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BINARY CONTROL CHARACTERISTICS OF RESISTIVE MODELS OF THE INDUCTION DEVICES

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Russia, Krasnoyarsk, 2021

General view of the equipment of Induction device

Methodical inductor

Intermittent inductor

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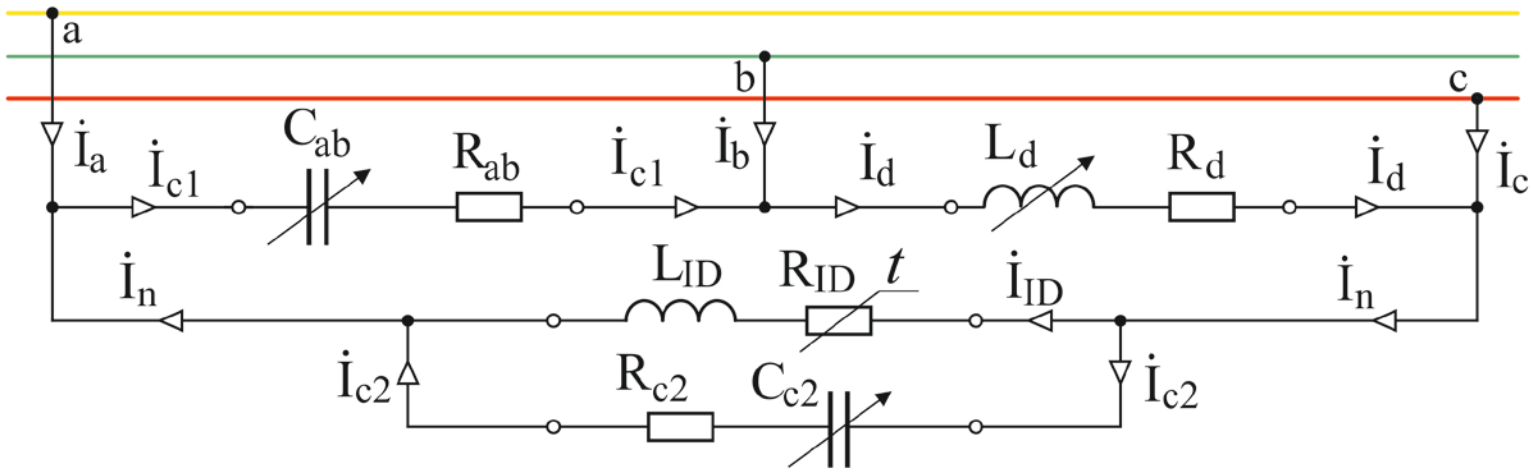
Schematic of an induction installation with parametric models



Steinmetz balancing device applied

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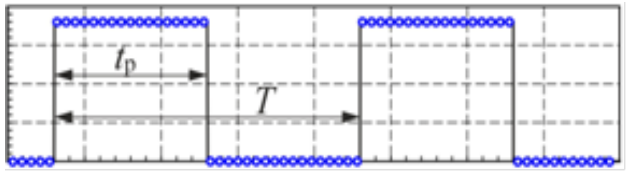
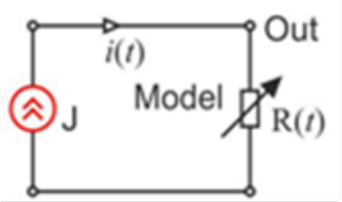
Parametric resistive models with impulse control

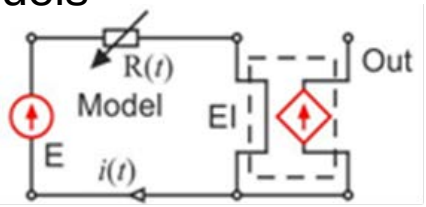
Resistive keys



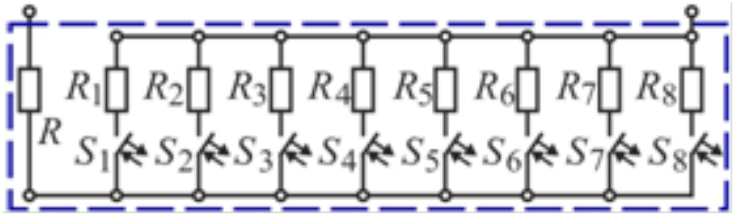
Control pulses

Test circuits for models

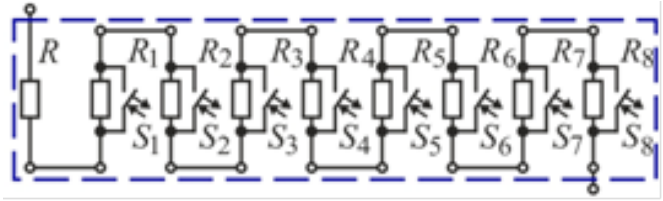




Parallel Matrix Regulator



Serial Matrix regulator



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Application of computational algorithms

Matrix models of elements

$$\begin{array}{c} \\ m \\ n \\ i_J \end{array}\begin{array}{c} \begin{array}{ccc} m & n & i_J \end{array} \\ \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & -1 \\ 0 & 0 & 1 \end{bmatrix} \end{array}\begin{bmatrix} V_m(t) \\ V_n(t) \\ i_k(t) \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ J_k \end{bmatrix}$$

$$\begin{array}{c} \\ m \\ n \\ i_E \end{array}\begin{array}{c} \begin{array}{ccc} m & n & i_E \end{array} \\ \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & -1 \\ -1 & 1 & 0 \end{bmatrix} \end{array}\begin{bmatrix} V_m(t) \\ V_n(t) \\ i_E(t) \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ E_k \end{bmatrix}$$

$$\begin{array}{c} \\ i \\ j \\ n \\ m \\ i_1 \\ i_2 \end{array}\begin{array}{c} \begin{array}{cccccc} i & j & n & m & i_1 & i_2 \end{array} \\ \begin{bmatrix} 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & 1 \\ -1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & -1 & 1 & k_R & 0 \end{bmatrix} \end{array}\begin{bmatrix} V_i(t) \\ V_j(t) \\ V_n(t) \\ V_m(t) \\ i_1(t) \\ i_2(t) \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

Computational method

$$\left[\begin{array}{ccc|ccc} g_{11} & & \cdots & b_{kk+1} & & \cdots \\ & \cdots & & & \cdots & \\ \cdots & & g_{kk} & \cdots & & b_{nn} \\ \hline a_{11} & & \cdots & r_{kk+1} & & \cdots \\ & \cdots & & & \cdots & \\ \cdots & & a_{kk} & \cdots & & r_{nn} \end{array}\right]\left[\begin{array}{c} V_1^g(t) \\ \cdots \\ V_k^g(t) \\ \hline i_1^r(t) \\ \cdots \\ i_n^r(t) \end{array}\right] = \left[\begin{array}{c} \cdots \\ \sum j_k^g(t) \\ \cdots \\ \hline \cdots \\ \sum e_n^r(t) \\ \cdots \end{array}\right]$$

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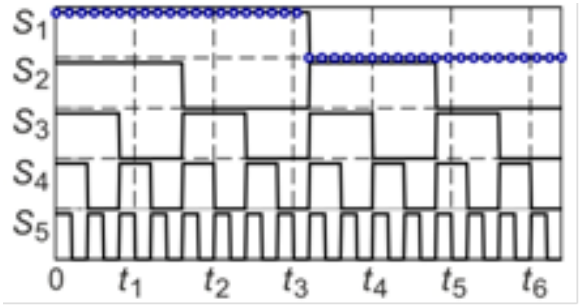
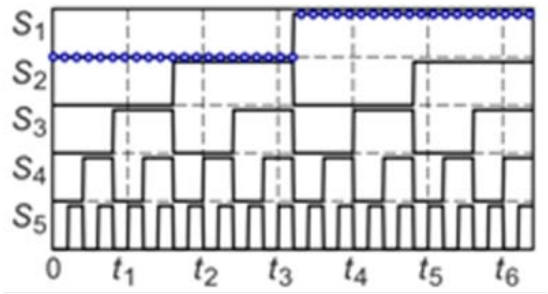
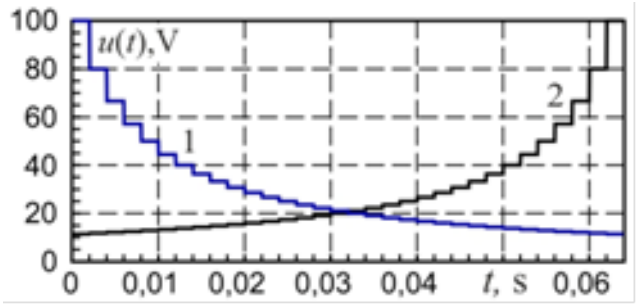
Calculation and simulation results

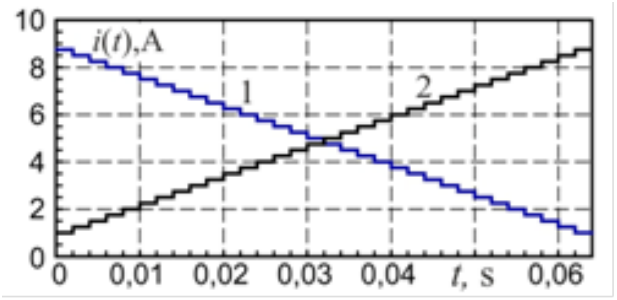
Control characteristics of the switches of the parametric model





Dynamics of changes in the operating parameters of the resistive model





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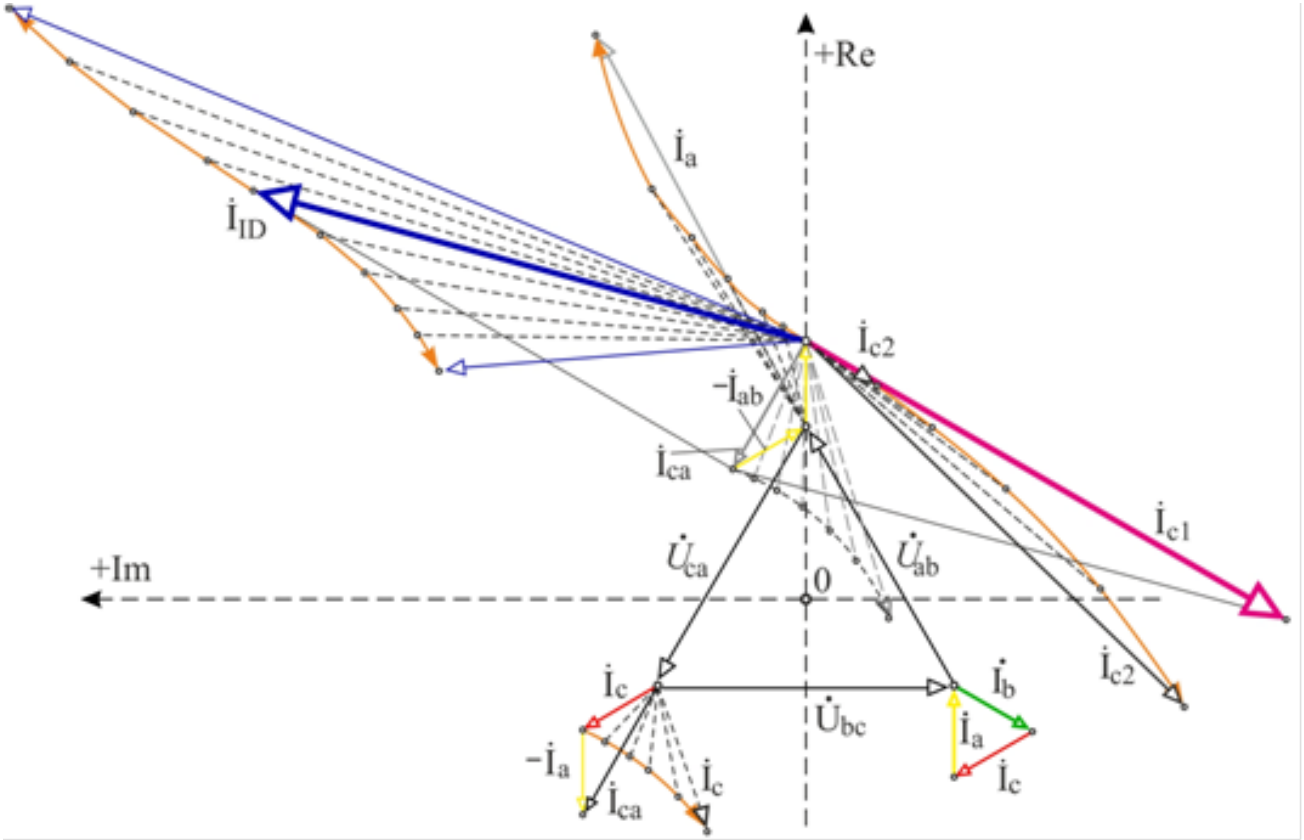
Calculation and simulation results

Modeling modes in the simulator



Vector chart for nonsymmetrical mode

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Conclusion

Control tools for parametric models are proposed

Functionality

In induction heater

In induction stirrers

Advantages

Calculation of the set of steady-state regimes

Transient Analysis