CHAPTER 7

CONCLUSION

7.1 SUMMARY AND CONTRIBUTION

The permanent magnet synchronous motor and BLDC motor have been used as variable speed drive due to its high efficiency and robustness. The performance of the drive depends on the type of speed controllers. The commonly used fixed gain conventional PI controller scheme has the disadvantage of increased peak overshoot, settling time, steady state error, and speed change under step change in load and restoration time to reach the command speed. Certain modern schemes have been proposed in this thesis to improve the drive system performances. The proposed accelerated fuzzy tuned PI and hybrid fuzzy PI control human expertise for efficient control of PMSM and BLDC motors.

The main contributions of the thesis are summarized as follows:

- The detailed modeling of current controlled voltage source inverter fed PMSM drive has been presented. The performances of the PMSM drive are investigated under open loop conditions

- The conventional PI controller based PMSM drive has been simulated. The performance of PI controller has been evaluated by simulation results with various gain valued at different speeds
- New fuzzy logic controller named as accelerated fuzzy PI controller has been developed for the PMSM drive. The performance comparison has been made between fuzzy PI, fuzzy PID and proposed accelerated fuzzy PI controller based PMSM in terms of overshoot, steady state error, speed change under load and restoration response to reach the command speed.

- Based on the performance analysis of fuzzy PI and accelerated of fuzzy PI, hybrid fuzzy PI and hybrid fuzzy PID controller have been developed by using switching algorithm and presented.

- Performance characteristic curves have been plotted for all the proposed schemes and detailed performance comparison has been made among the proposed schemes by using the simulation results of the PMSM drive.

- Based on the stimulation results, the peak overshoot in the speed response has been observed as 3.5% for conventional PI controller at 1000 rpm and 1.6% for hybrid fuzzy PI and 0.6% for hybrid fuzzy PID controller based PMSM drive. In practical industrial applications, the sudden change in load is a common phenomenon. The speed change due to step change in load is compared among various controllers. The speed change under load disturbance of 5 Nm has been observed as 1.2% for hybrid fuzzy PI and hybrid fuzzy PID controllers and 2.5% for fuzzy PI controllers. The simulation results reveal that proposed hybrid fuzzy controller scheme results in reduced overshoot and insensitive to load variations. The maximum speed attained by the motor during starting has been referred as peak overshoot in this context.
The proposed hybrid fuzzy PI controller scheme has been simulated for the BLDC motor drive and to validate the proposed controller performance. The speed change under load disturbance of 0.5 Nm has been observed as 1.5% for hybrid fuzzy PI controller and 2.3% for fuzzy PI controller. Real time implementation for the BLDC motor has been made using PIC, simulated and experimental results of this scheme for overshoot and steady state error responses have been presented for validation.

The performance comparison shows that the proposed hybrid fuzzy PI controller provides better performance than general fuzzy tuned PI controller.

Any drive scheme with reduced peak over shoot, less steady state error and speed change under load disturbances is said to have better performance characteristics. On these aspects, the hybrid fuzzy controller based PMSM drive and BLDC motor drive have been proposed.

7.2 SUGGESTIONS FOR FUTURE WORK

The hybrid fuzzy PI controller for PMSM drive can be validated with experimental setup and it can be tested for real time application like CNC machines in order to maintain constant speed with less sensitive to load disturbances. The hybrid fuzzy PI controller for BLDC drive can be validated with high rated motor and it can be tested for real time application. The hybrid fuzzy controller for permanent magnet motors can be studied with other soft computing techniques which emerge in future.