ABSTRACT

Induction motors are widely used in industry because of their ruggedness, higher power/ weight ratio and low maintenance. The development of variable frequency drives for induction motors have resulted in higher performance. These variable frequency drives use different control strategies to achieve high performance. The most widely used control strategies are namely - V/f or Scalar control and Vector control (which uses the concept of field orientation).

Scalar control strategy is highly rugged, robust because it is insensitive to any motor parameter variations such as the rotor resistance during motor operation. The control is modeled on the steady state model of the induction motor and has a good steady state response. During dynamic conditions (load and slip dynamics), the control strategy fairs rather poorly. Vector control on the other hand is modeled on the dynamic model of the induction motor. The dynamic response of vector control is excellent. But the dynamic model of the induction motor takes into account the motor parameters, and any change in the parameters during the course of the motor operation results in instability. It is very sensitive to motor parametric changes and therefore, parametric adapted control strategies must be incorporated to ensure a stable response in vector control. Vector control operation also ensures stator currents to stay within their rated limits.

With the merits and demerits seen in both scalar and vector control strategies, in this thesis we propose a control scheme which is a hybrid of the scalar and vector controls. That is, we wish to merge the merits of V/f control and vector control to form a Hybrid control strategy. The hybrid control is dominated by V/f control in order to provide the steady state response. Only during dynamics, a separate modified vector control module (based on the dynamic model of the induction motor) is incorporated to handle the dynamic response.

In the hybrid control, the ruggedness and robustness of V/f control is maintained with the addition of faster dynamic response.

The inputs that are available for motor control are - Supply Voltage, frequency and phase angle of the applied voltage. V/f control uses voltage and frequency as its control inputs. Vector control uses all the three parameters as its control inputs. Voltage and frequency control inputs are required for steady state response of the machine. Whereas, the phase angle control input is the parameter that is fast acting and comes into picture during transient conditions. Hence the name, transient angle. For fast dynamics, control of the phase angle or transient angle of the rotating flux space vector is essential. In this thesis, the effects of the phase angle control input on the dynamic response are studied and methods to estimate the transient angle component are proposed.