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Simulation and Optimization of Circuit Current Using Matlab Software Simulink Package

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Abstract
If only one of The Kirchgof's laws is used to calculate the distribution of land and power in electrical chains, i.e. equations are formed only for buttons KTQ or KKQ only for contours, then the total number of equations can decrease.
Equations should be structured in such a way that other laws are enforced. Two ways to structure such equations are proposed by Maxwell: one of which is called the contour tokens method, the other is called the Method of Node Potentials.

Introduction

The vine at the current branch of the electrical chain can be viewed as a collection of several vines, each of which is fluccing in its own solid contour, which does not change along that branch. Such organizers of real tokens are called *contour tokens* . Only the current branch that applies to one contour will be compatible with the contour token. Vineyards in branches that belong to two or more contours are equal to the algebraic sum of these contour tokens. Contour tokens are continuous when they pass through the nodes: that is, when describing the vine as such, the KTQ is done without a word.

Dividingshoe xobcha tokens into contour tokens is derived from the chain's analysis. Contour tokens can be likened to shoe xobcha-vatar tokens, in which case the number of independent contour token equations:

$$K = S + 1 - T \qquad (1)$$

is equal to the number of unknowns, and the tokens of all other branches are represented through the contour tokens.

Figure 3.3.1*presents a* simple electrical chain with two contour tokens I_1 and I_2. The tokens in the chain's a and b personalities are equal to the contour tokens:

$$I_a = I_1; \quad I_b = I_2.$$

The earth's tilt also prevents temperatures from becoming too often unpleasant.

$I_c = I_1 + I_2$.

$I_c = I_1 + I_2$.

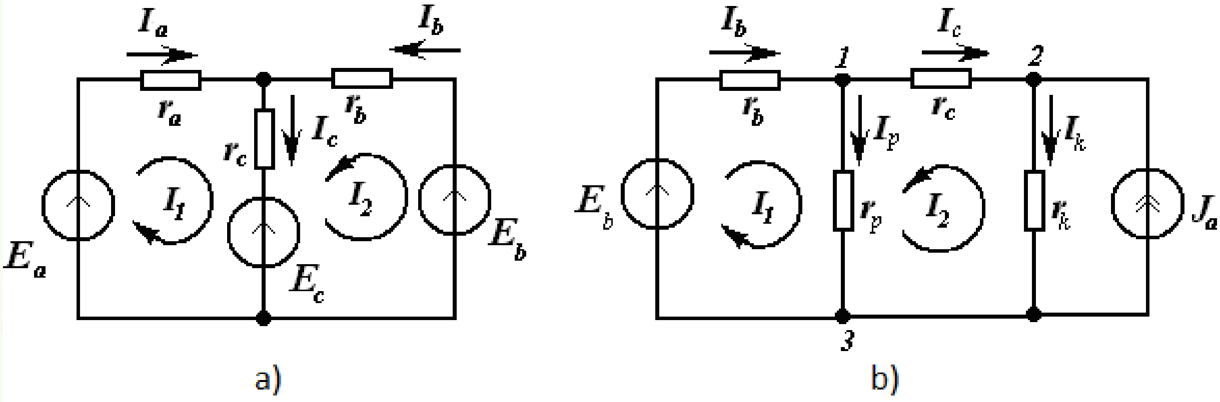


Figure 1.

(3.3) Jehovah's Witnesses would be pleased to answers with you. 1 a-rasm):

$$r\,a\,I_a + r\,c\,I_c = E_a - E_c$$

or

$$(r_a + r_c)\ I_1 + r\,c\,I\,2 = E_a - E_c(2)$$

If new markups are accepted:

$$r_{11}\cdot I_1 + r_{12}I_2 = E_1,$$

In this case $r_{11} = r_a + r_c$ - sum of the resistance of all branches that are part of the first contour: $r_{12} = r_c$ - common branch resistance for the first and second contours: $E_1 = E_a - E_c$ - all *EYUK* , which is part of the first contour Algebraic sum of larynx: with a positive sign, the direction of the contour is determined by *the EYUK*, which is consistent with the direction.

Similarly, in the second contour (3.3.1 a-rasm):

$r_{21}\cdot I_1 + r_{22}to\ 2 = E_2$

ass $r_{21} = r_c$; $r_{22} = r_b + r_c$; $E_2 = E_b - E_c$.

So we will have this system of equations for the given chain.

$$r_{11}\cdot I_1 + r_{12}I_2 = E_1,$$
$$r_{21}\cdot I_1 + r_{22}to\ 2 = E_2$$

Good yachib I_1 will I_2 topamiz toklarni.

The opposite of a common horn for two contours, according to the description

$r_{12} = r_{21}$.

If we combine the above for the number of current contours, the system of contour token equations for a chain that does not contain a token source will be written as follows:

$$\left.\begin{aligned} &r_{11}\cdot I_1 + r_{12}\cdot I_2 + r_{13}\cdot I_3 + \ldots = E_1;\ (\\ &r_{21}\cdot I_1 + r_{22}\cdot I_2 + r_{23}\cdot I_3 + \ldots = E_2; \end{aligned}\right\} \quad (3a)$$

You can also shorten and write a system of these equations in the form of a matrix:

$$r_{ln} I_n = E_l\ . \qquad (3b)$$

The same indexed resistors in the system of contour tokens equations are *equal to the* sum of $r_{ln,}$ all branch resistance in L-contour: any different indexed ($l \neq n$) r_{ln} resistance is equal to the common branch resistance for both neighboring *l* and *n* contours: if *l* and *n* If the positive gestures of the vine at the common branch of the contours are directed differently, then a minus sign is poured in front of the r_{ln} resistance.

By definition

$$r_{ln}= r_{nl} \quad (4)$$

When it comes to the contour tokens of the equation system (3.3.4), it makes it easier to write the y solution in the form of h am matrix:

$$I\,n= G_{nl}\,E_l \quad (5)$$

All elements of the matrix of conductivity G_{nl} are presented in this expression through Kramer's *D* determinant and the algebraic supplement of r $_{ln}$:

$$G_{nl} = A_{nl} / D. \ (6)$$

The next equation is valid only when the given $r_{ln}=r_{nl}$ resistance system matrix is symmetrical. The symmetry of the resistance matrix ($r_{ln}=r_{nl}$) is derived from the symmetry of algebraic additives ($A_{nl}=A_{ln}$). Therefore, the matrix of conductive elements should also be symmetrical:

$$G_{nl}=G_{ln}. \ (7)$$

In this case, ***the*** G_{nl} coefficients are generally called contour conductivity.

The presence of the J_a source in the chain, connected to the current two noses, cannot be a barrier to the use of the contour tokens method.

So (3.3.3*b*) $r_{la}\,J_a$ hadi is added on the left side of the system of equations , i.e.

$$r_{ln}\,I_n + r_{la}\,J_a=E_l. \quad (8)$$

At the same time, the number of equations remains equal, because ℓ the number of unknown contour tokens has not exceeded.

We transfer the Q extra excess to the right of the equations and (8) bring the system of equations into the following form:

$$r_{ln}\,I_n = E\,l - r_{la}\,J_a = Z_l. \quad (9).$$

The Z_l value can be called e the EYUK of the contour.

Nose-to-nose method. As a result of the name of this method, it is enough to compile the equations of the vine for the nose.

Suppose that *the l* and *k* $I_{\ell k}$ buttons (Figure 2) are connected to any branch: - this branch from the nose to the k nose; - $E_{\ell k}$ this branch from the *nose* to the *k* button is *THE BIBLE'S VIEWPOINT*; - the opposite of this branch. In it, the difference in potential between $r_{\ell k}$ *the l* and *k* buttons is as follows:

$$\varphi_\ell - \varphi_k = u_{\ell k} = -E_{\ell k} + r_{\ell k} I_{\ell k} \quad (14).$$

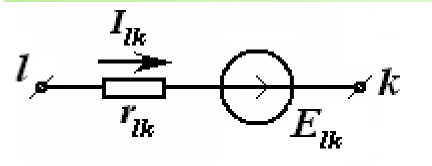


Figure 2

The result of the use of similar equations for all branches of the KKQ-solid contour and then the formation of their algebraic sum. Therefore, when the vineyards in the branches are written in the same equation (14):

$$I_{\ell k} = (\varphi_\ell - \varphi_k + E_{\ell k}) g_{\ell k} \qquad (15)$$

Kirchgof's second law is self-enforced. At the same time, this (3.3.14) equality can be viewed as an expression of the integrated law of Om. $g_{\ell k} = 1/r_{\ell k}$

In these markings , $I_{\ell k} = -I_{k\ell}$ $Э_{\ell k} = -Э_{k\ell}$
However,

$$g_{\ell k} = g_{k\ell} \qquad (15)$$

We assume that the resistance (or conductivity) of all branches of the chain with the tug of *T* = *n* + 1, *the EYUK* $E_{\ell m}$ of power sources, and the tokens of the token sources are given and go to the formation of button equations. $I_{\ell k}$

If *noun* 1 is flowing from the outside (from the source of the vine) J_1, then in accordance with Kirchgof law, the equation of tokens for noun 1 will be as follows:

$I_{12} + I_{13} + ... + I_{1,n+1} = J_1$;

ikkinchi tugun uchun $I_{21} + I_{23} + ... + I_{2,n+1} = I_2$

ixtiyoriy k tugun uchun $I_{k1} + I_{k2} + ... + I_{k,n+1} = J_k$.

If we spread the expressions of each token (3.3.14), we produce the following for the k-button:

$$(\varphi_k - \varphi_1 + E_{k1}) g_{k1} + \ldots + (\varphi_k - \varphi_n + E_{kn}) g_{kn} + \ldots$$
$$\ldots + (\varphi_k - \varphi_{n+1} + E_{k,n+1}) g_{k,n+1} = J_k. \qquad (16)$$

By grouping the multipliers in front of unknown potentials, hypothesizing that the potential of the last nose is zero, we transfer all known values to the right of the sign of equality and $(\varphi_{n+1} = 0)$ bring the equation for the k-noun to the following view:

$$-g_{k1}\varphi_1 - g_{k2}\varphi_2 - \ldots + g_{kk}\varphi_k - \ldots - g_{kn}\varphi_n = \bar{J}_k. \qquad (17).$$

To shorten the entries in this link, the following markups were introduced:

$$g_{kk} = g_{k1} + g_{k2} + \ldots + g_{kn} + g_{k,n+1}; \qquad (18)$$

this is a collection of conductivity of all branches connected to the k noun:

$$\bar{J}_k = J_k + g_{1k}E_{1k} + g_{2k}E_{2k} + \ldots + g_{nk}E_{nk} + g_{n+1,k}E_{n+1,k}. \qquad (19).$$

As the two indexes of the values participating in these markups changed, the gestures before *the EYUK*were changed. Notice that the add-on is not brought in among the excesses. (11) The contents of the sum can be interpreted simply: - this is a $g_{kk}E_{kk}$ J_k *full-fledged* token that comes from all real and equivalent sources to the k nose. Its value can be called the quoted value of the nose token. $\bar{J}_k$

(17) The equations can be kneeling for all buttons except the last. For the last nose, the button equation comes from all the remaining equations. As the "last" node, of course, one of the

nodes can be optionally selected. It can sometimes also be accepted as a sticky nod, because of its potential $\varphi_{n+1} = 0$.

You can create a system of equations with n independent equations (the full number of n=1 nodes) and so many unknown potentials:

$$\left.\begin{array}{l} g_{11}\varphi_1 - \ldots - g_{1k}\varphi_k - \ldots g_{1n}\varphi_n = \overline{J}_1; \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ -g_{k1}\varphi_1 - \ldots + g_{kk}\varphi_k - \ldots - g_{kn}\varphi_k = \overline{J}_k; \\ -g_{n1}\varphi_1 - \ldots - g_{nk}\varphi_k - \ldots + g_{nn}\varphi_n = \overline{J}_n. \end{array}\right\} \quad (20\,a)$$

Once the y solution of the Equation System (3.3.20) to potentials is determined, the power of branches and elements is calculated according to Om law.

Analyze in contour tokens mode

In this way, the equations are compiled only according to the second law of Kirchgofninng. To do this, the required number of contours will be selected. Each contour involves the presence of a contour, and the positive direction of the vine is indicated voluntarily. The principle of mastery is that in each contour, contour tokens flow and network tokens are formed from them. Equations are compiled for each contour. The contour itself is rotated in the direction of the contour, and each contour is accounted for by the voltage gained from the token. The resulting embryo was allowed to develop in nutrients and then inserted into her womb, where it implanted.

The sum of the resistance of this contour is called the resistance of the contour itself. The sum of resistance that is part of the two contours is called mutual resistance. The algebraic sum of all EYUK moving in any contour is called the contour EYUK. Any contour of the structured equations will be removed against K I and its value will be found. The power of the vineyard in each resistors is equal to the algebraic sum of the contour tokens.

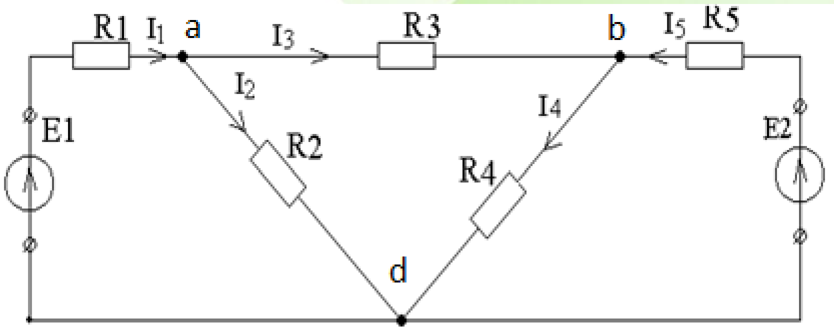


Figure 3.

For the chain given in Figure 1, pass only the contour tokens II, III, and III from the contours I, II, and III, and if these vineyards form a drop of power in the resistance, then the contour tokens with the actual tokens on the network will be connected as follows: $_1I_I$=I, $_2I_{III}$=I, –I_3I =I_{II} , I_4=I_{IIIII}+I, I_5=I_{III}.

For the given chain, you can create equations according to Kirchgof's second law, i.e.:

$$\begin{cases} I_I R_{12} - I_{II} R_2 = E_1 \\ -I_I R_2 + I_{II} R_{234} + I_{III} R_4 = 0 \end{cases}$$

These equations are called contour token equations.

Contour for a chain with n contours and m nodes in general The equations of the vine can be written as follows:

Here: R_{nn-n} chi is a private resistance of the contour, equal to the algebraic sum of all resistance entering this contour in quantity, E_{nn} - n chi contour is a private EYUK, which in quantity is

$$\begin{cases} I_{I\,R\,11\,II\,R\,12} + I_{II\,R\,13}\ n + I\ R\ldots\ldots + I_{1n} E \\ =_{11} \\ I_{I\,R\,21\,II\,R\,22\,II\,R\,23} + I_{n} + IR_{2n}\ldots\ldots + IE \\ =_{22} \end{cases}$$

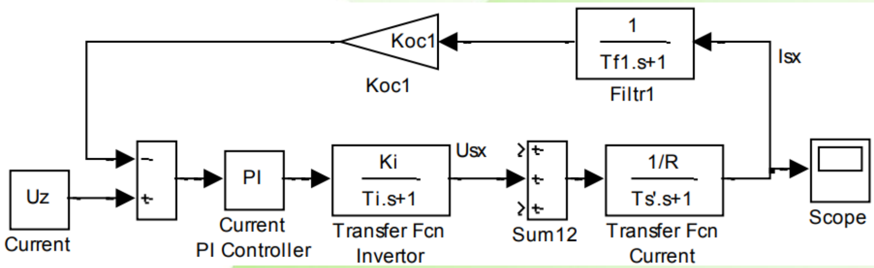
equal to the algebraic sum of all EYUK in the contour, in which the direction of the contour token should be taken into account.

You can find contour tokens bytabbing the identifiers and towers into the above system of skins.

Calculation of the parameters of the land regulator with the ideal source of land

Figure 4 below shows the structure scheme of the contour token.

We collect this structure scheme using the *Simulink* pact.



4-Rasm. Contour of tokini structure sxemasi

The function of transferring the structure chart of the contour token with the ideal inverter in the contour content is as follows:

$$W_{TFI\,(s)} = \frac{K_I}{T_I * S + 1}$$

Here

$K_I = \frac{U_{FT}}{U_{y\,max}} = \frac{220*\sqrt{2}}{10} = 31,11$ -invertorni kuchaytirish koeffisenti;

$U_S = U_{F*}\sqrt{2}$ - stotor kuchlanishi fazoviy vector modules;

$U_{y\,max}$*=10V* - _invertorning maximum kuchlanishini boshqarish;

Constant time of T_I***=0.5-inverter*** $\frac{1}{f_i} = 0,5\frac{1}{2500} = 0,0002s$;

fi=2500Gs– inverterning chastotasi (o'zgarishi).

The inverter frequency transmission function is as follows

$$W_{TFI\,(s)} = = \frac{K_I}{T_I * S + 1}\ \frac{31,11}{0,0002s+1} \qquad (\dots 21\dots)$$

The inverter's resistance is equivalent to R 5,503 =Om and equivalent permanent time as an equation to the stator desert resistance

$T'_s = 0,0123$ ***s.*** :

Yuklamni uzatish funksiyasi (stator cho'lg'ami):

$$W_{TFC\,(s)} = = \frac{1/R}{T'_I * S + 1}\ \frac{1/5,503}{0,0123s+1} \qquad (\dots 22\dots)$$

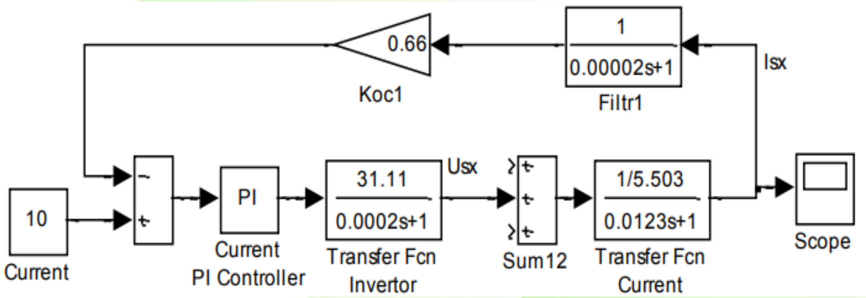
Filter's transmission function is Filter1:

$$In_{F1\,(s)} = = \frac{1}{T_{f1} * S + 1}\ \frac{1}{0,00002*s+1} \qquad (\dots 23\dots)$$

Here ***Tf10,00002 s=*** is the constant time of the filter, which corresponds to a 40 mks actual data period.

The reverse communication coefficient and the power of the vine were previously calculated and equal to the following (24) its structural model in Matlab will be as follows (5-rasm)

$$K_{0C1} = 0,66 \qquad (\dots 24\dots)$$



Picture 5.Contour to model scheme

Calculating the parameters of the regulator is based on the optimized model (Figure 5). With one large time constant, it is recommended to use proportional-integral controls based on the model's transmission functionality:

$$W_{reg\,(s)} = = K_{reg} = \frac{T_{iz} * S + 1}{T_{iz} * S} 7,492\ \frac{0,0123*s+1}{0,0123*s} \qquad (\dots 25\dots)$$

Here

$$K_{reg} = \frac{T'_s * R}{T_{\mu 1} * a_k * K_I * aK_{os1}} = \frac{0,0123*5,503}{0,00022*2*31,11*0,66} = 7,492$$

T'_s T_{trace}***=0.0123s*** – the largest time constant to give birth to isodrom, T_{trace};

$T_{\mu 1} = T_I * T_f = 0,0002 + 0,00002 = 0,00022s$_kichik kontur tokini equivalent vaqt doimiysi;

$a_k = 2$ –optimallashtirish koeffesinti.

So, all its parameters (21... 25) By calculating, we will be implemented in the Elements of the Simulink Library of the Matlab application, the model of which will be opened by the Look Under Mask command and shown in Figure 6.

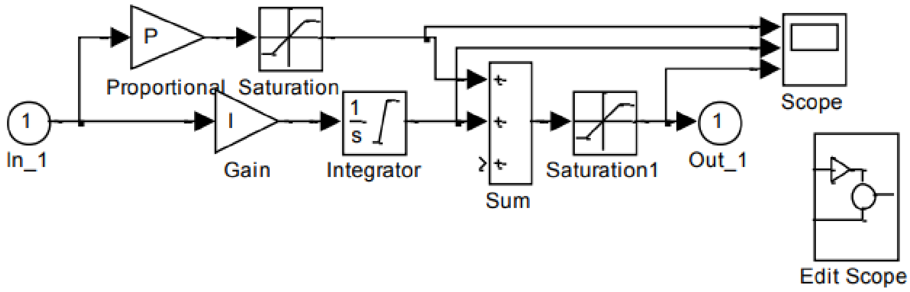
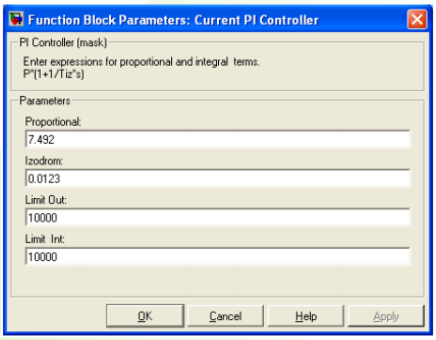


Figure 6 - Diagram of the model of the PI controller

Picture 6. Model diagram of the PI fixer.

The parameters of the modifier are entered into the controller image through the dialog box (Figure 7).



Picture 7.Input parameter of the PI-Maker

Simulation is carried out with a 10 V installation signal (Figure 8).

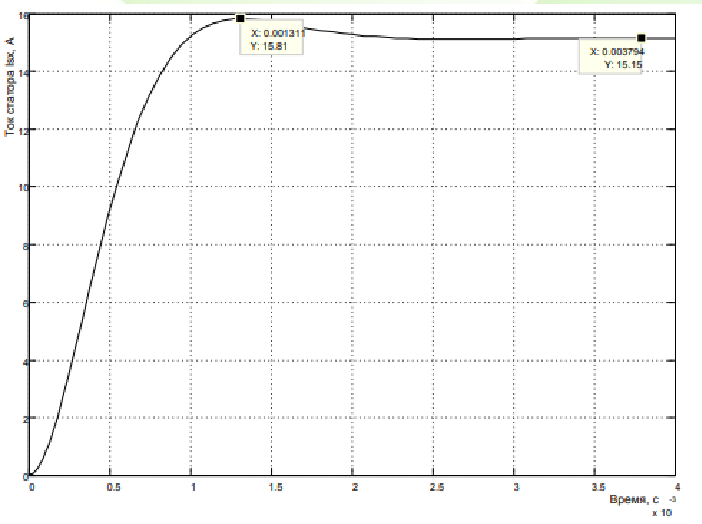
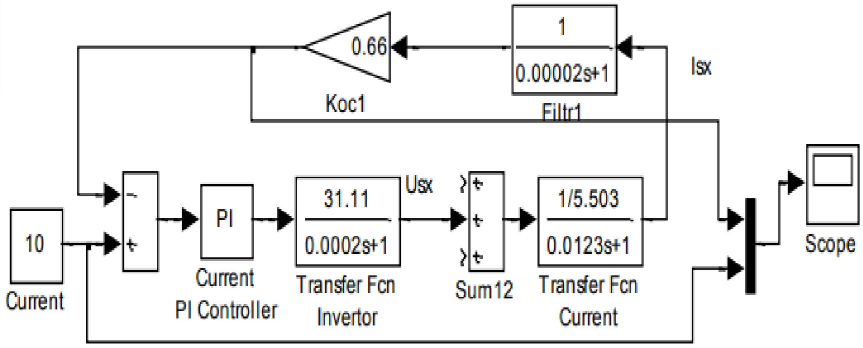


Figure 8.Optimized transition process in contour token

To simplify the order in which the simulation results are processed, the temporary process can be summed up in machine units (volts).

We will change the contour chart and perform the next experiment and bring it to the following view (Fig. 9).



Picture 9. Contour so that modified simulation scheme

From the modified simulation, we will have the following result.

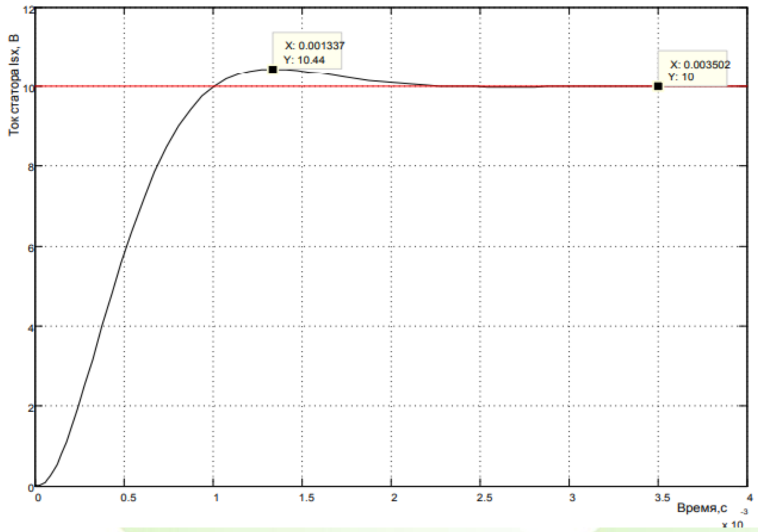


Figure 10: Simulation results are shown in machine units.

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