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# Evaluation of Lombard Speech Models in the Context of Speech Enhancement

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The environment noise changes the manner of expression. The Lombard effect is one of the most known effects of noise on speech production. The results obtained in our previous study lead us to conclude that speech with the Lombard effect is more recognizable in noisy environments than normal speech. Our investigations have also shown that that speech synthesis model may retain Lombard effect characteristics. In this study, we investigate several models of Lombard speech in the context of speech enhancement. For this purpose, 25 statements (15 sentences and 10 words) uttered by four speakers were used. These statements were recorded in two conditions: without additional noise as well as with interference. These conditions resulted in two types of recordings: 100 statements of normal speech and 100 with the Lombard effect, i.e., non-Lombard speech. In the experimental part of the research, the Lombard speech models such as harmonic, source-filter, and these based on sinewave oscillator bank were investigated. The main goal was to check how these models are recognizable when the signal is reverberant and at what the noise threshold the model stops working. For this purpose, the models and Lombard speech were mixed with babble speech and street noise recordings with a different signal to noise ratio (SNR). The quality of these models was measured employing objective indicators. The experimental investigations show the superiority of source-filter models over other models utilized.