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An Acousto-Optical Converter of Videosignal Temporal Scale

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Abstract—In this paper we discuss an operation of the acousto-optic videosignal temporal scale converter, which can operate in temporal compression mode and also in temporal expansion.

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GENERAL INFORMATION

Changing duration of signal realization devices, conseving signal shape are widely used in technical systems of signal processing. In some cases the devices are used for time expansion and at the same time bandwidth reduction (temporal scale expansion). It is necessary for obsevation and analysis of ultrahigh frequency signals using common resources, in some cases it allows to increase an information rate and information content, which is essential for infralow frequency processes study [1].

These devices in technical literature are called temporal scale converters (TSC) or spectrum transformers.

Temporal scale transformation provides for information accumulation of researched realization and it does not cause loss of information, included in selected initial signal realization. In case of fast writing and slow reading, it is occurred temporal scale expansion, in case of slow writing and fast reading it is occurred temporal scale compression. The first case corresponds to transformation rate of TSC $k < 1$, the second case—to $k > 1$.

A generalized structure of TSC of signal is shown in Fig 1. It consists of information recording device (IRecD), memory device (MD) and information reading device (IRD).

Depending on record and reading mode, and on MD type existing TSC are divided on electromechanical, electronic, and digital.

Electromechanic TSCs use magnetic tape, magnetic drum, magnetic disc or ultrasonic delay line (UDL).

General drawbacks of electromechanic TSCs are:

1. During record and reading distortion in temporal scale occurs
2. It is difficult to obtain a big writing and reading rate that leads to transformation rate limit.
3. Ultrahighfrequency signals are impossible to process.

Electronic TSC are based on ultrasonic dispersive delay line (DUDL). Physical basis of DUDL is effect of dispersion of elastic waves (EW) into solid bodies. Dispersion into solids is frequency relation of a wave propagation speed. Fitting the corresponding relation of wave dispersion in DUDL, we can obtain a required phase performance.

But the requirements to DUDL restrict field of application of TSC based on DUDL. In particular, a product of bandwidth and jump of delays, corresponding to linear range of dispersion performance (in best UDLs this value achieves a few hundreds) must be much greater than base of input signal of TSC (i.e much greater than product of spectrum width and signal duration). Therefore, TSCs based on DUDL can process signals with base not greater than 100. Another important drawback of mentioned above devices is impossibility to obtain a great transformation rate.

Digital TSCs digitize, quantize and encode an analog signal, then convert it into digital signal. This signal is stored in MD and then it is read with required rate (reading rate is defined by value of temporal-scale transformation rate) and converted into analog signal. This method is used in television, and also for repeated display. In this case, obviously, $k = 1$.