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Control of harmonic distortion in a motor driven subsonic acoustic source

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This paper presents a comparison of active control strategies used to reduce the harmonic distortion of a motor driven subsonic source. The source consists of a DC motor that drives a pair of speaker diaphragms through a belt drive system which in turn drives a pair of passive radiators through an acoustic enclosure. The motor drive system is inherently non-linear with significant losses in force at polarity changes. A number of control strategies were tested both theoretically and experimentally in order to determine the best strategy for linearizing the output from the speaker. The methodologies tested were: (i) an FXLMS based adaptive time domain controller using a linear plant model, (ii) an FXLMS based adaptive frequency domain harmonic controller using a linear plant model, (iii) an FXLMS based adaptive frequency domain harmonic controller using a non-linear plant model and (iv) a simplex based adaptive frequency domain harmonic controller. The time domain system is shown to suffer from slow adaption rates for the higher harmonics, the model based FXLMS harmonic controllers were shown to suffer from the non-stationarity of the non-linear plant and the simplex method was shown to provide good results while being robust to slow variations in the plant.