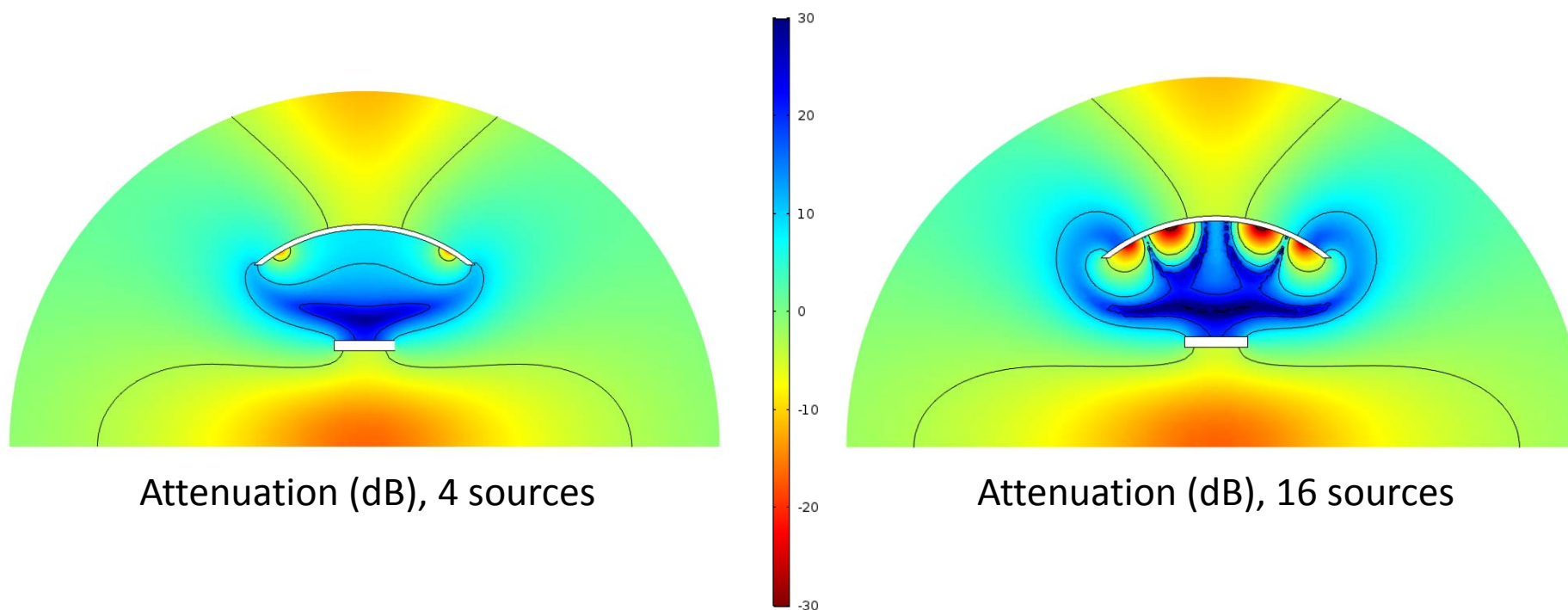
Parameters influence





Parameters influence

- Number of sources : low influence on quiet zone



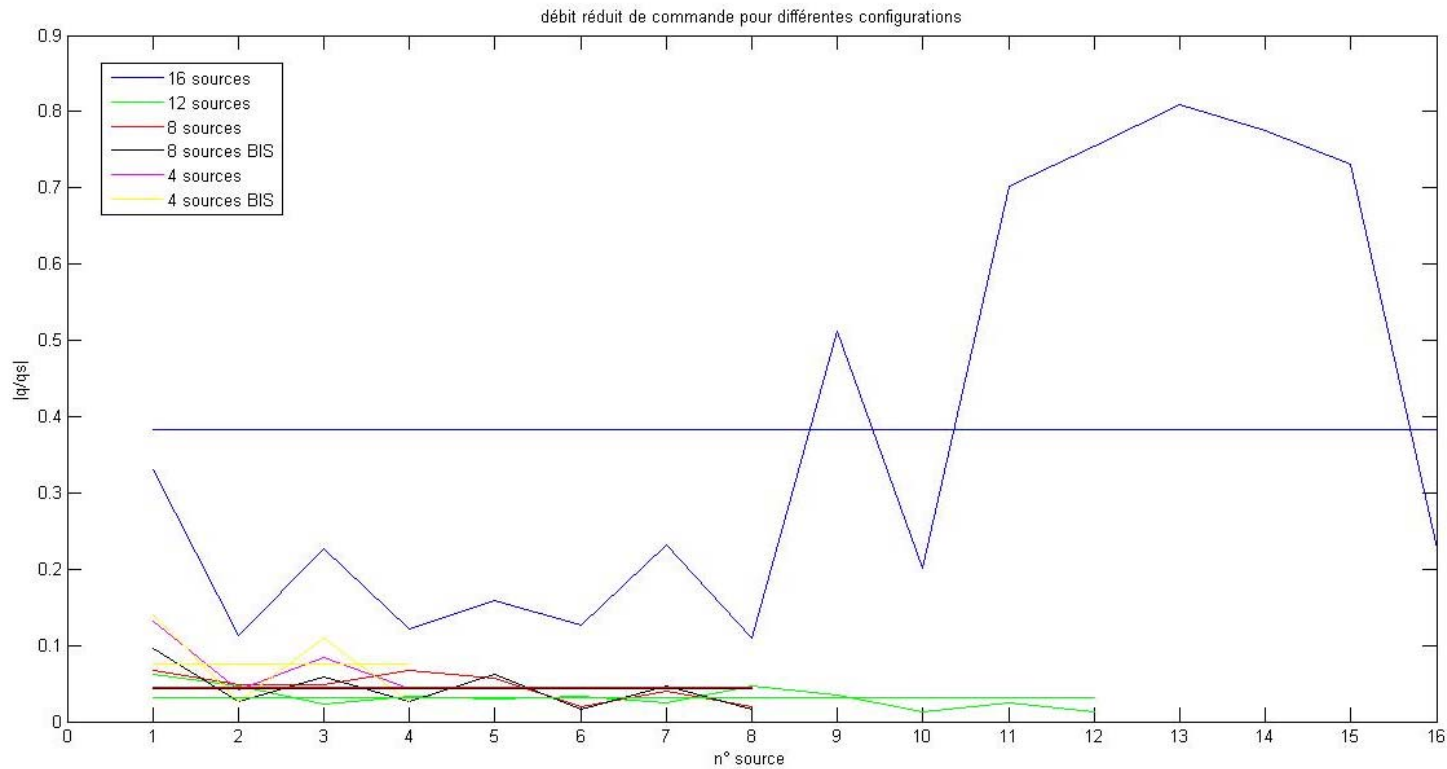
Attenuation (dB), 4 sources

Attenuation (dB), 16 sources



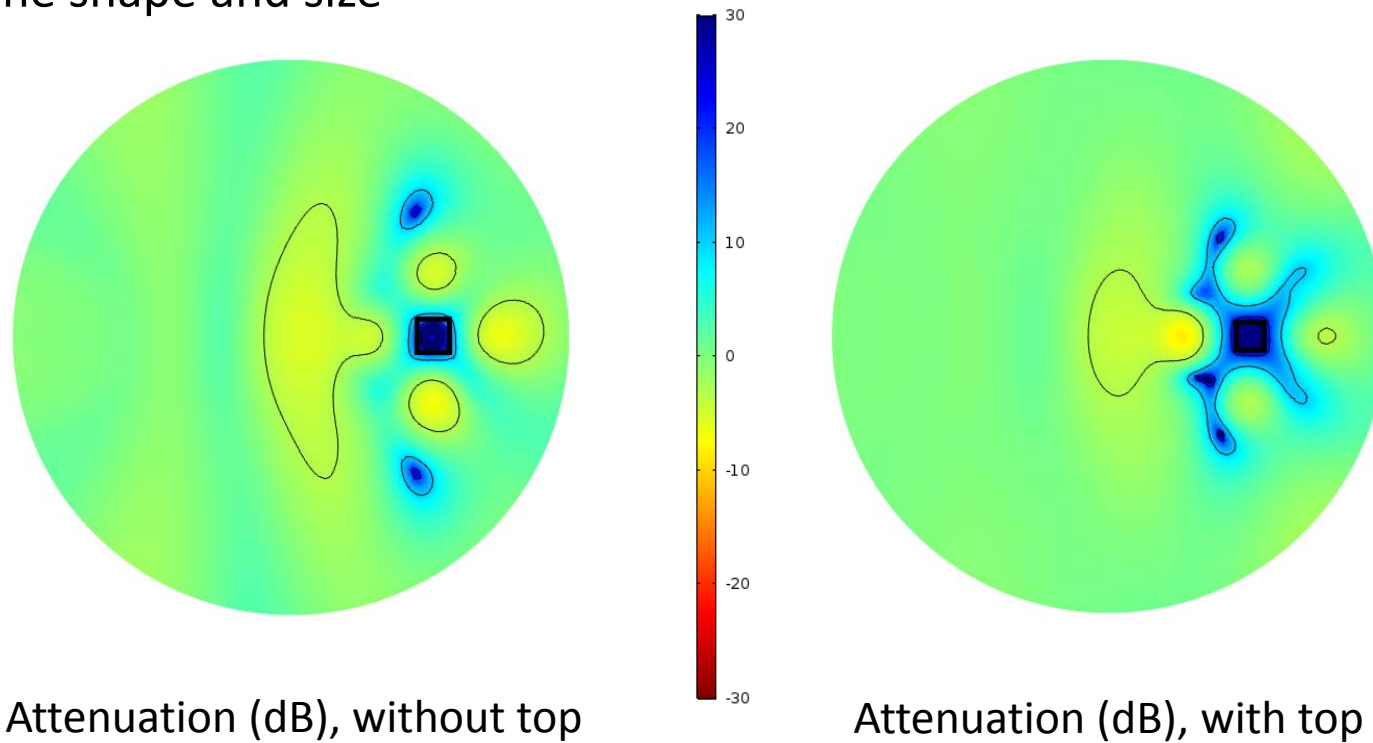
Parameters influence

- Number of sources : strong influence on strength of secondary sources



Parameters influence

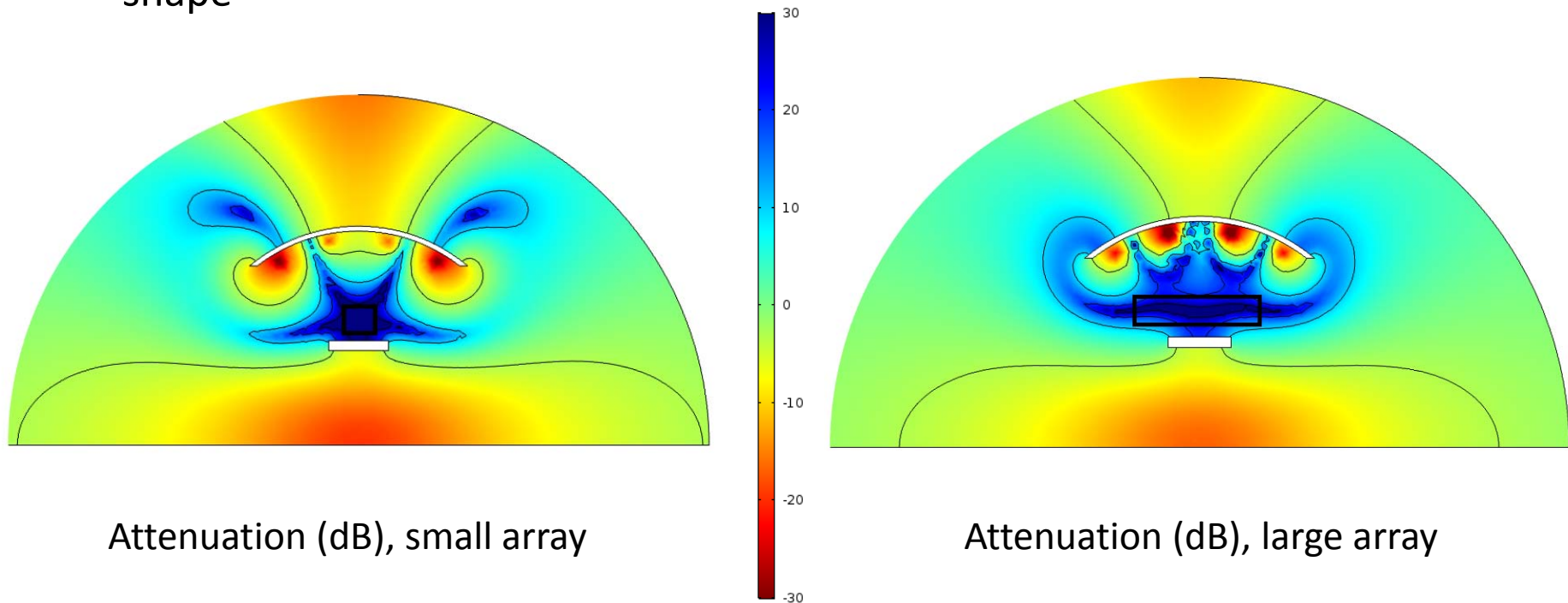
- Presence of a rigid top: influence on strength of the sources and quiet zone shape and size





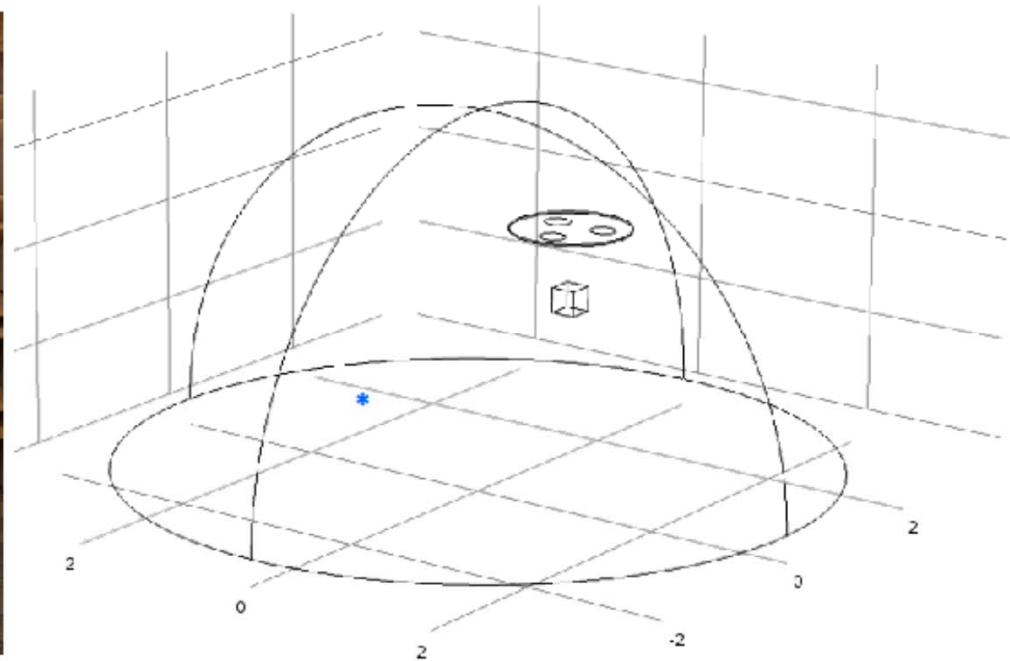
Parameters influence

- Shape of minimization points array: influence on quiet zone size and shape



Experimental validation

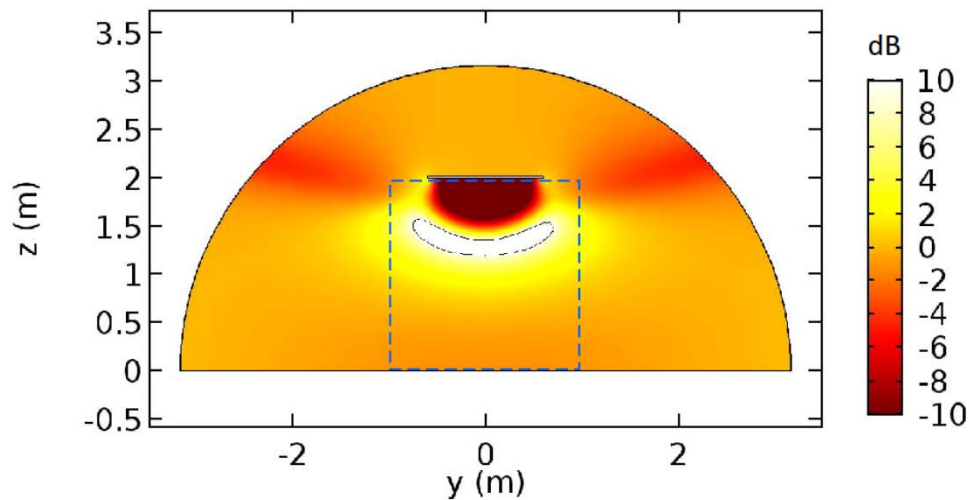
- Simplification of the model, harmonic real-time control, modelization then experiment



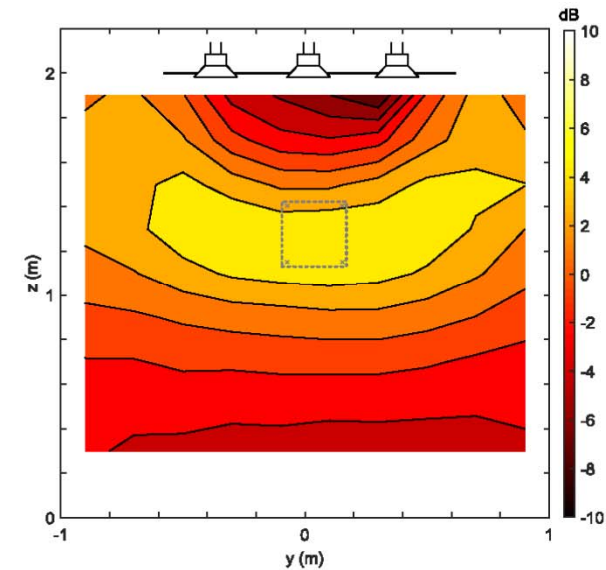


Experimental validation

- Very good agreement between the simulation and the experiment
- Level difference maybe due to the non-modelled couplings



Attenuation (dB), simulation



Attenuation (dB), experiment

Conclusion

- Working quiet zone concept, both in simulation and experiment
- We get an idea of the influence of parameters
- It's still difficult to anticipate, and to generalize the conclusions
- The simulations give us a great tool to optimize the system

Future work:

- Wideband and not harmonic (experiments mainly)
- Try to simulate this effect in a room



Thank you !

