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ABSTRACT

Doctoral dissertation

Diagnostic and control methods in the induction motor drives under faulty conditions of the two-level power converter

The development of the power converters based on IGBTs allows an implementation of the vector control methods of the induction machines, whose a low price and a high operation reliability make them the most frequently ones applied in an industry. Due to the highly-integrated microprocessor systems the control of the drives state variables, such as an angular speed and many others, are successfully realized. Since many years the diagnostic algorithms, which allow a drive condition monitoring or a diagnosis of faults, which can cause the fault development in a short time, that leads to costly maintenance downtimes. A fast identification of a faulty device makes a repair time of the drive shorter. Nevertheless, it does not allow to avoid the drive operation brake. Therefore in many research centers, the drives integrating diagnostic techniques with the fault dedicated drive control methods, which allows to maintain the high drive functionality, are designed.

In this work, the original transistor open-circuit fault diagnostic methods which are dedicated to the power converter with the energy bidirectional flow are presented. This converter is composed of the active rectifier and the special designed voltage inverter with the topology, which allows the drive safe operation after the fault detection. For this purpose, the original inverter voltage modulation algorithm has been designed. The considered faults can occur because of the semiconductor switch malfunctions as well as can be an effect of the transistor gate driver failures. Moreover, many advanced IGBT gate drivers ensure the switch short-circuit protection, which relies in the transistor open-circuit to avoid the high current stress.

In this thesis, two universal transistor fault diagnostic methods, which are dedicated to the two-level three-phase voltage inverters, that are applied in the closed-loop vector control structures, are presented. Additional, the transistor open-circuit algorithms for the vector controlled active rectifiers have been designed. The methods allowing the accurate transistor

fault identification by analyzing the standard signals, which are obtainable without using additional sensors, whose application increase the price of the system. The special topology of the applied inverter and the designed inverter phase modulation algorithm ensure the simultaneous drive operation even under its faulty condition. Due to the DC-link voltages imbalance control obtaining thanks to the novel inverter phase voltage modulation algorithm, the high quality drive control has been achieved.

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