Loudspeaker Response Optimization with the Aid of Impulse Response

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Abstract

Abstract: COMSOL Multiphysics® simulation software is receiving a lot of attention in the loudspeaker industry thanks to the quality of the results it provides making it an essential tool to optimize geometries so that the best reproduction capabilities of the loudspeaker system are achieved.

The setup usually has a given geometry, portion of which is the moving diaphragm of the transducer, and it can be as simple as specifying the velocity of the diaphragm within the Acoustic module or include full definitions of the Electromagnetic domain, Mechanical domain and Acoustical domain with the addition of AC/DC, and Structural Mechanics modules in a Multiphysics setup; alternatively, with just AC/DC module and Acoustic module and with the aid of lumped circuit equivalents to link the behavior of the transducer from the electrical domain to acoustic domain can suffice, but, whatever the case, an analysis is done in the frequency domain on a series of values for frequencies either following logarithmic spacing or a discrete set keyed in or stored in a file in order to profile a resulting frequency response. This process of iterations, unless floating network license and a cluster of computers are available, can be rather time consuming for an average workstation.

With the latest 5.3 update, improvements were done in the Acoustic module on time domain that allows an easier setup of acoustic simulations, opening the door to a practical use of an impulse response analysis in time domain, this way, results with a Fourier Transform give an idea of the behavior in the frequency response for a quick optimization or a more detailed inspection with translation of the data in frequency domain to map results in the far field with a similar amount of information, of a frequency sweep, but in this case focused on frequencies of interest within the same model which, when thinking of iterative changes, speeds up specific optimization of the geometries for the intended target of the design. This paper aims to illustrates such an approach to loudspeaker design.