

S. Khadar Basha, Enhancement of electrolaryngeal speech, M. Tech. Thesis, Department of Electrical Engineering, Indian Institute of Technology Bombay, June 2011.

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**Abstract:** An electrolarynx, a verbal communication aid used by laryngectomy patients, is a vibrator held against the neck tissue to provide excitation to the vocal tract, as a substitute to that provided by the glottal vibrations. Electrolaryngeal speech suffers from a monotonic nature, low-frequency spectral deficit, and background noise due to leakage from the vibrator. While the first two factors affect the speech quality, the background noise also affects the intelligibility. This project presents the investigations for enhancement of electrolaryngeal speech and real-time implementation of the enhancement techniques. Pitch-synchronous application of generalized spectral subtraction is used for reducing the background noise. Effects of different noise estimation and phase estimation techniques are investigated. Spectral compensation, and introduction of jitter and shimmer in the speech signal, using LPC based analysis-synthesis, is investigated for improving its naturalness. Two real-time implementations of the spectral subtraction for enhancement of electrolaryngeal speech are carried out using 16-bit fixed-point processors: first using dsPIC33FJ128GP804 based single chip circuit with sampling frequency of 10 kHz and subsequently using TMS320C5515 based board with sampling frequency of 12 kHz. In both the implementations, input and output are handled using DMA and memory buffers for block processing using two-pitch period analysis window with 50 % overlap. The noise is estimated using 3-point 4-stage median and speech is resynthesized using noisy phase. In both the implementations, the noise reduction is compatible with that obtained by Matlab based simulations.

