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Abstract Details

Title: Hybrid Pi-Fuzzy Speed Controller for Interior Permanent Magnet Synchronous Motor

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Abstract: Interior Permanent Magnet Synchronous Motors (IPMSM's) are used for fast torque response and for better performance of the machine. IPMSM's are used in low and mid power applications such as computer peripheral equipment, robotics, adjustable speed drives and electric vehicles and in servo applications. Simulation tools capable of handling motor drive simulations are in demand due to growth of PM motor drives. Simulation tools have the capabilities of performing dynamic simulations of motor drives in a visual environment so as to facilitate the development of new systems by reducing cost and time. In this thesis a simulation model has been developed for speed control and improvement in the performance of a closed loop vector controlled IPMSM drive which employs two loops for better speed tracking and fast dynamic response during transient as well as steady state conditions by controlling the torque component of current. The outer loop employ Hybrid PI Fuzzy logic controller (PI-FLC) while inner loop as Hysteresis Current Controller designed to reduce the torque ripple. Despite proportional plus Integral (PI) controller are usually preferred as speed controller due to its fixed gain (Kp) and Integral time constant (Ki), the performance of PI controller is affected by parameter variations, speed change and load disturbances in PMSM, due to which it results to unsatisfied operation under transient conditions. The drawbacks of PI controller are minimized using fuzzy logic controller (FLC). A fuzzy control technique has been designed. PI-FLC has also been designed for effective speed control under transient and steady state conditions. This thesis gives the detailed modeling of an Interior Permanent Magnet Synchronous Motor drive system in Simulink. Simulation results are presented to help analyze the system performance and PI controller parameters influence on the system performance. The analysis has also been performed with fuzzy logic controller as well. Finally analysis has been carried out by Hybrid PI Fuzzy logic controller (PI-FLC) under no load, variable speed condition and variable load conditions separately to show the results.

Keywords: Pi-Fuzzy, Speed Controller, Permanent Magnet, Synchronous Motor.