AN ACOUSTOOPTICAL CORRECTOR OF TIME DISTORTION OF ANALOG SIGNALS

A. R. Gasanov and Kh. I. Abdullayev

Institute of Physics of NAS of Azerbaijan, Baku, Azerbaijan

The paper considers the possibility of using the photoelastic effect for correction of time distortion of analog signals in a wide range. The correction is performed by variation of the controlled generator frequency.

The reasons for time distortion (time scale distortion) of signals, as well as the methods and tools for correcting such distortion have received much attention [1, 2]. Comparative analysis of different systems of time distortion correction (TDC) of signals [3] points to the advantages of the acoustooptical TDC method in respect to such parameters as the width of the range of correction, the level of distortion introduced into the signal under processing, accuracy of the time distortion correction, etc. A disadvantage of the acoustooptical device for TDC of signals considered in [3] is its narrow range of correction — corresponding to marginal angles of scanning of the optical beam in the aperture of the main acoustooptical modulator. Thus, of importance is the synthesis of the signal TDC systems with a wide range of correction, which is the purpose of the present work.

This problem can be solved in two stages (Fig. 1): large distortions are corrected by a discrete system of TDC of signals, while the rest — by a TDC system of continuous action, for instance, such as that described in [3].

A discrete system of TDC can be realized based on the acoustooptical delay line of discrete action with electronic control [4]. The time distortion present in the input signal \( u(t) \) is isolated and shaped by the unit responsible for isolation and generation of error signal (UIGES) 2 — by comparison of phases of signals from reference (controlled) generator 1 and that of \( u(t) \). The required time delay \( \tau \) of the input signal, corresponding to the relevant time error, is established in accordance with the output voltage of UIGES 2 in the acoustooptical time modulators of discrete and continuous action (3 and 4).

The structure and operation of the acoustooptical time modulator of continuous type has been described in detail in [3]. Therefore we limit ourselves to synthesis of the acoustooptical system of discrete TDC of signals. The controlled delay of signals is obtained by interaction of elastic waves (EW) with radiation of laser 10 (Fig. 2). The radio-frequency signal is converted into an acoustic wave at one end of photoelastic medium (PEM) 5 and then extracted, due to elastic-optical coupling, at some variable distance from the input electroacoustical converter (EAC) 12. The cell consisting of EAC 12, PEM 5, and acoustic absorber 13 is called acoustooptical modulator (AOM). A considerable delay of signal (dictated by the time of propagation of the acoustic wave from EAC to the acoustic interaction point) is explained by a relatively low propagation speed of EW in PEM 5.

Assume that the second input of UIGES 2 is driven by the signal \( u(t) \) with the instantaneous value of its time error equal to \( \delta t_0 \). By the moment of comparison of the signal to be processed with the signal of reference (controlled) generator 1 having a period \( T \), the time error \( t_0 \) can be defined as

\[
  t_0 \bigg|_{\tau=T} = \frac{1}{T} \int_0^T \delta t_0 \, dt.
\]

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