ABSTRACT

Switched Reluctance Motors (SRM) need rotor position detection, either directly or indirectly, for energization and de-energization of its stator phases in relation to its rotor position. To overcome the drawbacks of using direct rotor position sensors, various methods of sensorless rotor position detection are available. The general principle behind most sensorless drives is that, if at a given instant flux-linkage (or inductance) and current are obtained, rotor position can be obtained from pre-knowledge of the SRM magnetic characteristics.

The thesis proposes a novel analog sensorless scheme for SRM in variable-speed drive applications, and also includes an analog controller with position sensors for comparison with the developed sensorless controller. The proposed sensorless scheme requires no parameter estimation and remains operative right from start-up to the set speed in the closed-loop system. In the scheme, the stator phases are paired, and each pair comprises of two phases whose L_{min}-zones do not overlap. The entire working of the system is based on comparing the currents of the active phases with a closed-loop switching reference current, that depends on the state of the motor (running or starting) and/or load demand. Logical operations are so sequentially arranged that, when the rising current of one phase in the pair exceeds the switching reference current, its logic helps to switch-off the other phase in the pair near its L_{max}-zone. Next, when the falling current of the same phase in the pair becomes lower than the switching reference current, its logic helps to switch-on the same other phase in the pair in its L_{min}-zone. Same logic continues for the other phases also.

The thesis presents the development of the controllers both sensorless and with position sensors step-by-step and their hardware implementation to drive a 4 kW 4-phase Oulton SRM. A detailed simulation study of both the schemes,

supported by experimental steady-state and transients results, is also presented to assess the working of the proposed scheme. A double polynomial-fit is used in the simulation study to describe the static non-linear magnetization characteristics of the SRM, relating flux-linkage (ψ), current (i) and position (θ).

Key words : SRM, Sensorless, Variable Speed Drive, Without Parameter Estimation, Position Transducer, Hysteresis Controller, Inverter.