Santosh K. Waddi / Prof. P. C. Pandey (Supervisor): “Real-time enhancement of noisy speech using spectral subtraction”, *M. Tech. dissertation*, Department of Electrical Engineering, Indian Institute of Technology Bombay, June 2013.

ABSTRACT

Persons with sensorineural loss experience great difficulty when the speech is contaminated by noise. This thesis presents investigations for real-time enhancement of noisy speech using spectral subtraction for suppressing the external noise in hearing aids and sensory aids for the hearing impaired. Investigation using offline processing for enhancing the noisy speech with different types of noise and SNR values is carried out to select the optimal set of steps and parameters for real-time processing. Results show that median based noise estimation is effective in estimating noise from noisy speech without a voice activity detector, for different SNRs and types of stationary and non-stationary noises. It is shown that a cascaded-median can be used as an approximation to median for significantly reducing the computation and memory requirement. Speech enhancement using magnitude spectrum subtraction with 3-point 4-stage cascaded median for noise estimation and resynthesis using noisy phase resulted in improvements of 0.11 – 0.43 in PESQ scores for speech material from NOIZEUS database and different types of additive stationary and non-stationary noises at 6 dB SNR. Resynthesis using phase estimated from the enhanced magnitude spectrum did not result in any further improvement in the scores. The technique is implemented and tested for satisfactory operation, with sampling frequency of 10 kHz, 30 ms analysis window with 50% overlap, using a DSP board based on 16-bit fixed-point processor with on-chip FFT hardware. The implementation uses data transfer and buffering operations devised for an efficient realization of analysis-synthesis and codec and DMA for acquisition of the input signal and outputting of the processed output signal. The real-time operation is achieved with signal delay of approximately 48 ms and using about one-seventh of the computing capacity of the processor.