
Speech intelligibility in natural background noise with or without animal foreground in a open field and a tropical forest

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Abstract

Listening abilities in humans have developed in rural environments which are the dominant setting for the vast majority of human evolution. Hence, the natural acoustic constraints present in such ecological soundscapes are important to take into account in order to study human speech recognition. So far, there are very few systematic studies dealing with the impact of outdoor natural acoustic environments on speech. One difficulty explaining this situation is that natural rural sound environments are known to be rather variable. They depend on the geographical situation, the terrain, the vegetation, meteorological circumstances, but also biophony and geophony. However, the rather quiet natural soundscapes have common underlying basic properties characterized by a non uniform distribution of frequencies emphasizing low frequency content. In the present paper we measured the impact of such basic properties on speech, as well as the impact of acoustic propagation and some insect stridulations on speech. A behavioral experiment was implemented to analyze the intelligibility loss in spoken word lists with increasing listener-to-speaker distance in a typical low-level natural background noise recorded in a plain dirt field. Next, we measured until which distance (and Signal-to-Noise Ratios) the automatic method Speech Intelligibility Index (SII) was still relevant to measure speech recognition in such typical natural conditions. We showed that at low SNR values the SII missed significant low-frequency masking sources but was accurate at high SNRs and high frequencies. These data validated the fact that we could apply SII measures to similar low level background noise recorded in a tropical forest in Brazil, with or without stridulating insects. We found that SII decreased of about 15% with such rather stationary biophony because it impacted mostly bursts of plosive consonants, fricatives and upper formants of vowels.

Keywords: speech recognition, Speech Intelligibility Index (SII), natural background noise, insect stridulation, tropical forest

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