P. N. Kulkarni, Speech processing for reducing the effects of spectral masking in sensorineural hearing loss, Ph.D. Thesis, Department of Electrical Engineering, Indian Institute of Technology Bombay, December 2010.

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Abstract - Sensorineural hearing loss is associated with widening of auditory filters leading to increased spectral masking and degraded speech perception. The research objective is to investigate two techniques for improving speech perception by persons with sensorineural loss: (i) spectral splitting scheme for binaural dichotic presentation, and (ii) multi-band frequency compression for monaural presentation.

For binaural dichotic presentation, comb filter based spectral splitting scheme was investigated with respect to magnitude responses for perceptual balance and bandwidth. The listening tests were conducted (i) to assess the effectiveness of the scheme in improving speech perception and (ii) to study the effect of the scheme on sound source localization. The tests for consonant recognition showed that dichotic presentation with comb filters based on auditory critical bandwidth and magnitude response selected for monaural-binaural loudness balance resulted in an SNR advantage of 12 dB for normal-hearing listeners with hearing loss simulated by broad-band masking noise, and an improvement of 14 – 31 % in recognition scores for the hearing-impaired listeners. There was a significant decrease in the response time. The tests for sound source localization showed that identification of the direction of broad-band sound sources was not significantly affected.

For monaural hearing, multi-band frequency compression, applied on complex spectrum using overlap-add method, was implemented and investigated with different frequency mappings, bandwidths, segmentations for analysis-synthesis, and compression factors. Listening tests assessing quality of the processed speech showed best results for critical bandwidth based compression using spectral segment mapping and pitch-synchronous analysis-synthesis. The tests for consonant recognition on normal-hearing listeners with hearing loss simulated by broad-band masking noise and on listeners with moderate-to-severe sensorineural loss showed maximum improvement in speech perception for a compression factor of 0.6: the SNR advantage was 6 dB for the normal-hearing listeners and 9 - 21 % improvement in the recognition scores for the hearing-impaired listeners.