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# ESTIMATION OF SMOOTH APPROXIMATION ACCURACY OF AMPLITUDE-FREQUENCY RESPONSE OF A RAYLEIGH RADIO CHANNEL UNDER SELECTIVE FADING CONDITIONS

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**The upper estimate of the error of smooth approximation of amplitude-frequency response of a fading Rayleigh-type signal is obtained.**

The signals of cellular networks of mobile communication undergo considerable distortion because of selective fading caused by multibeamness of radio wave propagation. The time scattering may be regarded as the result of signal filtering in the radio channel, which distorts the signal if the duration of the latter exceeds the coherence time $T_C$ (i.e., the interval in which the fading in the channel retain correlation no lower than some threshold level $\rho$). Particularly, at $\rho \geq 0.5$ the duration $T_C \approx 9/(16\pi f_D)$, where $f_D$ is the maximum Doppler shift of frequency [1]. In the range of 900 MHz, when the motion speed of a subscriber is 90 km/hr, the correlation time is below 2.4 μs. Because of this, in the present-day cellular communication systems this effect is hardly noticeable (the duration of GMSK-signal in the GSM standard equals 3.693 μs).

Of more importance is the reverse effect consisting in scattering of signal energy in the time domain because of its selective fading in frequency. The fading occurs when the bandwidth of the system is large compared with the bandwidth of channel coherency (the frequency domain in which the channel passes all the components of the signal spectrum with roughly the same attenuation and linear variation of phases). The frequency-selective fading of a signal is physically equivalent to its filtering with a nonuniform amplitude-frequency response of the channel filter (Fig. 1).

While distorting the spectrum of signals, the fading changes their shape (the time dilatation of the latter leads to intersymbol interference between the transmitted symbols). In addition, the difference between frequencies of the forward and backward channel in modern cellular communication systems exceeds their coherency band considerably, which in turn results in the channels' asymmetry complicating the procedure of transmission power control in the communication system.

One of the prerequisites of successful design and technical implementation of countermeasures [1] to such distortion is the precise mathematical description of the communication channel. In theoretical inquiries we usually resort to the so-called "smooth" approximation of amplitude-frequency response of the channel [2, 3] (under the assumption that the system bandwidth does not exceed the coherency band of the channel). Then there arises a question of the error of such approximation and of the domain of its applicability.

Let the mathematical representation of the received signal in the main band of system's frequencies, having the width $W$, for a channel with fading have the form [4]

$$r(t) = \sum_{l=1}^{L} \alpha_l e^{-j\varphi_l} s(t - \tau_l) \quad (1)$$

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