Saketh Sharma / Prof. P. C. Pandey (Supervisor), "Implementation of a Digital Hearing Aid as a Smartphone Application," *M. Tech. dissertation*, Department of Electrical Engineering, Indian Institute of Technology Bombay, June 2017.

ABSTRACT

Persons with sensorineural hearing loss suffer from degraded speech perception caused by frequency-dependent elevation of hearing thresholds, reduced dynamic range, abnormal loudness growth, and increased temporal and spectral masking. Several signal processing techniques are used in hearing aids to alleviate the effects of sensorineural hearing loss and to improve speech perception. As an alternative to existing ASIC-based hearing aids which are expensive to develop, a digital hearing aid is implemented as a smartphone application.

The implementation provides user-configurable processing for (i) background noise suppression and (ii) dynamic range compression and frequency-selective amplification. To reduce the effect of increased masking, signal processing for background noise suppression is incorporated. Noise spectrum estimation using dynamic quantile tracking and speech enhancement using spectral subtraction and geometric approach are implemented to improve speech perception. Enhancement of speech corrupted with different types of additive stationary and non-stationary noise showed improvement in speech quality to be equivalent to an SNR advantage of 3 – 6 dB. To compensate for reduced dynamic range and frequency-dependent elevation of hearing thresholds, a sliding-band dynamic range compression technique is used. It does not introduce perceptible distortions associated with the single-band and multi-band compression techniques. Both processing blocks are implemented for real-time processing using single FFT-based analysis-synthesis.

Implementation as a smartphone application has been carried out using Nexus 5X with Android 7.1 Nougat OS. A touch-controlled graphical user interface enables the user to fine tune the processing parameters in an interactive and real-time mode. The processing delay is approximately 45 ms, making it suitable for face-to-face communication.