Estimation of Efficiency of Protection Construction by Speech Intelligibility Criterion

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Abstract—Efficiency of protection constructions is usually estimated by criterion of “signal-to-noise ratio” at the reception point. In this paper it is proposed to use criterion of speech intelligibility, which is more suitable from viewpoint of finite user. Represented results of computer simulation show constructiveness of proposed approach.

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INTRODUCTION

Speech information is one of main source of illegal information receive, which influences directly on economic security [1–3].

Efficiency of constructions, protecting rooms 2 (Fig. 1) from speech information leakage, which is usually estimated by using criterion of “signal-to-noise ratio” at the reception point [4, 5]. But from viewpoint of finite user the estimation of such efficiency using “speech intelligibility” criterion is considered as more reasonable.

In this paper it is proposed to use formant-modulation method for calculation of intelligibility of speech, attenuated by walling and masked by noise and reverberation.

PROBLEM STATEMENT

When acoustic signal passes through protection construction 1 (Fig. 1) it is attenuated by this construction (in different frequency bands differently), and also it is under the influence of distortion due to reverberation and noise of the environment.

As a model of acoustic signal pass the authors propose to use following equivalent electric circuit of the speech signal pass, where protection construction 1 (Fig. 1) is substituted by band pass filter (Fig. 2). In this case analysis of protection construction efficiency by speech intelligibility of the signal can be reduced to analysis of mutual influence of transfer factor \( k_i \) of filters, environment noise and reverberation on speech signal intelligibility in adjoining room 3 (Fig. 1).

Further there are considered two types of protection constructions: monolithic and framehouse. Transfer factors \( k_i \) of the first ones are slowly modified with frequency growths, so we call them slowly attenuating, the second ones are called fast-attenuating with frequency growths.

Since influence of masking noise and reverberation is mutual, estimation of speech intelligibility in the room 3 it is advisable to be carried out with formant-modulation method [6].

METHODOLOGY OF SPEECH INTELLIGIBILITY CALCULATION

Detailed description of formant-modulation method is represented in [6, 7]. Analogous to formant method words intelligibility is calculated by intelligibility of formants \( A \), which is characterized by additive

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