Laboratory work on identification of linear dynamic systems using a digital oscilloscope PV6503

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***Abstract* – One of the first implemented in the control systems has been the method of identification methods based on the use of pulse influences. The aim of this work is a graphical identification of linear dynamic systems with a digital oscilloscope.**

Let have some device one-port and by one output which is described unknown dependence. At the input of a pulse, the output is a graphic signal. According to this signal is identified which of these devices is considered.

Key words – identification, oscilloscope, linear dynamic system, impulse.

I. Introduction

One of the first implemented in control systems methods of identification was the method based on the use of pulsed impacts. This method requires special input signals, namely pulse input for the identification of the impulse transition function. When identifying pulse effects often there are technical difficulties, associated with the formation and use of pulsed input signals. Since the amplitude of the pulse can not be small, this method cannot be applied to nonlinear systems

For identification of linear systems with their use of the pulse transition functions necessary to attach a pulse signal (Delta-function) to the input of the system is identified. Delta-function is a pulse-width with an area equal to 1. It is obvious that the Delta-function cannot be practically implemented. [1] However, it can generate a pulse generator set duration.

In many cases, to determine the transfer function of the system you can use a recording of her pulse transition function. This method can be applied to most types of linear systems, namely to the systems of first and second orders and aperiodic systems of higher order.

The most correct graphical identification method with the use of the pulse transition functions apply to proceedings of the first order.

The purpose of this work is the graphical identification of linear dynamic systems using a digital oscilloscope.

To retrieve a record of the time series of the impulse transition function in our work we use digital oscilloscope PV6503 (4 channel mixed signal oscilloscope. Two analog channels, two digital channels, generator) (Fig. 1). Advantages of this model are:

- work with personal computer;
- management and power supply of the device from a PC via USB;
- works in a mode of the oscilloscope, the generator and frequency meter.

Fig. 6 PV6503 - 4-channel mixed signal oscilloscope. Two analog channels and two digital channels Generator

II. Problem

Let have some device one-port and by one output which is described unknown dependence of F (Fig. 2). It is necessary to give an impulse on the entrance of device, on an output to get a graphic signal and on this signal to identify, which one device is identified.

Fig. 7. Generalized block diagram of a linear dynamic system

III. Process image results

For the leadthrough of research will collect on a pay the link of the first order, presented on a chart (Fig. 3).

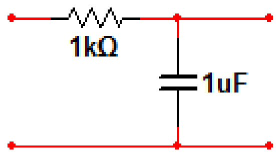

Fig. 8. Integrator of the 1st order

Since the voltage measured between two points , the input of the oscilloscope has dual terminals. And they are not equivalent . Internal terminal , called the "phase " is connected to the input amplifier vertical deflection. External terminal – "land" or " body". It is called so because it is electrically connected to the housing unit (a common point of all its electronic circuits). Oscilloscope shows the phase voltage with respect to ground. To do this, enter the device must be connected from the generator oscilloscope probe. Probe "land" is connected to the corresponding output circuit. The tested signal is fed to the left of the slot on the front of the oscilloscope. This oscilloscope can be used as a pulse generator. Therefore, we will use it as a power source. This second probe is connected to the generator and the oscilloscope input circuit. Now you can see on the oscilloscope GUI (Fig. 4) graphic signal.

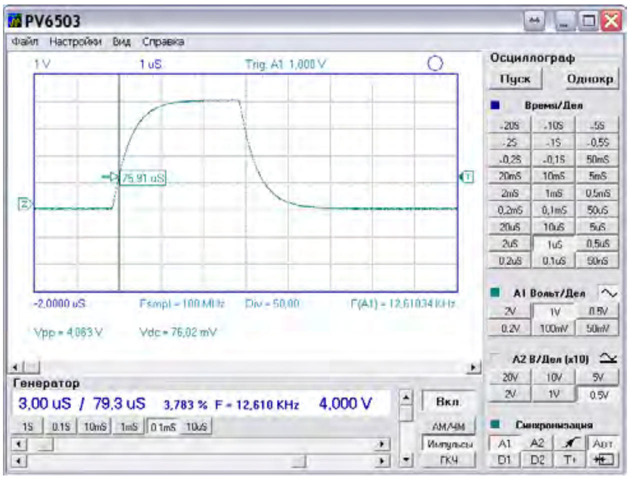

Fig. 4. Oscilloscope GUI PV6503

For this purpose the program oscilloscope press the button «start». Choose the height of the oscilloscope sweep 1 V/div and width of the horizontal scan 1 uS. Next, switch the generator on the bottom of the GUI. Will file the input of the circuit pulse 4 V length 3 uS and period 80uS. We obtain output signal, shown in Fig. 5.

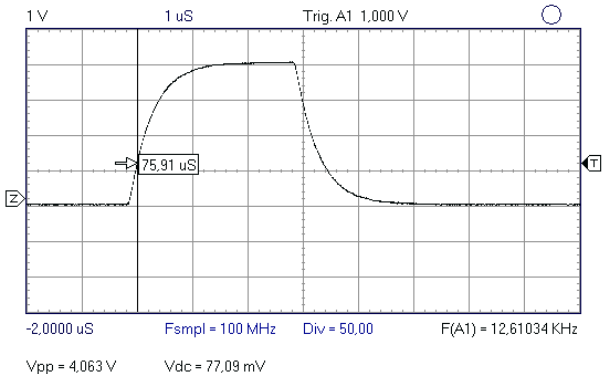

Fig. 5. The reaction of an integrator of the 1st order on impulse

Knowing the nature of the transition process, you can evaluate the system. Under the transitional (dynamic, nonstationary) process mode or in electrical circuits refers to the transition process chain from one steady state (mode) to another. The graph clearly shows the character of transient processes. On the basis of the obtained data can be assessed that the considered system is an integrating link of the first order.

Connect the oscilloscope to link the second order (Fig. 6).

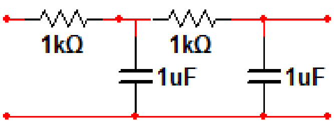

Fig. 6. Integrator of the 2nd order.

Obtain graphical representation (Fig. 7), which is different from shown in Fig. 5 only the nature of the transition process that occurs in this system more smoothly.

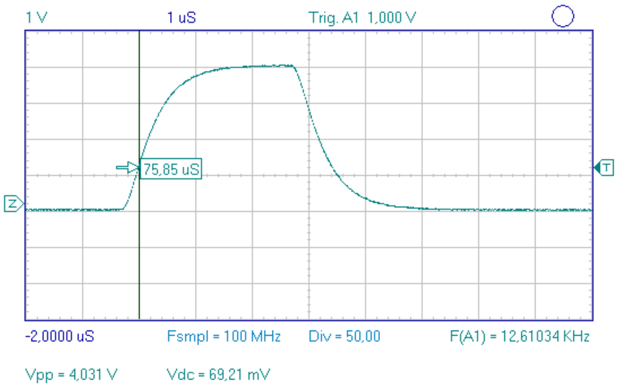

Fig. 7. The reaction of an integrator of the 2nd order on impulse

Similar calculations can be obtained for other linear systems of low orders of magnitude. The process of graphic interpretation of the linear dynamic systems is described in detail in [1].

Very important is the fact that the signal x(t) , which operates at the entrance of a linear dynamic system with pulse transients, g(t) and response of the system y(t) at the signal linked integral convolution (1),

$$y(t) = \int_0^{\infty} u(\tau)h(t-\tau)d\tau \qquad (1)$$

which has extremely transparent meaning - output signal dynamic system is formed by the sum of reactions to every impulse of the input signal at the time of submission of this input as a sequence of pulses with a height equal to the value of the input signal at the appropriate time.[2]

Conclusion

Data obtained at the output of the oscilloscope can be obtained in the form of time series, enabling them to continue working with them. The next stage of work can be parametric identification of dynamical systems using splines. Then reportedly about changing the input and output signals will need to obtain the impulse response of the system, finding a solution of the integral equations of convolution.

References

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