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Abstract of the doctoral dissertation:
"Analysis of the nonlinear control method of the multiphase induction motor"

The doctoral dissertation consists of the eight chapters, a list of references and three appendixes.

In the first chapter the introduction and an overview of the state of the problem concerning the analysis of the control methods of multiphase induction motors have been presented. The review of the literature on control methods for multiphase induction motors has been presented. The purpose, thesis and scope of the doctoral dissertation have been presented.

In the second chapter the mathematical models of the five-phase and six-phase induction motors in phase coordinate system have been presented. The transformation matrices of electromagnetic variables are described. The mathematical models of the five-phase and six-phase induction motors in transformed coordinate systems are presented.

The analysis of the multiphase two-level Voltage Source Inverters has been presented in the chapter three. The analysis of the voltage vectors generated by the multiphase Voltage Source Inverters has been carried out. The analysis of the selected modulation methods for multiphase Voltage Source Inverters has been presented. The modulation methods based on the application of different switching sequences of selected active vectors and zero vectors generated by the analyzed multiphase Voltage Source Inverters were considered.

In the chapter fourth the analysis of the selected linear control methods of multiphase induction motors has been carried out. The direct field-oriented control method (DFOC) and the direct torque control method with space vector modulation (DTC-SVM) with multiphase induction motor have been analyzed.

The fifth and sixth chapters constitute the most important part of this dissertation and contain the results, that are the main achievements of the Author.

In the chapter five the analysis of nonlinear control methods for multiphase induction motors have been presented. The advanced Sliding-Mode and Fuzzy-Logic Control methods have been analyzed. The verification of the theoretical analysis has been carried out on the

base on simulations and experimental studies. The theoretical description of the equivalent Sliding-Mode Control method and principles of the rules for designing of the Sliding-Mode controllers have been presented. The theoretical descriptions of the second order Sliding-Mode control method called as Super-Twisting have been presented. The direct field-oriented control method in which the conventional PI controllers were replaced by Super-Twisting controllers has been analyzed. In this chapter the DTC-SVM control method with five-phase and six-phase induction motor with application of the Super-Twisting controllers has been also presented.

The analysis of the DFOC method of multiphase induction motor has been described, in which the conventional PI controller in a speed control loop has been replaced by a Fuzzy-Logic controller. The DTC-SVM methods with a five-phase and six-phase induction motors have been also analyzed. In the analyzed control systems, the conventional PI controller in the speed control loop has been replaced by a Fuzzy-Logic controller.

The analysis of the control methods of six-phase induction motor in fault states has been presented in the chapter six. The control systems with linear PI controllers, with Fuzzy-Logic speed controller and with Super-Twisting Sliding-Mode controllers have been analyzed. The fault state consisting in blocking of the control system of the transistors of the three -phase Voltage Source Inverter has been analyzed. The control system resistant to damage of the speed sensor was also developed.

The description of the designed and made laboratory set-up, used to carry out experimental studies of the selected control methods with six-phase induction motor has been presented in the chapter seven.

Chapter eight contains a final summary of the dissertation and general conclusions.

Jacek Listwan

Wrocław, 12.03.2018