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Publication date: 2017

Document Version
Publisher's PDF, also known as Version of record


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Prediction of speech intelligibility based on a correlation metric in the envelope power spectrum domain

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\textbf{Introduction} 

A powerful tool to investigate speech perception is the use of speech intelligibility prediction models. Recently, a model was presented, termed correlation-based speech-envelope power spectrum model (sEPSM)\textsuperscript{[1]}, based on the auditory processing of the multi-resolution speech-based Envelope Power Spectrum Model (mr-sEPSM)\textsuperscript{[2]}, combined with the correlation back-end of the Short-Time Objective Intelligibility measure (STOI)\textsuperscript{[3]}. The sEPSM\textsuperscript{[4]} can accurately predict HI data for a broad range of listening conditions, e.g., additive noise, phase jitter and ideal/ideal binary mask processing.

The sEPSM\textsuperscript{[5]} model includes audibility thresholds, such that sensitivity loss can be combined with the correlation back-end of the Short-Time Objective Intelligibility measure among listeners even when hearing sensitivity is similar. Therefore, the predictive power of the sEPSM\textsuperscript{[6]} back-end was further investigated in combination with a more realistic auditory pre-processing front-end adopted from the computational auditory signal processing and perception model (CASP)\textsuperscript{[6]}. Here, the speech-based CASP (sCASP) was evaluated in HI conditions and compared to the sEPSM\textsuperscript{[7]}.

\textbf{The sEPSM\textsuperscript{[8]} model} 

The CASP model offers more flexibility to model hearing impairments, beyond the audiogram, due to the Dual Resonance Non-Linear filterbank (DRNL),\textsuperscript{[5]} The model has been shown to account for psychoacoustic data from individual HI subjects.

\textbf{sCASP model} 

\textbf{Test conditions} 

The models were evaluated in conditions: 

- Speech mixed with stationary or non-stationary interferers: Speech shaped noise (SSN), which was also used to fit the model; Amplitude modulated SSN ($\Delta$SSN) with $\Delta = \pm 0.8$ Hz and modulation depth of 1. and the speech like, but non-semantic international speech test signal (ISTS).
- Noisy speech in the presence of reverberation: $T_{60} = 0, 0.4, 0.7, 1.3$ and 2.3 s
- Noisy speech subjected to different types of non-linear processing - Ideal Binary Mask processing (IBM) with four interferers.

\textbf{Fitting of the models} 

The models are fitted per speech material to the condition of clean speech with SSN by fitting a sigmoid function between the model outputs and the human scores.

\textbf{Results} 

The overall performance of the sEPSM\textsuperscript{[9]} and sCASP model is depicted in a scatter plot of the correlation coefficients ($\rho$) between the model outputs and the human scores. The sEPSM\textsuperscript{[10]} model shows better results than the sCASP model.

\textbf{Conclusion} 

The model can now serve as foundation for the development of a HI model, since the DRNL-based framework allows for fitting to individual impairments.