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TRANSIENTS IN A COMMUNICATION CHANNEL WITH AMPLITUDE PREDISTORTION OF SIGNAL

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The paper considers the possibility for idealization of a communication channel, possessing the amplitude-frequency response (AFR) of the aperture-type filter, by connecting a linear predistortion filter with the inverse AFR. Comparative analysis of the transient processes is performed for the channel with and without optimal amplitude predistortion.

The AFR of a communication channel, corresponding to the so-called aperture filter response (Fig. 1), can be approximated by the following expression

$$|K(j\omega)| = \cos\left(\frac{\omega}{\omega_{up}}\frac{\pi}{2}\right) \quad \text{at} \quad 0 \le \omega \le \omega_{up},$$
$$|K(j\omega)| = 0 \quad \text{at} \quad \omega \ge \omega_{up}, \tag{1}$$

where ω_{up} is the highest angular frequency in the pass-band of the channel.

Channels with AFR of the form (1) are commonly used in communication systems, for example, in television, facsimile and, with certain approximations, in telephony (channels of voice frequency). Transients in channels with other AFR, in the presence and absence of predistortion, were investigated in [1–4].

Let a sine voltage jump be applied to the channel input:

$$U(t) = \left(\frac{1}{2} + \frac{1}{\pi}\int_0^\infty \frac{\sin \omega t}{\omega} d\omega\right) \sin \omega_0 t \tag{2}$$

where ω_0 is the carrier frequency (high-frequency filling), while the phase-frequency response (PFR) of the channel is linear, i.e., $\varphi(\omega) = k\omega$. If the latter condition is not met, linearity of PFR can be attained by an additional phase corrector [3].

The step response of the channel, with regard for expression (2), can be represented in the form [1]

$$F(t) = B(\omega_0)\cos \omega_0 t + \frac{2}{\pi}\int_0^\infty \frac{\omega_0}{\omega_0^2 - \omega^2} A(\omega) \cos \omega t d\omega \tag{3}$$

where $A(\omega) = |K(j\omega)| \cos \varphi(\omega)$ is the real component of the channel transfer function while $B(\omega_0) = |K(j\omega_0)| \sin \varphi(\omega_0)$ is the imaginary component at the carrier frequency of the input signal.

With (1) and (3) taken into account, we may write

$$F(t) = |K(j\omega_0)| \sin \omega k \cos \omega_0 t + \frac{2}{\pi}\int_0^\infty \frac{\omega_0}{\omega_0^2 - \omega^2} |K(j\omega)| \cos \omega k \cos \omega t d\omega.$$

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