A MICROPROCESSOR TRACKING PHASEMETER

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The work has proposed a method for constructing a microprocessor tracking phasemeter (demodulator) which implements algorithms for optimal nonlinear filtering. The utilization of microprocessors (MP) in such devices, as is well known, allows significant expansion of the functional capabilities of the latter, but in a number of cases it requires the search for nonstandard solutions in constructing the hardware section and in creating the software. Below we describe one of the possible solutions of the problem of implementing a tracking phasemeter based on an MP.

Let us state the problem in terms of optimal-filtering theory. Assume that a certain dynamic system c an be described by a system of linear stochastic differential equations

$$dX/dt = AX + N_0(t). \tag{1}$$

In order to be specific, we shall henceforth consider the case of a third-order system for which

$$A = \begin{Vmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & -\alpha \end{Vmatrix}; \qquad N_0(t) = (0, 0, n_0(t))^T.$$

$n_0(t)$ is white Gaussian noise having the known statistical characteristics: $M[n_0(t)]=0$; $M[n_0(t)n_0(t+\tau)]=q\delta(\tau)$

The signal

$$\xi(t) = a_0 \sin(\omega t + x_1(t)) + n(t), \tag{2}$$

where n(t) is white Gaussian noise having the characteristics $M[n(t)]=0$; $M[n(t)n(t+\tau)] = R\delta(\tau)$, is accessible to sampling.

In accordance with the theory of optimal filtering (see [1]), the equation for the optimal filter has the form

$$dX\hat{}/dt = AX\hat{} + P(t)\, C^T a_0 \cos(\omega t + \hat{x}_1)\, \xi(t), \tag{3}$$

where P(t) is the covariational matrix of the filtering errors and is determined from the Riccati equation

$$dP/dt = AP + PA^T + Q + PC^T R^{-1} CP. \tag{4}$$

In these equations,

$$Q = \begin{Vmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & q \end{Vmatrix}; \qquad C = (1, 0, 0).$$

Of course, the filter cannot be implemented directly on the MP in accordance with Eq. (3), since the microprocessor operates with discrete quantities. Taking this into account, one can attempt to use a discrete-filtering algorithm operating as follows for the microprocessor meter. In the time interval between measurements, the following prediction is constructed:

REFERENCES

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2. V. N. Kharisov, Yu. N. Kirilenko, M. I. Masliukov, et al., "Microprocessor implementation of nonlinear-filtering algorithms," Radiotekhnika, no. 3, pp. 20-24, 1984.

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