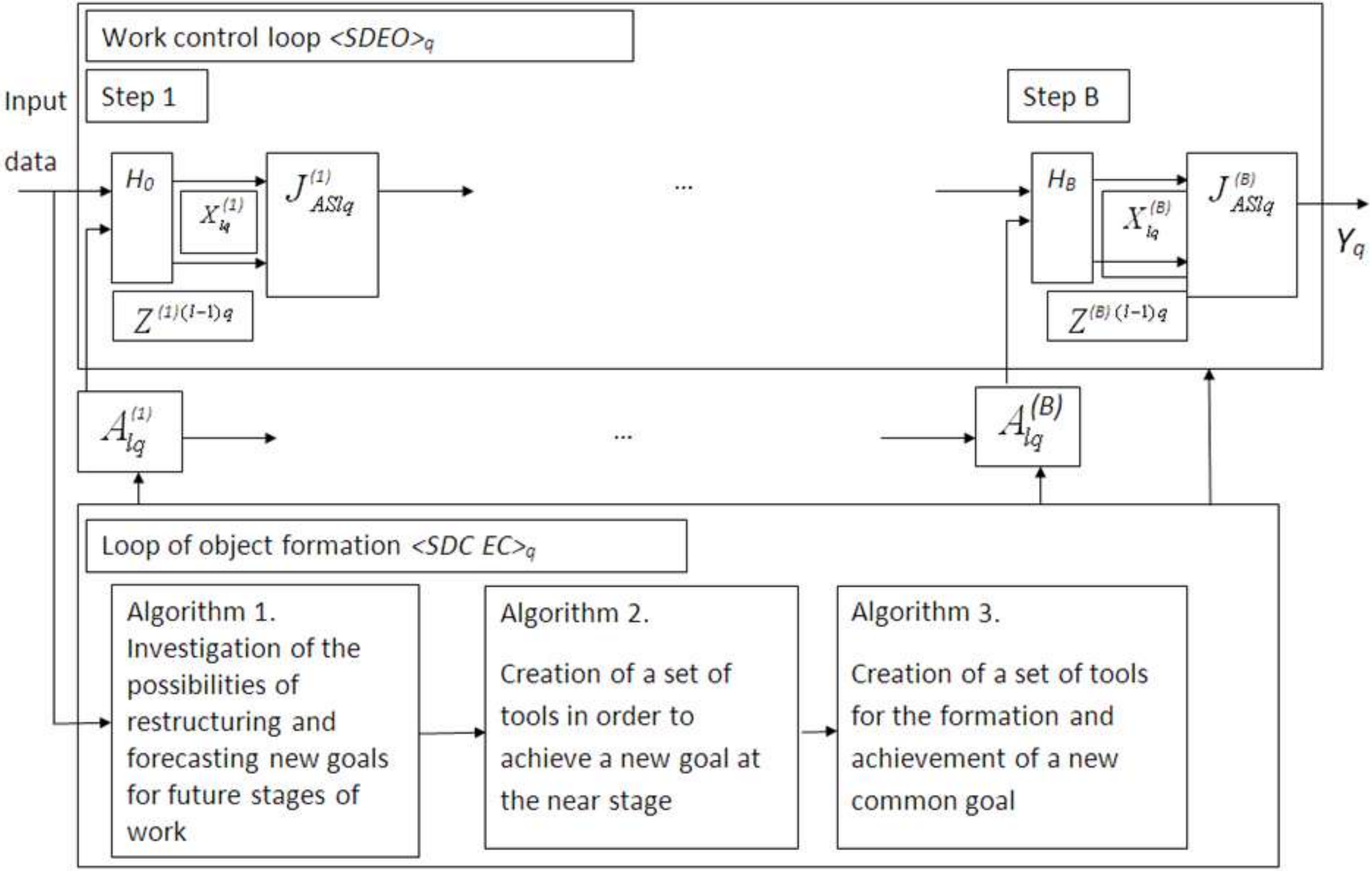
Automation of the Development of Electrodynamic Objects Based on the Dual Approach

I Ya Lvovich[1], Ya E Lvovich[2], A P Preobrazhenskiy[1], Yu P Preobrazhenskiy[1] and O N Choporov[2]

[1] Information Systems And Technologies Department, Voronezh institute of high technologies, 73a, Lenina st, Voronezh, 394043, Russia
[2] Information Security Department, Voronezh state technical university, 14, Moscow dist., Voronezh, 394026, Russia

E-mail: komkovvivt@yandex.ru


Work control loop <SDEO>$_q$
Step 1
Step B
Input data
H_0
$X^{(1)}_{lq}$
$J^{(1)}_{ASlq}$
$Z^{(1)(l-1)q}$
...
H_B
$X^{(B)}_{lq}$
$J^{(B)}_{ASlq}$
$Z^{(B)(l-1)q}$
Y_q
$A^{(1)}_{lq}$
...
$A^{(B)}_{lq}$
Loop of object formation <SDC EC>$_q$
Algorithm 1. Investigation of the possibilities of restructuring and forecasting new goals for future stages of work
Algorithm 2. Creation of a set of tools in order to achieve a new goal at the near stage
Algorithm 3. Creation of a set of tools for the formation and achievement of a new common goal

Performance analysis results

Let us give an example of the developed approaches to control the characteristics of a complex electrodynamic object. The structure of such an object is shown in Fig. 2. The object is made of metal. There is a dielectric layer with a thickness of d_2. The known parameters are as follows: $L_1 = 16\lambda$, $L_2 = 5\lambda$, $L_3 = 3.5\lambda$, $d_1 = 1.7\lambda$, $L_4 = 2.5\lambda$. Characteristics of metal-dielectric material is ε=0.1-0.3j, μ=0.2-0.6j. It is necessary to determine the values of the dimensions L_5 and d_2.

As a quality requirement, there is a condition that in the sector of observation angles $0° < \varphi < 10°$ the value of radar cross section (RCS) is not more than 25 dB. As a method for calculating electromagnetic characteristics, we used the method of integral equations. The design goal is associated with the creation of an object with the smallest possible mass. During the implementation of the constructed algorithm, two possible options were found: 1) $L_5 = 1.1\lambda$, $d_2 = 1.2\lambda$, 2) $L_5 = 2.6\lambda$, $d_2 = 1.75\lambda$. In the expressions λ is the wavelength of electromagnetic wave. Based on the design goal, the first option is required.

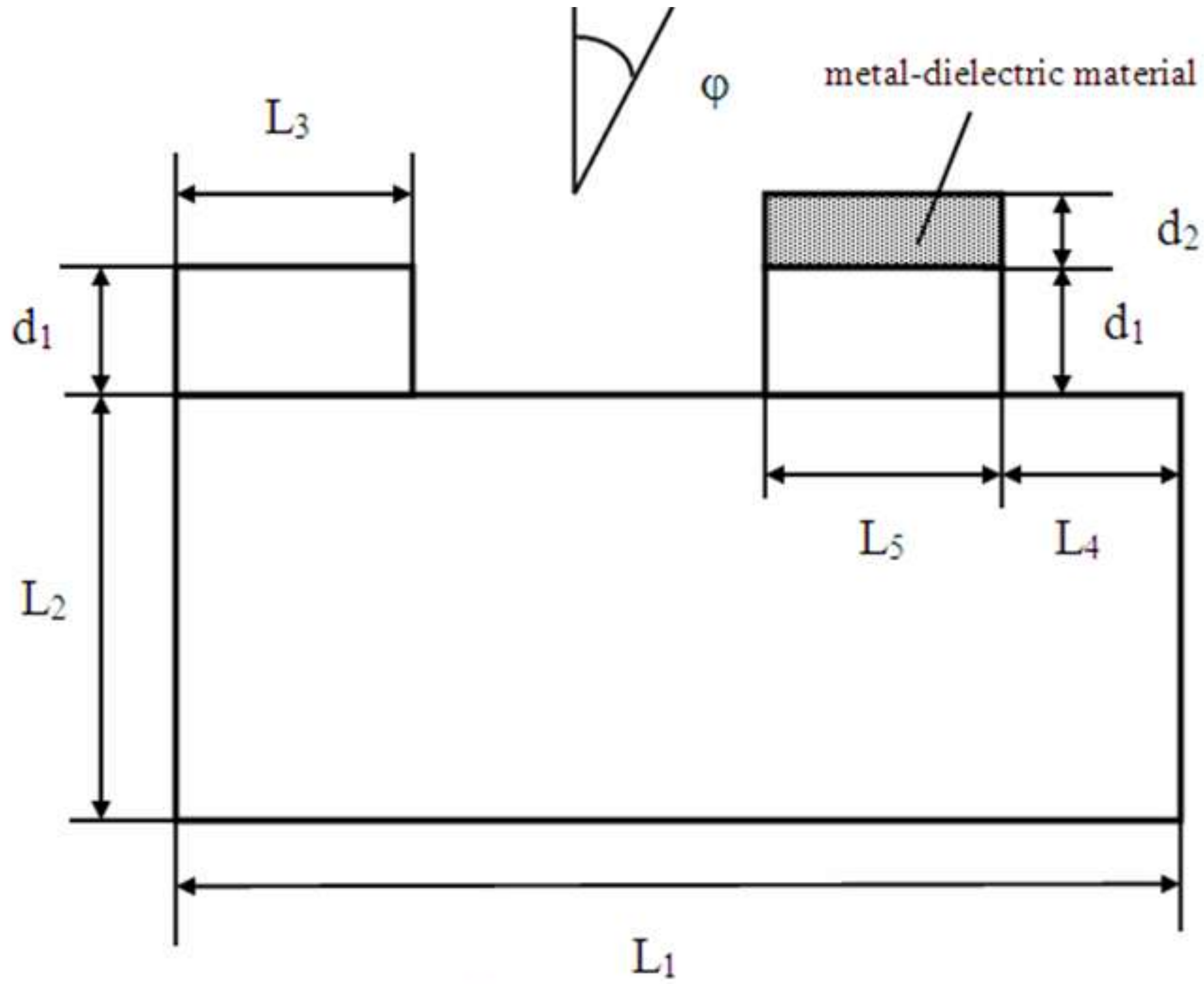


Figure 2. Illustration of an electrodynamic object that is analyzed in the control system.

Conclusion

The paper demonstrates the possibility of constructing an automated system that makes it possible to assess the quality of characteristics of complex electrodynamic systems. The structure of such a system is given. The peculiarities of the formulation and solution of the problem associated with assessing the quality of electrodynamic characteristics are shown. When solving the design problem, it is proposed to use the optimization method with consistently applied criteria.