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COMSOL Multiphysics® Simulation of Electro Dynamic Planar Loudspeaker (EDPL)

M. Asgarisabet[1], R. Czapla[1], J. Krueger[1]

1. HARMAN International, Lifestyle Division, Novi, Michigan, USA

Introduction: The lightweight and ultra-thin design of Electro Dynamic Planar Loudspeaker (EDPL) [1], enables to integrate into difficult installation locations where conventional loudspeakers could not be installed. Better understanding the performance of EDPLs using simulations, will drive future design improvements. A 3D model of EDPL has been developed in this study.

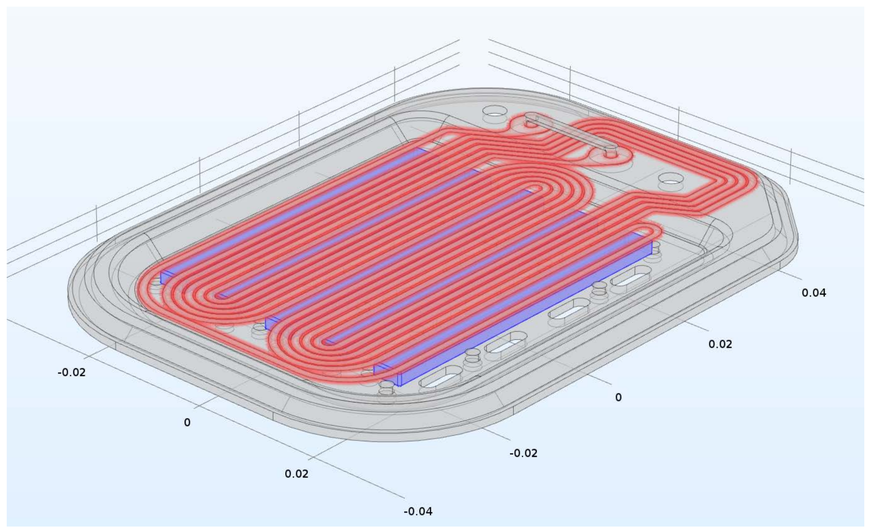


Figure 1. The Geometry, Magnets (Blue) are under the thin transparent diaphragm and coil (Red)

Computational Methods: The forced obtained from magnetic field (AC/DC Module) is applied to the coil and the velocity of the coil and the thin diaphragm under it, is coupled with pressure acoustics (Structural Mechanics and Pressure Acoustic Modules) [2,3].

Governing Equations:

$$-\rho\omega^2 u = \nabla.S + F_V e^{i\varphi}$$

$$\nabla.\left(-\frac{1}{\rho_c}(\nabla p_t - q_d)\right) - \frac{k_{eq}^2\, p_t}{\rho_c} = Q_m$$

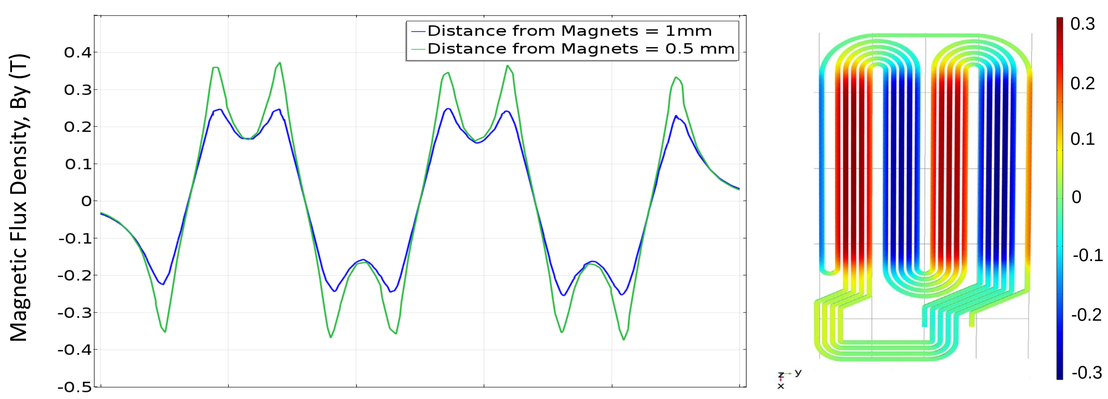


Figure 2. Magnetic Flux Density (Obtaining the optimal location of coil)

Results: Magnetic flux density, sound pressure level distribution, frequency response and directivity index have been obtained.

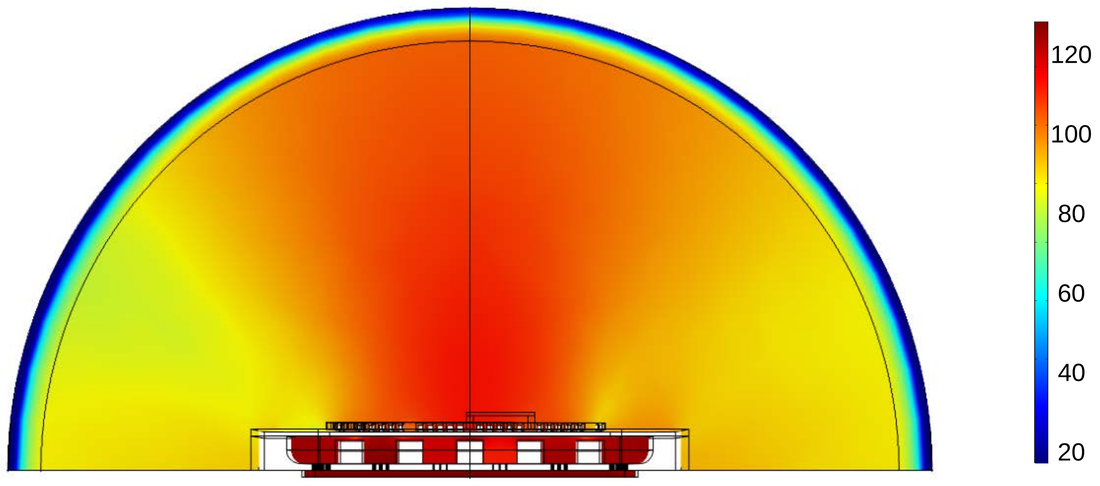
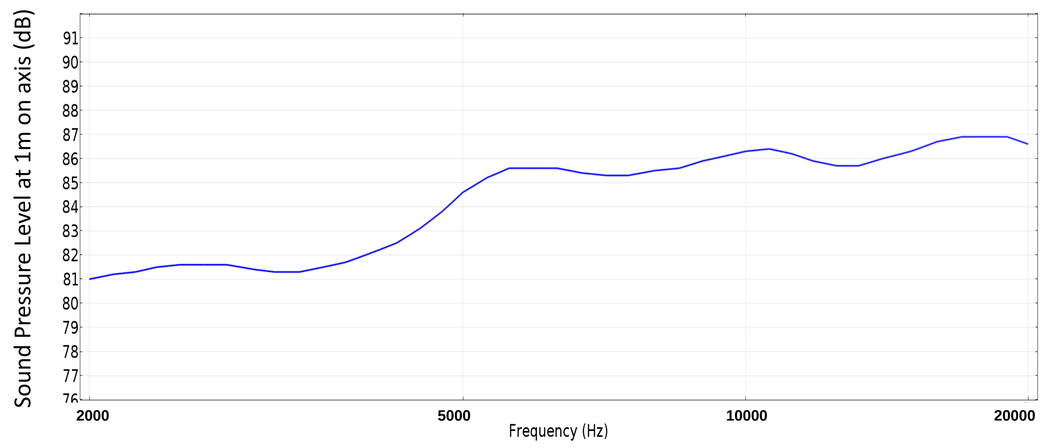


Figure 3. Simulated Sound Pressure Level at 10 kHz(dB)



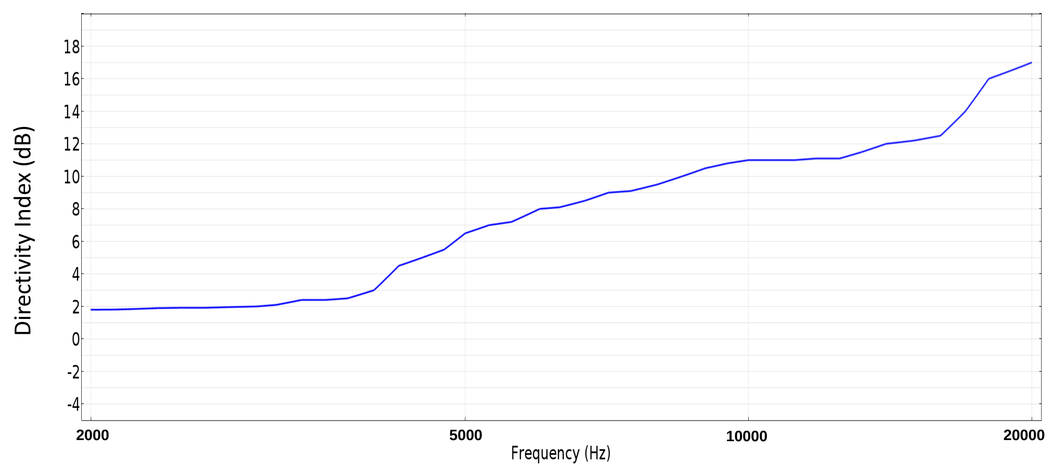


Figure 4. Sound Pressure Level and Directivity Index as a function of frequency

Conclusions: Simulations help to study the performance of the system and obtain the optimal geometry and materials. The effect of different parts, geometries and material properties can be studied using simulated model.

References:

1. US 20040182642 A1, Acoustic Lens System (2004)
2. L. L. Beranek, Acoustics, the Acoustical Society of America (1993)
3. COMSOL, Loudspeaker Driver, Application Library (2016)