Abstract

In the field of multimedia products, development trends have seemed to aim at the reduction of size over the past decade and that concerns built-in audio systems as well. Besides this, users have ever increasing requirements on sound quality. That often tends to meet with quite a few difficulties when using small size speakers. The most problematic points are the deficiency of transferring low frequency signals and the problem of having ripples in the transfer function. Up-to-date techniques of digital signal processing may offer solutions for all of these questions.

In this thesis, I introduce the methods which are often used to compensate the imperfections of a loudspeaker's frequency response. I attempt to do this through the design process of an active loudspeaker with small wide-range speaker unit. First I describe a technique that is widely used to measure the linear frequency response and harmonic distortion of a loudspeaker applying logarithmic sweep signal. Then I review the filter types which are suitable for the equalization of a linear transfer function, including FIR, IIR, WFIR, WIIR and parallel IIR structures. I also introduce the basics of virtual bass synthesis (VBS) and two options for its realization.

After general descriptions, I present all the steps of designing my own active loudspeaker. First I give a review of building the wooden box and introduce the aspects of choosing the optimal parts (speaker, power amplifier, etc.). I also describe the basic parameters of the SigmaDSP evaluation board which has been used to implement all the compensation methods. After that I evaluate the results of the frequency response measurements performed using the "raw" loudspeaker. I give a description of the applied methods – such as Linkwitz-transformation and parallel IIR structure – which were used to compensate the defects of the measured frequency response. Their implementation on the SigmaDSP board is also discussed. Then I make a comparison between time- and frequency-domain VBS algorithms in MATLAB, and realize the better sounding one on the evaluation board. Finally, I evaluate the whole system that was set-up and make suggestions about the possible directions of future development.