PERFORMANCE EVALUATION OF SWITCHED RELUCTANCE MOTOR OPERATING UNDER DIFFERENT TYPES OF CONTROLLERS

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Switched Reluctance Motor (SRM) is one of the recent entrants to the competitive field of variable speed drive. Although the first acknowledged application of SRM dates back to 19thcentury, its development then had been hampered by the non-availability of fast switching devices.

The motivation for the present work is to simplify the control of SRM drive to cut down the complexity and cost so that it can be accepted as a viable variable speed drive in general, and become a preferred drive for industrial and domestic use in under-developed and developing countries, in particular.

In this thesis, a conscious effort has been put to simplify the control scheme of the SRM drive to make it economic without much sacrifice of its performance. The investigations reported in this work pertain to the development of a generalized approach towards performance prediction of the SRM from the available flux-linkage and static torque characteristics data. The work is broadly divided into modeling, simulation, and performance evaluation of the SRM drive system working first under PID controller and later under Variable Structure Controller (VSC).

A comprehensive model of SRM and its electronic controller is developed for performance prediction of drive, working with two types (PID and VSC) of speed controllers, over a wide range of operating conditions.

The major contribution of the present work is a comprehensive study comprising mathematical modeling, development of algorithm, digital simulation and performance analysis of the SRM drive system. The study is conducted for determination of a pair of optimum fixed switching turn-on and turn-off angles that is then used throughout the investigations. The performance evaluation using PID controller with fixed gains is conducted for a wide range of operating conditions, covering both mechanical and electrical response. The different operating conditions for which simulation algorithm has been evolved include starting in forward and reverse directions, load perturbation, speed reversal, intermittent operation, four-quadrant operation, and bidirectional multispeed operation. The analysis has been conducted under different load conditions, which include no-load, full load, and speed dependent load conditions. The performance under some selected operating conditions is then evaluated using variable structure controller and is compared with the corresponding performance under PID controller.

In a closed loop control, the performance indices of the SRM drive system are defined in terms of its dynamic response during transients such as starting, stopping, speed reversal, and load perturbation. In terms of these responses the simulated results have confirmed the feasibility of using SRM as an alternative to other electric drives. Since the drive operates satisfactorily with fixed turn-on and turn-off angle control, this scheme should be preferred due to its simplicity in lieu of currently used variable switching angle control requiring additional data acquisition, complex software and signal processing that together consume critical computation time and increase system cost. Using the PID controller with carefully selected fixed controller gains and switching angles can further reduce the drive cost, which meets the objective set out for this work.