The algorithms of spectral transformations can be realized on the basis of digital processor NM6403. The choice of required basis of functions can be carried out by replacement of weight factors, which can be written down in cells of the vector processor NM6403.

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STRUCTURE METHODS OF COMPENSATION OF COMMUNICATION LINES INFLUENCE BY CURRENT IN ACTIVE RESISTANCE SIMULATORS

Key words: four-wire active resistance simulator, compensation of communication lines influence

The structure methods of compensation of communication lines influence by current in four-wire active resistance simulators with transmission functions $R_{sim}=R_0\mu$, $R_{sim}=R_0(1-\mu)$ are considered.

Active simulators are widely used because of their advantages over classic resistance boxes [1-3]. The main advantage of active resistance simulators is the possibility of resistance reproduction with necessary accuracy in the points, which are placed on big distances from device.

Different transmission functions are used at designing of active simulators [4,5]. But the most spread functions are the following [6,7]

$$R_{sim}=R_0\mu, \quad R_{sim}=R_0(1-\mu),$$

where R_{sim} is the value of simulated resistance, R_0 is the standard resistor resistance, μ is the gain of code-controlled voltage divider (CVD).

To provide necessary accuracy at resistance simulation on big distances it is necessary to decrease the influence of communication lines resistance. There are two types of compensation circuits of communication lines influence: compensation circuits by voltage and compensation circuits by current. The compensation by voltage consists in separation of voltage drop on communication line and in subtracting of it from output voltage of input amplifier. Compensation by current consists in formation of compensating current I_c which is proportional to voltage drop on the communication line resistance, i.e. $I_c=f(I_{in},R_L)$, where I_{in} is input current, R_L is the resistance of communication line.

Generalized structural diagrams of active simulators of resistance with compensation of communication lines influence by current are given in Fig.1.

Four-wire connection circuit compensates the communication lines influence of output operational amplifier and the influence of the line connected with the input of the first amplifier.

The compensating current driver (CCD) is used for compensation of line connected consecutively with standard resistor.

The output voltage of input operational amplifiers for given structures is defined from expression

$$U = I_{in}R_L + (I_{in} - I_c)R_0 = I_{in}R_0 + I_{in}R_L - I_cR_0 . \qquad (1)$$

where $R_L=R_{L1}$ for the scheme given in Fig.1.a, $R_L=R_{L2}$ for the scheme given in Fig.1.b.

As can be seen from expression (1), for full compensation of influence of communication line connected consecutively with standard resistor it is necessary to fulfill the condition

$$I_{in}R_L = I_cR_0 . \qquad (2)$$

The compensating current value is equal

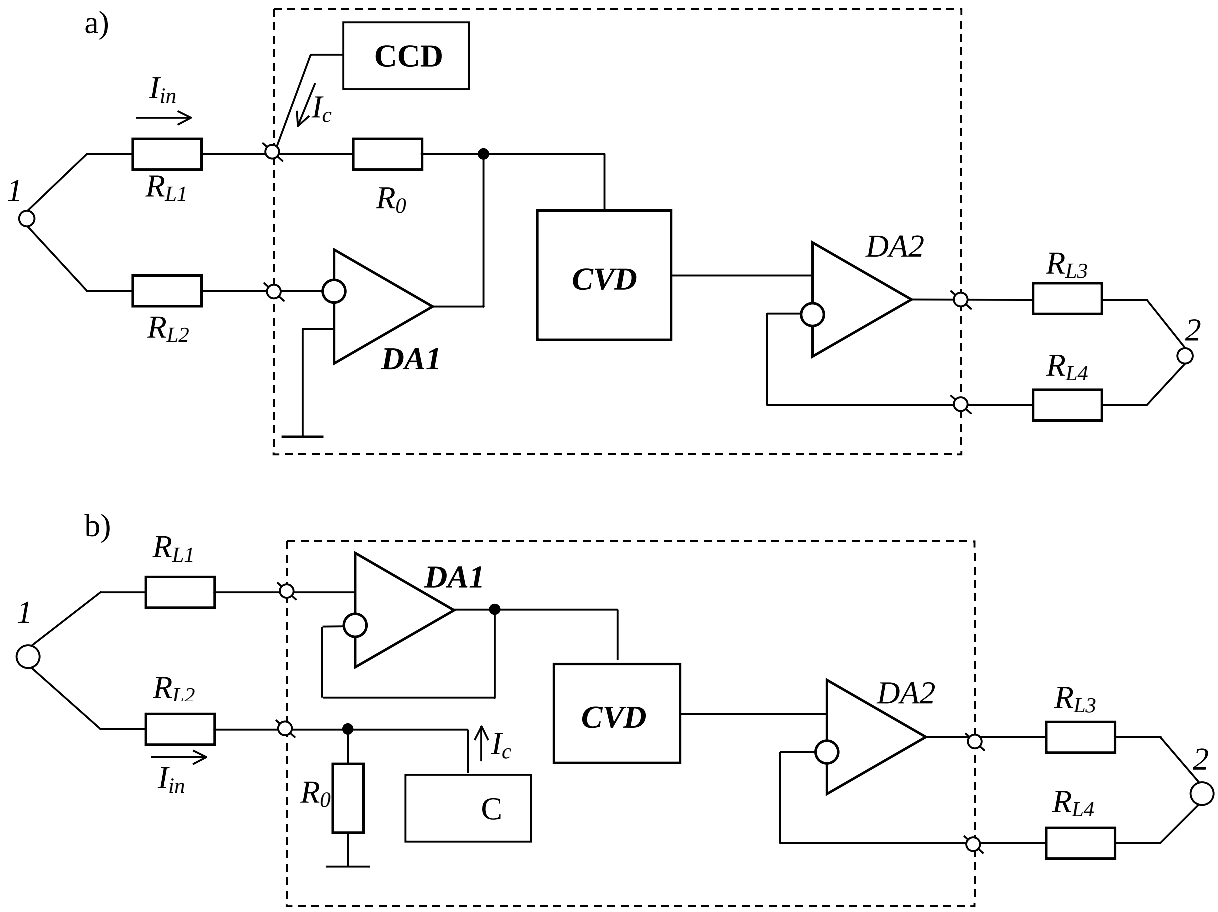

Fig. 1. Generalized structures of active simulators with compensation of the influence of the communication lines resistance by current: a) with the transmission function $R_{sim}=R_0\mu$, b) with the transmission function $R_{sim}=R_0(1-\mu)$

$$I_c = \frac{I_{in}R_L}{R_0} . \qquad (3)$$

The structure of active resistance simulator with transmission function $R_{sim}=R_0\mu$ and with the scheme of compensation of communication lines influence by current is given in Fig. 2.

The compensation circuit is created on operational amplifier DA2. On the input of operational amplifier DA2 is applied the voltage, the value of which is equal

$$U_{in} = I_{in}R_{L1} + \Delta U_1,$$

where ΔU_1 is bias voltage of operational amplifier DA1.

The output voltage of DA2 is defined as

$$U_{DA2} = k \cdot \left(I_{in}R_{L1} + \Delta U_1 + \Delta U_2\right), \tag{4}$$

Compensating current is given by resistance value of resistor R_1 and is equal

$$I_c = \frac{\left(I_{in}R_{L1} + \Delta U_1\right)\left(k-1\right) + \Delta U_2 k}{R_1} \tag{5}$$

where $k = 1 + \frac{R_2}{R_3}$ is amplification factor of operational amplifier DA2, ΔU_2 is bias voltage of operational amplifier DA2.

On the output of DA1 the voltage value is equal

$$U_{DA1} = I_{in}R_0 + I_{in}R_{L1} + \Delta U_1 - \frac{\left(\Delta U_1 + I_{in}R_{L1}\right)\left(k-1\right)}{R_1}R_0 - kR_0\frac{\Delta U_2}{R_1} \tag{6}$$

The simulated resistance value is given by expression

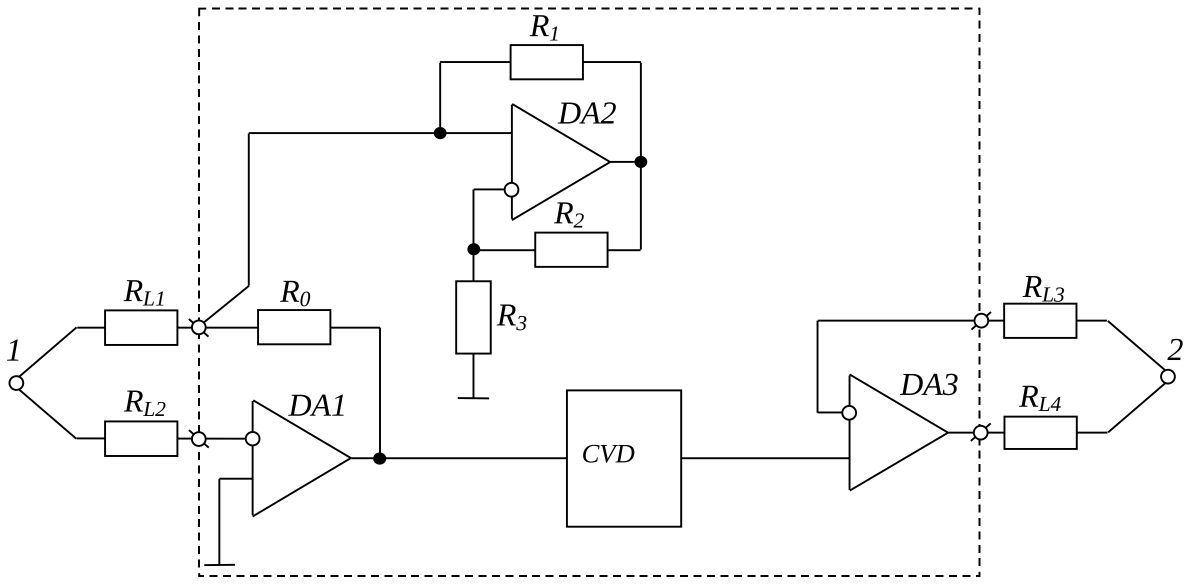

Fig. 2. Structure scheme of active resistance simulator with transmission function $R_{ім}=R_0\mu$ and compensation of resistance of communication lines by current

$$R_{sim} = \mu R_0 + \mu\left(R_{L1} + \frac{\Delta U_1}{I_{in}}\right)\left(1 - \frac{(k-1)R_0}{R_1}\right) + \frac{1}{I_{in}}\left(\Delta U_3 - \frac{\mu R_0 k}{R_1}\Delta U_2 - \Delta U_1\right) \quad (7)$$

Absolute error from communication lines influence resistance is equal

$$\Delta R_{sim}(R_L) = \mu R_{L1}\left(1 - \frac{(k-1)R_0}{R_1}\right) = \mu R_{L1}\left(1 - \frac{R_2 R_0}{R_3 R_1}\right). \quad (8)$$

As evident from analysis of expression (8) it is necessary to fulfill the condition (9) for full compensation of influence of the resistance of the line R_{L1}.

$$R_1 = (k-1)R_0 . \quad (9)$$

In this case the simulating resistance value is equal

$$R_{sim} = \mu R_0 + \frac{1}{I_{in}}\left(\Delta U_3 - \frac{\mu R_0 k}{R_1}\Delta U_2 - \Delta U_1\right). \quad (10)$$

If choose k=2, i.e. $R_2=R_3$, than resistance value R_1 must be equal to the resistance of standard resistor R_0. Absolute error from the communication lines resistance influence mainly is defined by the error of resistors R_0, R_1, R_2, R_3 and its maximum value is at $\delta R_1 = \delta R_3 = -\delta R_2 = -\delta R_0 = |\delta_{max}|$

$$\Delta R_{in\,max}(R_L) = \mu R_{L1}\left(1 - \frac{R_2 R_0 (1-\delta)^2}{R_3 R_1 (1+\delta)^2}\right) = \mu R_{L1}\frac{4\delta}{(1+\delta)^2}. \quad (11)$$

The efficiency of four-wire scheme of active resistance simulator can be evaluated comparing the values of errors from communication lines influence of four-wire and two-wire circuits. It is appropriate use the damping coefficient of the communication lines influence the value of which is given by expression

$$K_{at} = 20\lg\frac{2R_L}{\Delta R_{sim_{max}}(R_L)} = 20\lg\frac{(1+\delta)^2}{2\delta\mu} \quad [dB]. \quad (12)$$

The structure of active resistance simulator with transmission function $R_{sim}=R_0(1-\mu)$ and with the scheme of compensation of communication lines influence by current is given in Fig.3. The compensation circuit is created on operational amplifier DA2 with resistors R_1, R_2, R_3.

The value of simulated resistance between points 1 and 2 is defined from expression

$$R_{sim} = \frac{1}{I_{in}}\left[I_{in}(R_0 + R_{L2}) - I_c R_0\right](1-\mu) - \frac{1}{I_{in}}(\Delta U_1\mu + \Delta U_3) = \left(R_0 + R_{L2} - \frac{I_c}{I_{in}}R_0\right)(1-\mu) - \frac{1}{I_{in}}(\Delta U_1\mu + \Delta U_3) \quad (13)$$

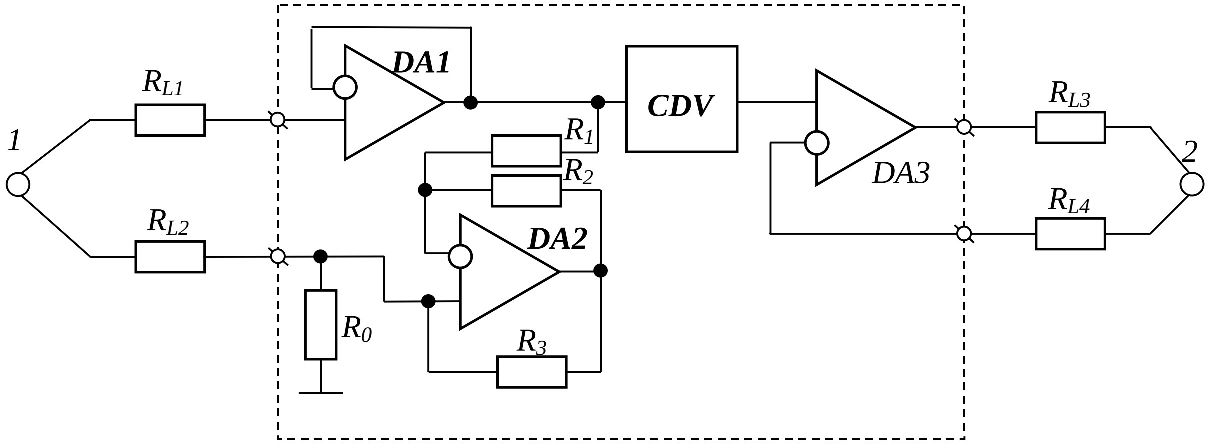

Fig. 3. Structure diagram of active simulator with transmission function $R_{i.м}=R_0(1-\mu)$ and compensation of influence of the resistance of communication line by current

Compensating current is equal

$$I_c = \frac{I_{in} R_{L2} + \Delta U_1 - \Delta U_2}{R_1 R_3} R_2 + \frac{\Delta U_2}{R_3}. \tag{14}$$

After substituting (14) in (13) one can receive

$$R_{sim} = \left(R_0 + R_{L2} \left(1 - \frac{R_2 R_0}{R_1 R_3} \right) \right) (1-\mu) - \frac{1}{I_{in}} (\Delta U_1 \mu + \Delta U_3) + \\ + \left(\frac{R_0}{I_{in} R_3} \left(\frac{R_2}{R_1} - 1 \right) \Delta U_2 - \frac{R_2 R_0}{I_{in} R_1 R_3} \Delta U_1 \right) (1-\mu) \tag{15}$$

As can be seen from expression (15) the influence of the resistance of communication line is compensated when

$$\frac{R_2 R_0}{R_1 R_3} = 1 \tag{16}$$

For full compensation of the influence of communication line and bias voltage ΔU_2 of operational amplifier DA2 it is necessary to fulfill the condition

$$R_2 = R_1 \;\; \text{i} \;\; R_0 = R_3 \tag{17}$$

In this case the value of simulating resistance is equal

$$R_{sim} = R_0 (1-\mu) - \frac{1}{I_{in}} (\Delta U_1 + \Delta U_3) \tag{18}$$

Absolute error from the influence of resistance of communication lines depends on accuracy of resistors R_0, R_1, R_2 i R_3 and is defined from the following expression

$$\Delta R_{sim}(R_L) = R_{L2} \left(1 - \frac{R_2 R_0}{R_1 R_3} \right) (1-\mu) \tag{19}$$

Maximum value of error is achieved at $\mu=0$ and is equal

$$\Delta R_{sim}(R_L) = R_{L2}\frac{4\delta}{(1+\delta)^2} \qquad (20)$$

The damping coefficient of the communication lines influence is defined as

$$K_{at} = 20\lg\frac{(1+\delta)^2}{2\delta} \qquad (21)$$

Structures of resistance simulators with compensation of communication lines influence give the possibility of simulation of resistance on big distances and they can be used for creation of multirange measures of resistance with compensation of the influence of the commutating elements resistance. Such simulators are needed on the objects on which the device can not be placed directly in the place of resistance simulation because of construction or in the zones with aggressive factors, for example on nuclear heating plants with increased radiation which influence on the work of electronic circuits.

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ELECTROMAGNETIC FIELD STRENGTH SENSOR FOR TRAFFIC-SAFETY SECURITY

Keywords: sensor, electromagnetic field strength, traffic safety.

One of the directions of traffic-safety security is reveal registration and inspection of emergency dangerous sections of roads in which electromagnetic field exists. This electromagnetic field influence on psychophysical processes of functioning of driver of motor transport. The connection of the traffic accidents places with revealed anomalous electromagnetic field is confirmed today. To secure the traffic safety there is searching of means of registration of these anomalous (from the point of view of electromagnetic field) sections of roads. For this aim known and elaborated new electrical and electronic means of magnetic field strength measuring and registration are used.

One of the simplest measuring device is the system which includes the receiving antenna, consecutively connected direct current amplifier and generator. But magnetic field strength