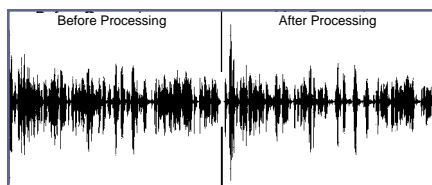


ClearSpeech technologies -
a suite of signal processing
algorithms, hardware and
technical expertise for enhancing
voice communications.



Line echo removed from
a far end signal

Operation

ClearSpeech® Line Echo Cancellation (LEC) is an algorithm designed to continuously and adaptively remove hybrid echo from speech.

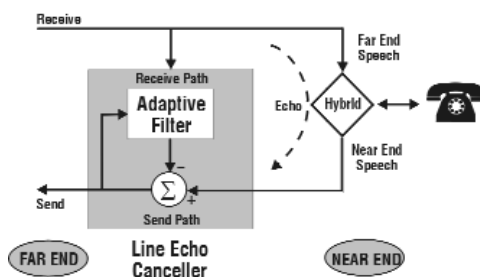
This echo is caused by the impedance mismatch at the hybrid connection between the 2-wire and 4-wire portions of a telephone network.

The impedance mismatch results in part of the voice signal being reflected back to the talker. This reflection, in conjunction with path delays, causes the talkers on either side of the connection to hear an echo of their own voice.

By continuously monitoring the receive signal, LEC removes echo from the send path improving listener comfort.

Block Diagram

As illustrated below, LEC can remove the electrical echo introduced at the 2-to-4 wire hybrid connection in a telephone network.



Performance Characteristics

- Convergence rate < 2 seconds
- ERLE > 20dB
- Processing time < 1ms
- No attenuation

Implementation

LEC is an adaptive, time-domain block-update LMS algorithm designed as a re-entrant module. The algorithm has been developed in Texas Instruments fixed-point assembler for the TMS320C54x DSP and includes documentation and test vectors.

Available version:

- 8ms echo span, 8kHz sampling rate

Software Requirements

DSP	Fixed Point
	TMS320 C54X
MIPS	< 2.5
Program Memory (words)	140 (16 bit words)
Data Memory (words)	175 (16 bit words)
Algorithmic Delay (msec)	< 1

Demonstration Platforms Available

1. For customers wishing to process their own wavefiles a Windows®-based demonstration program is available upon request.
2. An executable for the following Texas Instruments fixed point evaluation platform is available: TMS320C549 (Tiger Board).

Other ClearSpeech Products

LEC is part of the ClearSpeech suite of algorithms for enhancing voice communications by removal of unwanted noise.

Other algorithms in the suite are:

Acoustic Echo Cancellation, which removes unwanted echo from hands-free communications.

Adaptive Speech Filter, which removes unwanted 'stationary' noise from microphone signals.

Referenced Noise Filter, which removes noise where a reference signal from the noise producing source is available.

Intelligent Squelch Filter, which reduces unwanted signals such as pops and pre-speech noise experienced in some radio communications.

Speech in Noise Detector, a noise-robust voice activity detector producing a binary value and an audio output for which non-speech segments have been muted.

For Additional Information

Contact sales@nctclearspeech.com.