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FEATURES OF MATHEMATICAL MODELING OF AC ELECTROMECHANICAL CONVERTERS

Three-phase asynchronous electric motor drives hold a dominant position across all sectors of industrial activity. Initially, asynchronous motors were primarily used in non-regulated drives. However, with the development and mass production of highly efficient systems for controlling the electromagnetic torque and rotational speed of the motor shaft – by adjusting the amplitude and frequency or only the amplitude of the supply voltage (current)—these electric machines are now actively replacing DC machines, even in their traditionally dominant application: regulated electric drives. This shift is due to the significantly superior technical, economic, energy efficiency, and operational characteristics of both asynchronous machines themselves and the drive systems based on them, compared to other types of electric drives.

The implementation of controlled asynchronous electric drives is also taking place in areas where traditionally non-regulated or parameterically regulated drives were used (such as in water supply systems, sewage, heating, ventilation, transportation, crane drives, etc.). This allows for elevating several technological processes to a qualitatively new level. Thus, the three-phase asynchronous electric motor is one of the primary types of electromechanical energy converters, and the controlled drives based on it are one of the main types of industrial drives.

Current research is focused on: improving the control systems of asynchronous motors to facilitate their integration into specific technological processes; optimizing the parameters of control systems and operating modes of asynchronous motors according to various criteria, taking into account the features of particular technological processes; eliminating the impact of parameter changes and measurement errors of controlled variables on control quality; reducing the number of sensors for controlled variables by developing devices for their indirect measurement, etc. Research is also continuing in the area of improving the structure of control systems for asynchronous motors, considering their design features and the characteristics of semiconductor converters. All of these studies aim to enhance the efficiency of asynchronous motor control systems and, ultimately, to reduce energy consumption per unit of product.

The foundation of modern control systems for asynchronous electric drives and all the aforementioned research relies on mathematical models of the asynchronous motor, in which three-phase variables are represented by Cartesian coordinates of resulting vectors. The Cartesian coordinate system is not the only possible form for representing resulting vectors. As is known, a vector in three-

dimensional space can be characterized, for example, by cylindrical coordinates, and a vector in a plane can be represented using polar coordinates.

Mathematical models of asynchronous machines using polar coordinates of resulting vectors as state variables are not widely discussed in the literature, and the properties of such models have been insufficiently studied. At the same time, there are examples of the successful application of fragments of these models for investigating processes and designing control systems for asynchronous motors. Mathematical models in polar coordinates not only expand the possibilities for studying processes in asynchronous machines but also, due to the different set of state variables compared to Cartesian coordinate models, provide the opportunity to create new structures for automatic control systems for asynchronous electric drives.

Thus, there is a scientific and technical task aimed at the development, research, and application of mathematical models of the asynchronous motor as a component of the electric drive in polar coordinates.