

On The Directional Response Of Multi-Driver Column Loudspeaker Configurations Using FEA And BEM

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Introduction: Column Loudspeakers employ multiple drivers giving several acoustic advantages versus a point source, especially in highly reverberant environments. The exploration of a design suitable for home theater sound, but for bigger and untreated environments is illustrated.

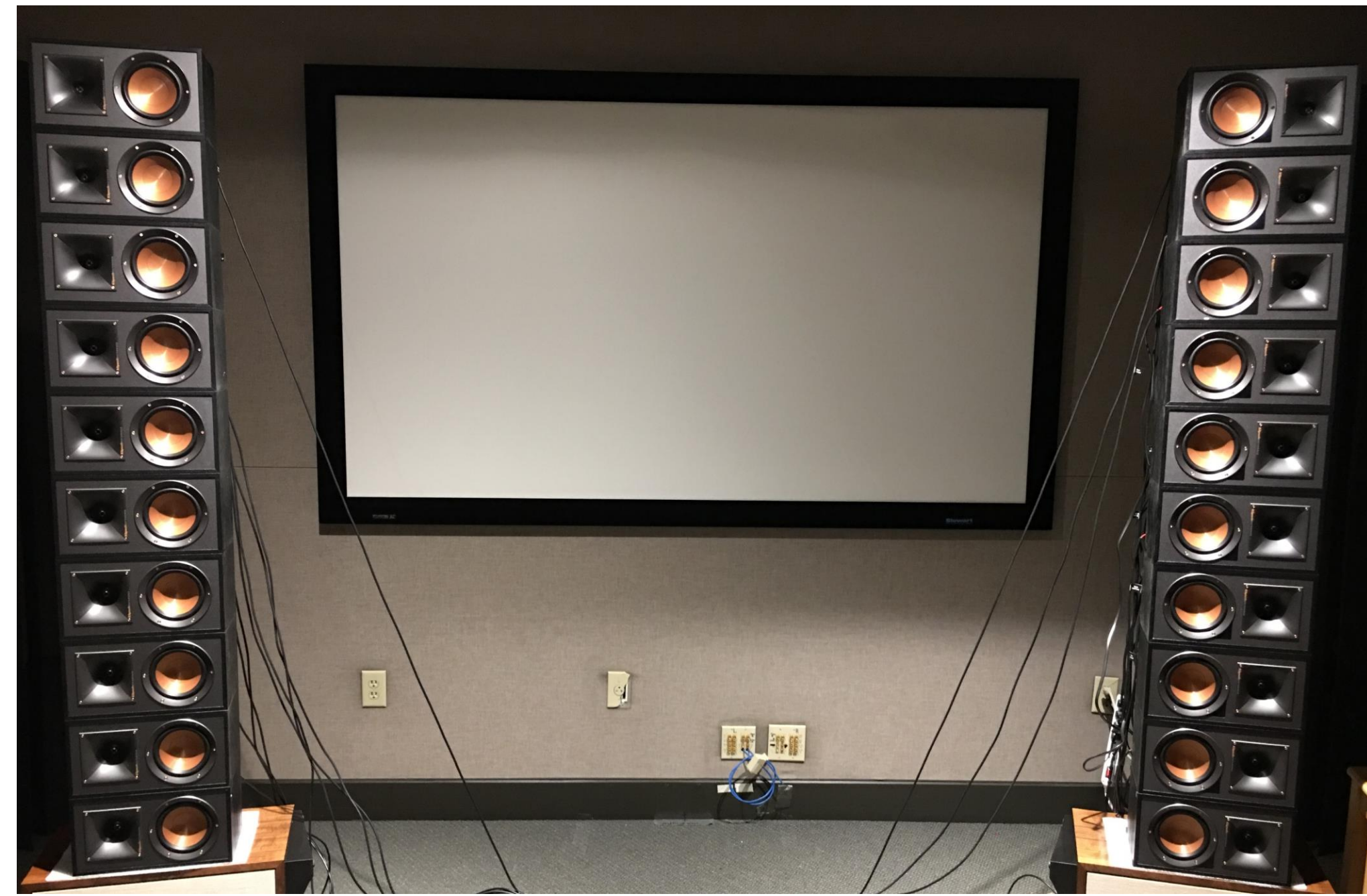


Figure 1. inspirational idea, courtesy of Klipsch

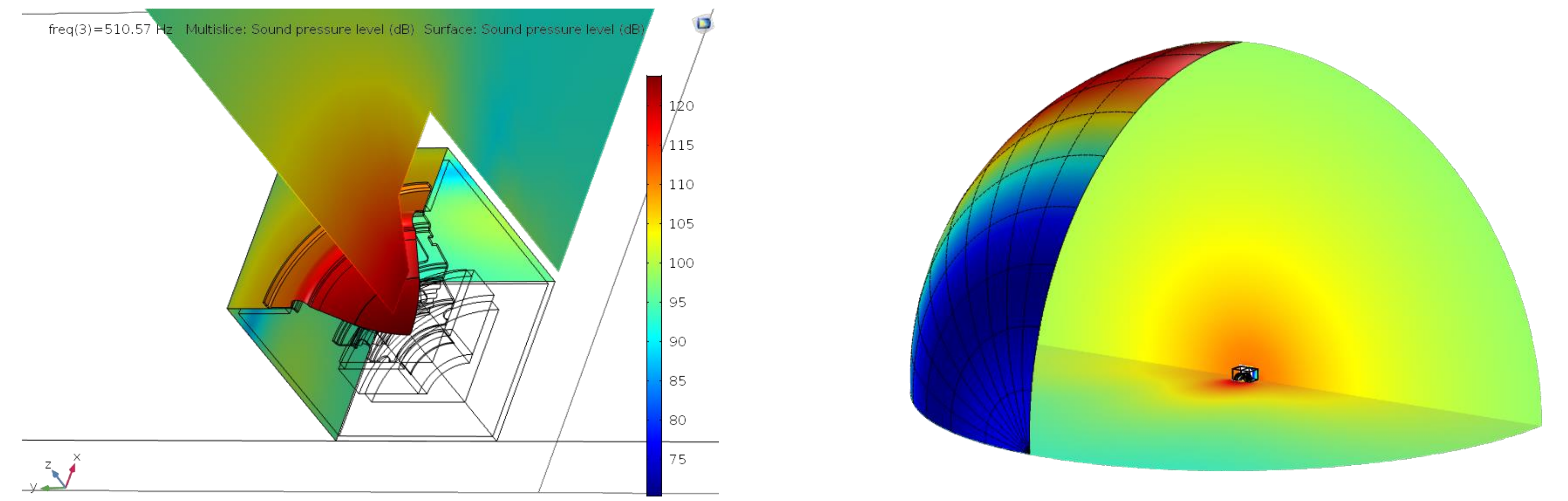


Figure 5. BEM & FEA simple enclosure verification

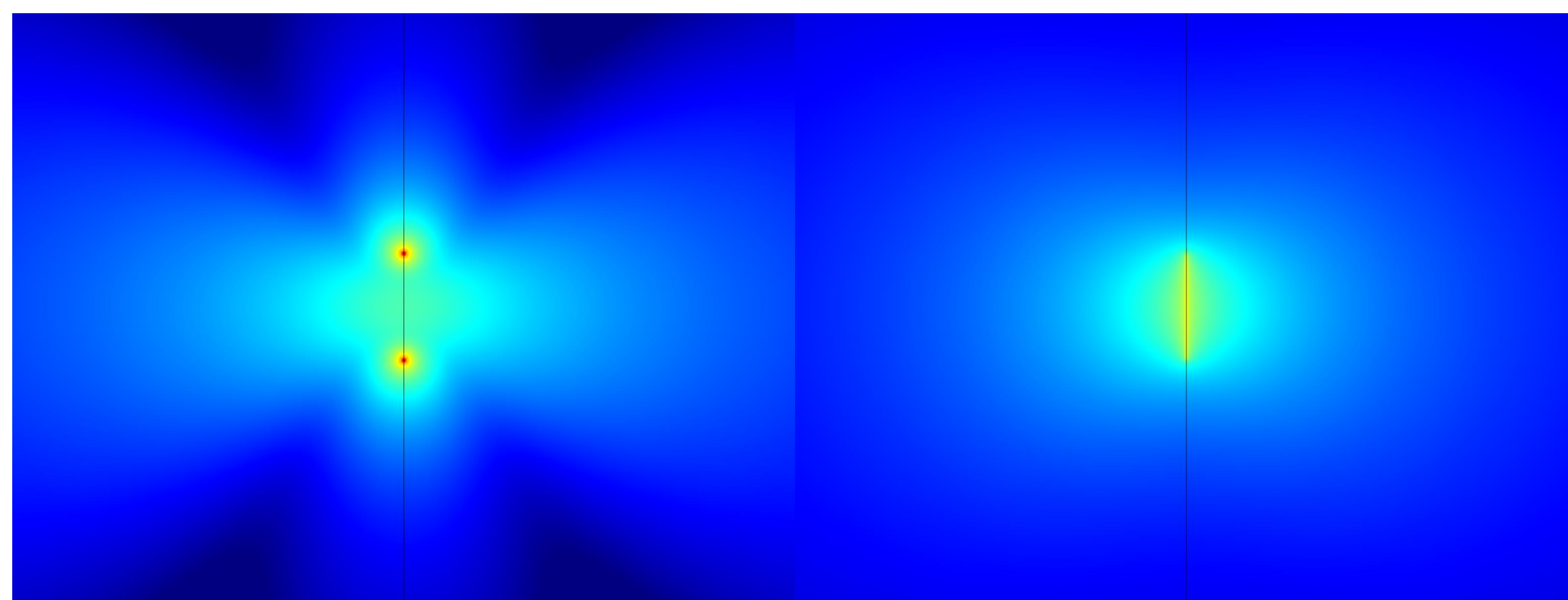


Figure 2. Vertical sound field of point vs. line sources

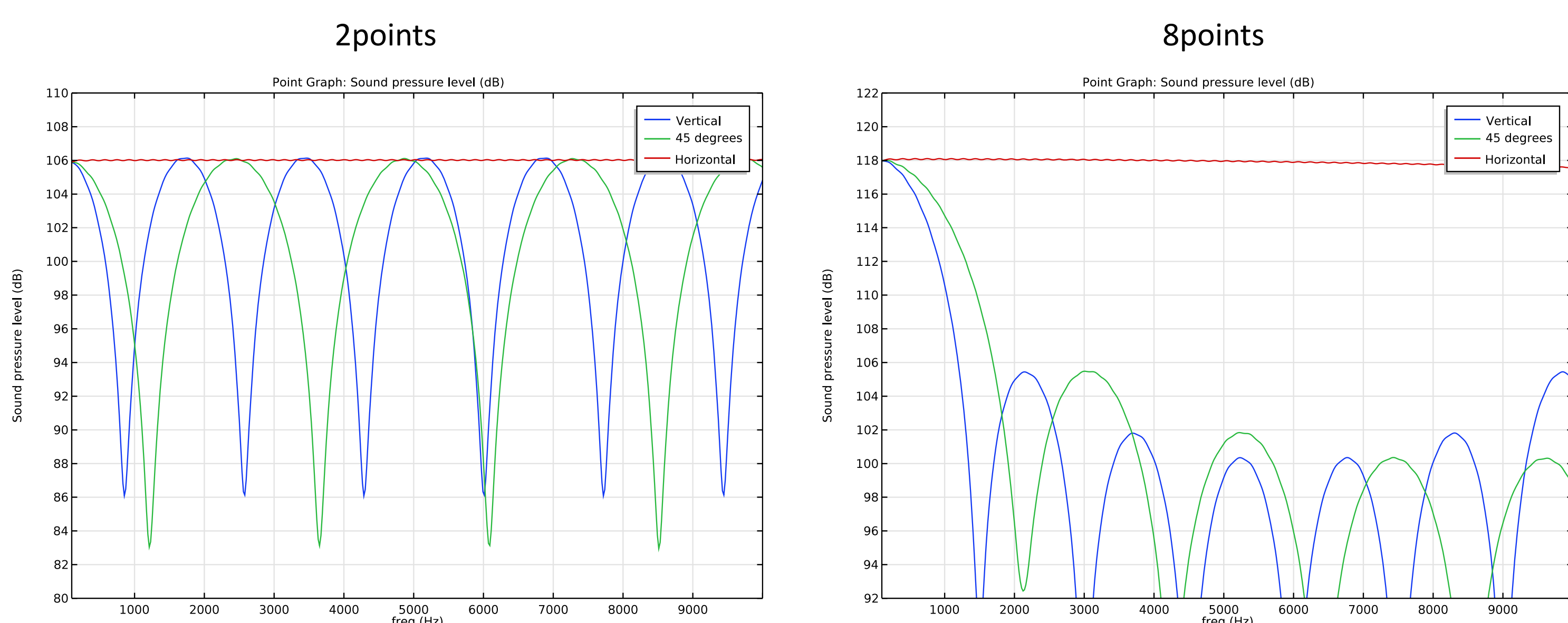


Figure 3. Response of sources aligned within 200mm

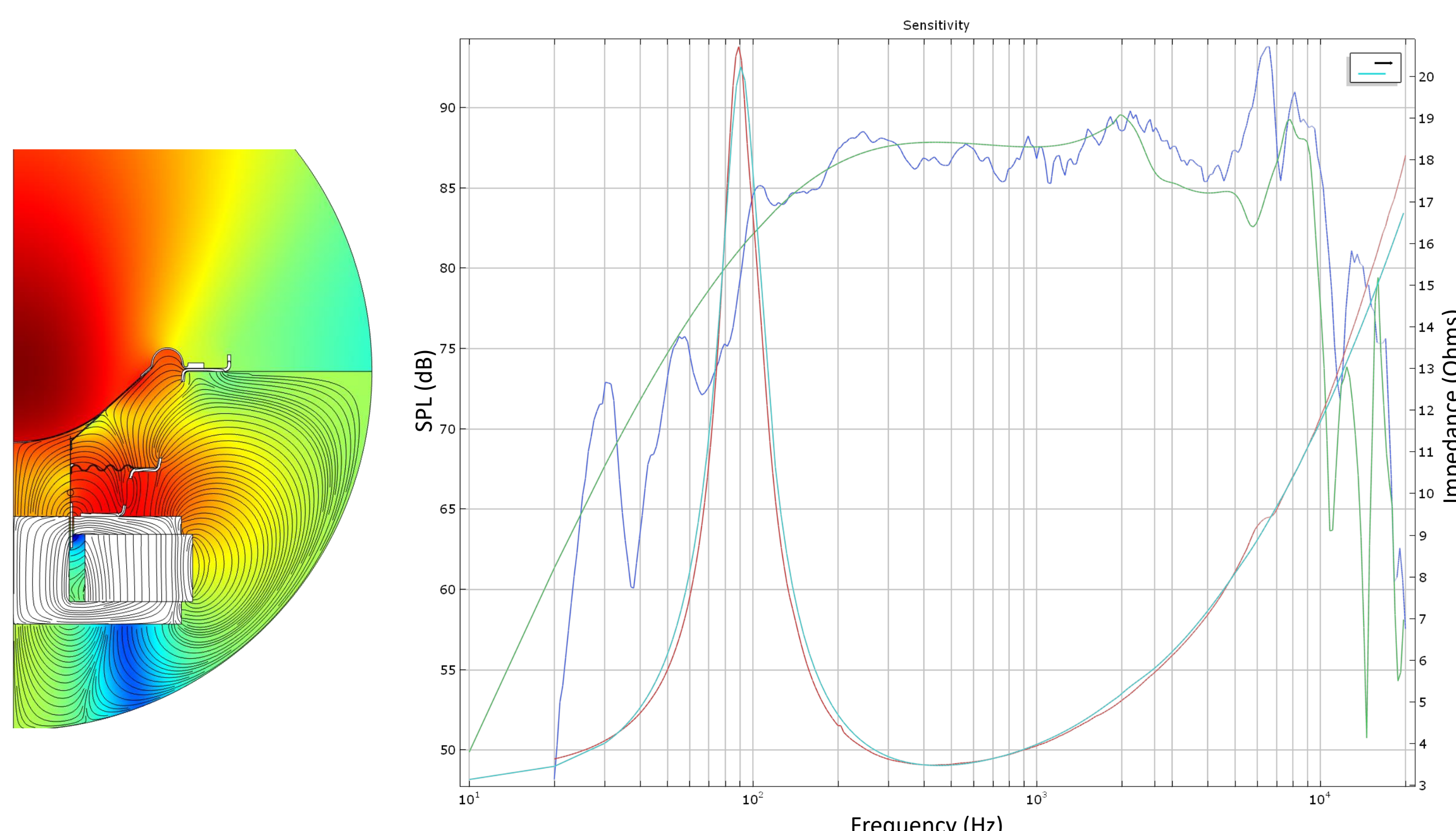


Figure 4. simulation vs. measurements of driver

Computational Methods: The transducer was firstly solved for its Magnetics then analyzed in Pressure Acoustics physics interface coupled with mechanics for verification. Then, those results were brought into an enclosure with multiple drivers with and analyzed with a combination of FEA and BEM.

$$\nabla \cdot \left(-\frac{1}{\rho_c} (\nabla p_t - \mathbf{q}_d) \right) - \frac{k_{eq}^2 p_t}{\rho_c} = Q_m$$

Equation 1. Scalar Wave Equation Frequency Domain

Results: An optimal amount of transducer drivers were chosen and spaced to give the best results in an average non treated listening environment.

Conclusions: The empiric alternative to this method is multiple iterations of prototypes with drivers, or perhaps approximate results with the use of lumped circuit equivalents. The use of FEA and BEM allows the accurate investigation in the far field and with enclosure sizes that would be prohibitive in terms of RAM with FEA alone, shortening time to a finalized design.

References:

1. Master Handbook of acoustics