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A Technique for Enhancing the Noise Immunity of Multichannel Communications Systems with Repetition

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Abstract—This study presents the estimation of the noise immunity of multichannel communications systems with repetition of messages transmitted, where each of channels employs the nonlinear predistortion and correction of signals and also the channel having the highest noise immunity employs adaptive linear filtration.

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The multichannel data transmission system with repetition (MDTSR) is well-known. This system employs adaptive control of the time delay of signal in each channel during transmission and reception, as well as adaptive selection during reception based on the threshold choice of the channel with the highest noise immunity. Such system makes use of the adaptation to the interference environment by the software variation of carrier frequencies in each of the channels [1, 2]. Disadvantages of such MDTSR include the following: the implementation of such system involves the need of a sufficiently complex unit of program control for changing the carrier frequencies of transmitters; a private control line is needed for tuning the data receivers while changing the carrier frequencies of appropriate transmitters in each of the channels; the first decision circuit for determining the largest value of the signal-to-interference ratio at the output of communications channels is very complex due to its implementation on the basis of automatic optimizer; exact determination of the threshold value of the signal-to-interference ratio is required; functioning of the second decision circuit involves the need of analog-to-digital converters at its inputs; the effective methods of optimal predistortion of signals and optimal linear filtration are not applied for enhancing the noise immunity in MDTSR [1].

The purpose of this study is the investigation of opportunities for further improvement of the noise immunity and efficiency of MDTSR by way of introducing additional signal processing means into transmitting and receiving paths.

For enhancing the noise immunity of the system [1, 2] it is expedient to introduce into each communication channel the nonlinear predistortion and nonlinear correction of signal that are implemented by tandem connection in the transmitting path of the optimal linear predistortion filter and compressor. In this case the expander and the linear optimal correction filter are connected in tandem in the receiving path. The compressor is used for compressing the dynamic range of signal owing to optimal predistortion, while the expander and correction filter are used for an appropriate expansion of the dynamic range of signal and the restoration of signal waveform. In addition, adaptive optimal linear filter is introduced into the communications system at the receiving end for the final processing of signals. This filter ensures an additional enhancement of the noise immunity of MDTSR [3].

The functional block diagram of the multichannel system of radio reception is displayed in Fig. 1 [3]. Its operation can be described as follows. The signal from the output of signal source *1* is concurrently applied to the inputs of optimal linear predistortion filters *2*, *2–1*, …, *2–n*, while from the outputs of the latter the signals are applied to the inputs of compressors *3*, *3–1*, …, *3–n*. In each of communication channels of MDTSR the law of amplitude predistortion is selected in advance in such way that it will be different for all channels. The dynamic range compression of the preemphasis signal in appropriate compressors is selected from the condition of compensating the dynamic range increase of preemphasis signals in each of communication channels.

The signals of each channel from the outputs of compressors are supplied to the appropriate inputs of communication channels *4*, *4–1*, …, *4–n*. Each channel consists of the data transmitter, radio wave propagation medium, and the data receiver. Expanders *5*, *5–1*, …, *5–n* are connected at the outputs of each radio receiver (line links); these expanders are designed for restoring the initial dynamic range of signal that