Active Noise Control of Speech in Headphones using Linear Prediction

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Introduction Active Noise Control (ANC) is a widely used technique in consumer headphones for attenuating noise. ANC is useful for attenuation of periodic noise e.g. machinery but has limited ability to attenuate quasiperioc noise e.g. speech (50 Hz – 4000 Hz). This paper therefore focuses on improving attenuation of speech. Feedforward ANC systems are widely used, where an FIR-filter is adapted by a Filtered-x Least Mean Square (FXLMS)-algorithm. The main problem when implementing ANC feedforward systems is delays in converters. A tested $\Sigma\Delta$-converter has a delay of 225 μs – 900 μs. Therefore a Linear Prediction (LP) method combined with multirate processing is proposed to compensate for the introduced conversion delays.

Methods and Proposals The feedforward FXLMS algorithm uses a control filter which coefficients are adapted by a FXLMS optimization algorithm to output a counterphase signal. For LP Wiener filtering is used in cascade to predict 10 samples which is outputted to the ANC system

Simulation Results The combined LP FXLMS system is found by simulation to have a 36 dB larger attenuation at 1600 Hz than the system without LP. The combined system yields a high attenuation for all frequencies in the speech area.

Discussion No real time implementation is attempted because the computation cost of the LP is >50,000 instructions per sample.

References

[1] SpeechCoding Wai C. Chu: *Speech Coding Algorithms*, Wiley 1^{st} Edition 2013

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