A Neural Network Approach for an Automatic Detection and Localization of an Open Phase Circuit of a Five-Phase Induction Machine Used in a Drivetrain of an Electric Vehicle

Authors : Saad Chahba, Rabia Sehab, Ahmad Akrad, Cristina Morel

Abstract : Nowadays, the electric machines used in urban electric vehicles are, in most cases, three-phase electric machines with or without a magnet in the rotor. Permanent Magnet Synchronous Machine (PMSM) and Induction Machine (IM) are the main components of drive trains of electric and hybrid vehicles. These machines have very good performance in healthy operation mode, but they are not redundant to ensure safety in faulty operation mode. Faced with the continued growth in the demand for electric vehicles in the automotive market, improving the reliability of electric vehicles is necessary over the lifecycle of the electric vehicle. Multiphase electric machines respond well to this constraint because, on the one hand, they have better robustness in the event of a breakdown (opening of a phase, opening of an arm of the power stage, intern-turn short circuit) and, on the other hand, better power density. In this work, a diagnosis approach using a neural network for an open circuit fault or more of a five-phase induction machine is developed. Validation on the simulator of the vehicle drivetrain, at reduced power, is carried out, creating one and more open circuit stator phases showing the efficiency and the reliability of the new approach to detect and to locate on-line one or more open phases of a five-induction machine.

Keywords : electric vehicle drivetrain, multiphase drives, induction machine, control, open circuit (OC) fault diagnosis, artificial neural network
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