Modeling the Sound Radiation By Loudspeaker Cabinets

M. Cobianchi[1], M. Rousseau[1]

[1]B&W Group Ltd, Steyning, UK

Abstract

While musical instruments often rely on a body which resonates on purpose to amplify the vibration produced by a string or a membrane, like in a violin or a guitar, loudspeaker cabinets should not contribute at all to the total sound radiation, but aim instead to be a perfectly rigid box which encloses the drive units in charge to transform the electrical signal at their terminal into acoustic waves.

A direct sound radiation measurement of the sole cabinet contribution is almost impossible to obtain because of the far higher masking level of the main drive units radiation, thus only vibration based measurements through accelerometers or no-contact techniques are viable options. This makes even more desirable the capability of accurately modelling inside a fem package the cabinet vibration behavior and compare different design option for a product optimization. It`s worth mentioning as well that prototyping curved panels requires an effort which is far greater than prototyping standard "box style" cabinets, thus reducing the total number of prototypes to be actually tested is of the uttermost importance when developing curved panels cabinets like in this case study.

Two phenomena are contributing to the total SPL radiated from the cabinet: the sound which leaks by transmission through the wall, which will be the subject of another paper in the near future, and the mechanical excitation of the cabinet by reaction force related to the drive units operation, the subject of this paper.

Modeling steps in the COMSOL Multiphysics® simulation include measuring and fitting orthotropic material properties, including damping, simplifying the geometry for the purpose of saving computation time, 3D mechanical modelling with curvilinear coordinates system and thin elastic layers, and proper post processing to extract useful and easy to compare plots.

While proving an effective and powerful tool for optimization of cabinets, where geometries and materials can be easily tested without building the actual cabinets, the understanding of modes coupling and the role of reinforcement panels is an additional benefit. The predictions have been validated with laser Doppler based measurements, and with subjective listening tests in our reference listening room.

Optimization of the cabinet design for a new generation of loudspeakers has led to an average

improvement of 20dB reduction in the SPL radiated by the cabinet walls, lowering the "noise floor" of sound reproduction.