

Design of Echo Cancellers and Their System Applications

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This paper describes the design methodology and applications of echo cancellers (EC), which may control echoes occurred due to electrical feedback in a long distance telephone network and due to acoustic feedback in audio teleconference systems (ATSs). The following subjects are investigated:

- (1) Requirements for ECs. In particular, subjective requirements for acoustic echo in ATS are given to ensure wide band high-quality speech. The thresholds of detectable and/or objectionable echoes are determined considering round-trip propagation delay time and room reverberation time.
- (2) EC algorithm and implementation. A new algorithm which offers high speed convergence for speech signals is proposed. The structure and behavior of subband ECs are also shown.
- (3) EC design methodology. Finite word length effects in digital EC are investigated using both floating and fixed point arithmetic. EC tap length is also discussed with the goal of reasonable echo cancellation. The design of subband EC is also addressed.
- (4) The implementation of an EC with noise cancelling is proposed. It is shown that echo cancellation is greatly improved by rejecting the interference noise.
- (5) A prototype EC for high-quality speech ATSs is presented. A subband EC using the decorrelation algorithm shows greatly improved echo cancellation characteristics. Furthermore, it is shown that the harmonic processor (HP) using time scale companding, improves the howling margin of ATSs. In addition, the proposed combination of EC and HP can greatly improve the howling margin.
- (6) The application of EC to telephone networks is presented. The configuration and algorithms of a 2-wire voice-band two-way amplifier applicable to automatic call-transfer repeaters are proposed. It is shown that the amplifier yields higher amplification and better speech quality than conventional amplifiers.