

Education-based, Graphical User Interface Design for Analyzing Phase Winding Inter-Turn Faults in Permanent Magnet Synchronous Motors

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Abstract : In recent years, Permanent Magnet Synchronous Motors (PMSMs) have found extensive applications in various industrial sectors, including electric vehicles, wind turbines, and robotics, due to their high performance and low losses. Accurate mathematical modeling of PMSMs is crucial for advanced studies in electric machines. To enhance the effectiveness of graduate-level education, incorporating virtual or real experiments becomes essential to reinforce acquired knowledge. Virtual laboratories have gained popularity as cost-effective alternatives to physical testing, mitigating the risks associated with electrical machine experiments. This study presents a MATLAB-based Graphical User Interface (GUI) for PMSMs. The GUI offers a visual interface that allows users to observe variations in motor outputs corresponding to different input parameters. It enables users to explore healthy motor conditions and the effects of short-circuit faults in the one-phase winding. Additionally, the interface includes menus through which users can access equivalent circuits related to the motor and gain hands-on experience with the mathematical equations used in synchronous motor calculations. The primary objective of this paper is to enhance the learning experience of graduate and doctoral students by providing a GUI-based approach in laboratory studies. This interactive platform empowers students to examine and analyze motor outputs by manipulating input parameters, facilitating a deeper understanding of PMSM operation and control.

Keywords : magnet synchronous motor, mathematical modelling, education tools, winding inter-turn fault

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