ACOUSTICS2008/2908 Neural coding of envelope and fine structure in noise degraded speech

Jayaganesh Swaminathan and Michael Heinz
Purdue University, 500 Oval Drive, West Lafayette, IN 47907, USA

Numerous perceptual studies have revealed that envelope is sufficient for speech perception in quiet, but that temporal fine structure (TFS) is required for speech perception in noise. However, the neural correlates of these perceptual observations remain unknown. The primary focus of the present work was to develop and evaluate neural cross correlation coefficient (CCC) metrics to quantify envelope and TFS coding in auditory-nerve responses to noise degraded speech. Shuffled auto- and cross-correlogram analyses were used to compute separate CCCs to quantify stimulus-related envelope and fine structure based on neural spike train data from a computational auditory-nerve model. The neural CCCs have a wide dynamic range as revealed by near-zero values for uncorrelated conditions and near-one values for correlated conditions based on broadband noise responses. Spectrally matched noise was systematically added to a speech sentence at different signal-to-noise ratios (SNRs). Initial analyses reveal that $CCC\_ENV > CCC\_TFS$ for positive SNRs, whereas $CCC\_TFS > CCC\_ENV$ for negative SNRs. Predicted effects of hearing loss on envelope and TFS coding will also be discussed. These neural metrics can be used to evaluate temporal coding of speech with implications for cochlear-implant and hearing-aid strategies. Supported by NIH-NIDCD.