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Relationship between voice coil fill factor and loudspeaker efficiency - DTU Orbit (09/11/2017)

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In modern audio systems, utilizing switch-mode amplifiers, the total efficiency is dominated by the rather poor efficiency of the loudspeaker. For decades voice coils have been designed so that nominal resistances of 3 to 8 Ω are obtained, despite modern audio amplifiers, using switch-mode technology, can be designed to much lower loads. A thorough analysis of the loudspeaker efficiency is presented and its relation to the voice coil fill factor is described. In addition to this the influence of the driver's mass ratio is investigated and it is found that high mass ratios is beneficial for the efficiency of drivers using high fill factor voice coils. Different voice coil winding strategies are described and their fill factors analysed. It is found that by lowering the nominal resistance of a voice coil, using rectangular wire, one can increase the fill factor. However a practical realization of four voice coil designs could not proof this due to wire insulations issues. Despite that a good correlation between theory and experimental results is found and it is shown that the efficiency is dependent on the fill factor as predicted. Moreover the fill factor of a conventional 4 Ω voice coil was measured to be 53 % which leaves plenty of room for future fill factor optimization.

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