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Automatic Device for Reconciliation Transmitter Feed Line Loaded On the Antenna

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ABSTRACT*:* It is shown that for the radio systems of control systems analysis tasks need to take new approaches of modern control theory based on mathematical apparatus requires a large amount of calculation and based on the methods of machine design. The technical implementation of an automatic device to align the transmitter with the feeder line, loaded to the antenna, offered engineering method for calculating the digital matching device for an antenna on-board communication stations.

KEYWORDS*:* transmitter, antenna onboard communication, feeding line, a matching device, computer-aided design system.

To analyze the problems of radio control systems technical systems need to take new approaches of modern control theory based on mathematical apparatus requires a large amount of calculation and based on the methods of machine design. In the framework of the technical implementation of an automatic device to align the transmitter with the feeder line, loaded to the antenna, offered engineering method for calculating the digital matching device for an antenna on-board communication stations.

I. INTRODUCTION

Control system receiving and transmitting devices radio tracking system (the frequency tracking device, phase, voltage, current, goniometric device rangefinders, and so on) and radio systems are widely used in electronics [1, 2].
With the advent of reliable high-speed computers became possible to solve highly complex challenges such as the optimal management of radio systems. At the same time became clear unsuitability of the old methods and the approach to the design of control systems, and has been given an impetus to the development of new methods, which formed the basis of modern control theory [3], which uses mathematical techniques needed to solve even simple problems of a large number of calculations. Its effective use is not possible without the involvement of the computer, which in turn requires the creation of application libraries that implement algorithms for solving individual problems, but on the next stage - the creation of a system of machine design.
Machine design - a new, rapidly developing in many sectors of the direction of the use of computers. It is fundamentally different from the use of computers for scientific and technical computing systems approach to the design process.
Computer-aided design system presupposes:

- Translators with modeling languages;

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- Library of standard simulation routines, synthesis analysis and optimization of systems of various types and levels;
- Debugging software simulation of complex systems;
- Machine technical documentation file;
- Specialized operating system for managing complex engineering programs.

There are a large number of works devoted to specific issues of machine design. However, the literature, illuminating systemic approach to machine design optimal control of systems with many variables, even a little.

II. STATEMENT OF A PROBLEM

Formulation and solution of problems of designing devices to align the transmitter with the loading on the antenna feed line.

An analog implementation of an automatic device for matching with the transmitter feed line, loaded on the antenna is considered in [3]. In this paper calculated digital matching device for an antenna on-board communication stations.

The desired portion of the device is composed of an antenna-feeder path with the antenna, compensators, measuring and executive devices. The serial and parallel oscillatory circuits, mounted on a coaxial output line (Fig. 1) are used as compensating elements. The configuration is done at the expense of adjustable capacitances C_1 and C_2

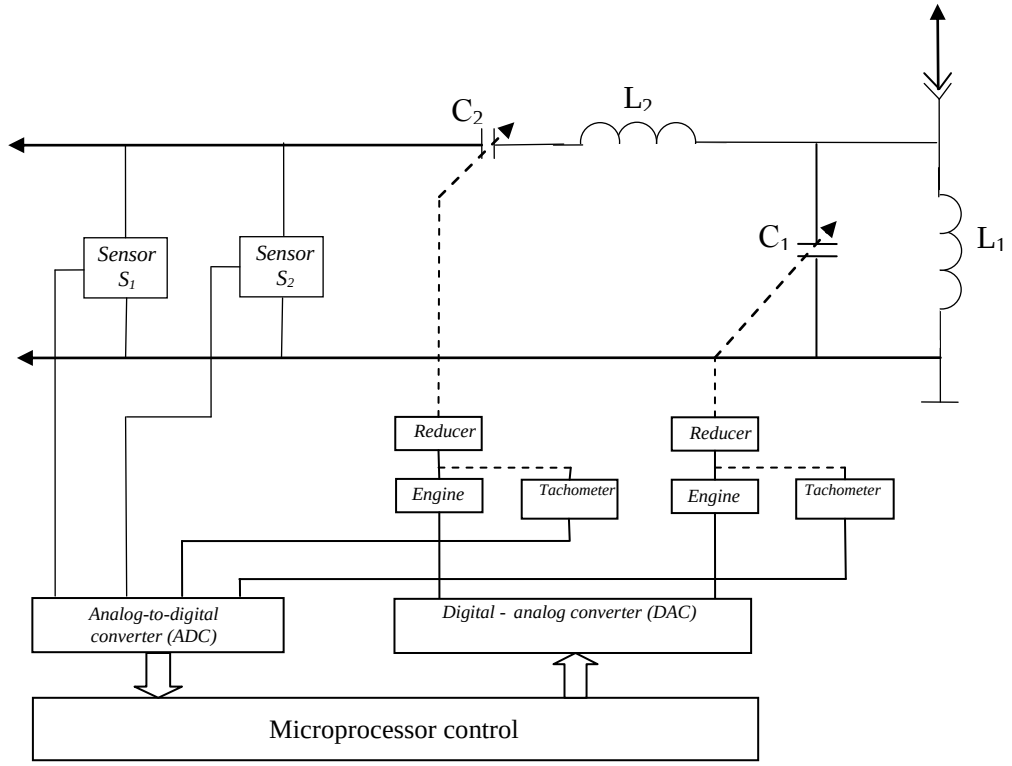

Fig. 1. Automatic device for matching the transmitter with a feeder line, loaded to the antenna

The characteristic impedance of the coaxial line purely active and equal to W=50 ohms.

Restructuring sequential circuit only affects the jet supplying the said resistance. The task is to configure both circuits to ensure that the resistance matching device with the antenna was purely active and equal impedance coaxial line W=50 ohms.

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Mismatch on the active resistance is measured by a sensor circuit is shown in (Fig. 2, a). Mismatch on the reactive component is determined on the testimony of the discriminator, which measures the phase shift between current and voltage in the line (Fig. 2, b). Actuators are direct current motors with gearboxes. Motor speed is determined by a tacho-generators TL.

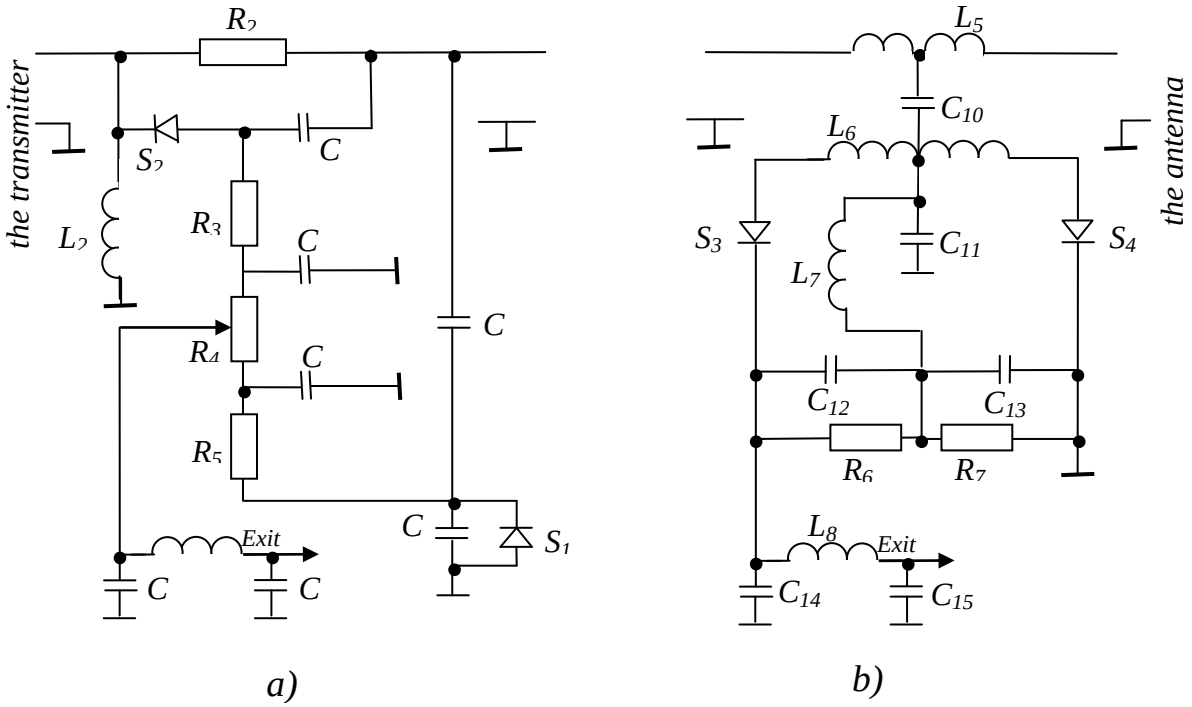

Fig. 2. Scheme of the sensor switching

The dynamics of the control object without taking into account external disturbances described by a system of differential equations, of linear zed with respect to the mid-point of the working range of the device:

$$\dot{x}_1 = x_2; \dot{x}_2 = a_{22}x_2 + b_{21}u_1; \dot{x}_3 = x_4; \dot{x}_4 = a_{44}x_4 + b_{41}u_1 + b_{42}u_2. \quad (1)$$

Here x_1 and x_3 - voltage to a sensor error S_1 and S_2; x_2 and x_4 - the rate of change of the voltage; u_1 and u_2 - the voltage applied to the actuators motors. The coefficients in the equations are based on linearization expressions for the active and reactive components. The coefficients of the equations also take into account the characteristics of electric actuators and gearboxes [4, 5].

The state variables x_1 and x_2 are measured by sensors S_1, S_2. Variable values x_2, x_4 can be formed on the basis of indications tacho-generators follows:

$$x_2 = S_2 U_{TG} / K_{TG}; x_4 = S_{41} U_{TG1} / K_{TG} + S_{42} U_{TG2} / K_{TG}. \quad (2)$$

where U_{TG1}, U_{TG2} - voltage from the tacho-generators (TG); K_{TG} - conversion factor tachometer; S_{21};S_{41};S_{42} - proportionality factor.

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The quality criterion is chosen so that the interval of the system was limited to control signals and power mismatch:

$$J = \int_1^2 (q_{11}x_1^2 + q_{33}x_3^2 + \ell_{11}u_1^2 + \ell_{22}u_2^2)dt. \tag{3}$$

Here $q_{11}; q_{33}; \ell_{11}; \ell_{22}$ - weights, selected on the basis of allowable values of power control signals and error.

Choosing a sampling interval equal to 0.015 with and accept the following numerical values of the parameters of the system: $a_{22}=a_{44}= - 50;$ $b_{22}= - 23;$ $b_{41}=55;$ $b_{42}=157;$ $S_{21}=-0,136;$ $S_0=0,0314;$ $S=0,09;$ $K_{TG}=0,05;$ $q_{11}=10^4;$ $q_{33}=10^4;$ $\ell_{11}=0,01; \ell_{22}=0,01.$

Determine the controller parameters:

$$\begin{bmatrix} U_1 \\ \\ U_2 \end{bmatrix} = \begin{bmatrix} -46,6 & -0,49 & 0,005 & 0,000037 \\ \\ 16,3 & 0,17 & 70,87 & 0,75 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}.$$

III.CONCLUSION

Synthesized using algorithms allow this method to improve the dynamic characteristics of the automatic matching device and can be technically implemented in real time using digital computational structures used by the device in question in the control loop.

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