A method of deriving calculation formulas and analytical estimates of the errors for them in the digital modeling of linear dynamic sections using a piecewise-polynomial approximation of the input signal is described. Using this method, transfer functions are obtained for several methods of approximation, and they are compared using the example of the modeling of an aperiodic section. The results obtained are presented in a table.

In the digital modeling of linear dynamic sections, methods based on the piecewise approximation of the input signal by polynomials are extremely effective. A number of such methods are described in the literature [1-3]. These methods differ in the techniques used for the approximation, as a rule, the interpolation and extrapolation of different series. When choosing a method when solving a specific problem it is necessary to have estimates of the errors of the digital model, which depends both on the approximation procedure employed and the sampling interval, as well as on the parameters of the dynamic section. In this paper we describe a method of deriving computing formulas and analytical estimates of the errors for them for a piecewise-polynomial approximation of the input signal.

Digital modeling implies that, instead of the input signal $x(t)$, only its readouts $x[n]=x(t)|_{t=nh}$ are known, where $h$ is the sampling interval. The approximation of the input signal consists in transferring from the lattice function $x[n]$ to the function of time $\tilde{x}(t)$. The method of approximation is given by the function

$$u(\tau, n) = \tilde{x}(nh + \tau), \quad n = 0, 1, \ldots, \tau \in [0, h[,$$

(1)

since

$$\tilde{x}(t) = \sum_{n=0}^{m} u(t-nh, n) \delta_{h}(t-nh),$$

(2)

where $\delta_{h}(\tau) = 1$ for $\tau \in [0, h[, \delta_{h}(\tau) = 0$ for $\tau \notin [0, h[.$

The approximation error

$$e(t) = x(t) - \tilde{x}(t)$$

(3)

is also given by a function specified in the $n$-th interval

$$\eta(\tau, n) = e(nh + \tau), \quad n = 0, 1, \ldots, \tau \in [0, h[$$

(4)

and

$$e(t) = \sum_{n=0}^{m} \eta(t-nh, n) \delta_{h}(t-nh).$$

(5)

The piecewise-polynomial approximation of degree $k$ in the $n$-th interval is determined by a polynomial of degree $k$, whose coefficients contain the sequential readouts $x[n+i], i \in \{-k_1, \ldots, k_2\}, k_1, k_2 \geq 0$, where $k_1 + k_2 = k$ [4]. If $k_2 = 0$, this is extrapolation, and if $k_2 > 0$ it is
REFERENCES

2. J. M. Smith, Mathematical and Digital Modeling for Engineers and Scientists [Russian translation], Mashinostroenie, Moscow, 1980.

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