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A METHOD FOR MULTI-PULSE TRANSMISSION OF SIGNALS IN MIMO-SYSTEM

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A new principle is suggested for shaping pulse signals in the transmitting antenna of the MIMO-system. The new method differs from the known ones in introducing, in every channel, a certain time shift of signals. As a result, in space there occurs superposition of pulses overlapping in time. At the reception side, after analog-digital conversion of the signal mixture, by known times of signal arrival we can estimate their amplitude components, and perform demodulation of the transmitted messages.

In the last few years, much attention has been paid to investigations related to application for wireless access of so-called MIMO-systems (Multiple Input — Multiple Output) based on usage of digital antenna arrays (DAA) with a small number of channels. These systems permit to realize different variants of orthogonal frequency discrete modulation (OFDM) of signals in the form of bursts of oscillations, which are extended in time and orthogonal in frequency. At the same time, little attention was paid to the use of pulse signals in communication systems based on MIMO-principle.

The purpose of this paper is description of a new approach to implementation of MIMO-systems, which differs from known ones in that we use pulse signals radiated by M partial antenna elements of DAA with a determinate relative inter-channel shift of signals in time.

This paper is an extension of the methods described in [1] and is devoted to synthesis of procedures of demodulation of the multi-signal mixture at the reception DAA output in the case of pulsed mode of operation of a MIMO-system.

All subsequent derivations will be performed as applied to the uniform or non-equidistant interchannel time shift of pulse signals. Figure 1*a* illustrates the suggested principle of radiation of pulse signals by the antenna array (the signals in r transmitting channels are generated at different time instants, but their mutual shift never exceeds the duration of a single pulse). Figure 1*b* represents a traditionally used scheme of pulse radiation by the transmitting antenna array (the signals in all r channels are radiated at the same time instant).

The rules of variation of envelopes of the pulses shaped in different channels may be identical to each other, or different, but in any case they are assumed exactly known. Prior to radiation, the amplitudes of the partial pulses undergo multilevel amplitude or quadrature amplitude modulation (M-QAM). Here, as distinct from OFDM, there is no need in orthogonality of signal carrier frequencies, which makes it possible to narrow the spectral band of the radio communication line. In addition, we may relieve requirements to the instantaneous dynamic range of DAA transmitting channels, since the radiated pulses are overlapping in time not in the analog-type transmitting channel (as in [1]), but in space.

In the case of such operation of the transmitter, the receiving DAA will contain a mixture of M signals overlapping in time (Figure 2 shows schematically an M-pulse signal mixture at the output of the partial reception channel). In order to demodulate the received messages, this mixture must be processed simultaneously over all the antenna channels. Particularly, based on signal mixture samples, picked out from the outputs of analog-to-digital converters (ADC),

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