Development And Implementation Of A Hybrid Intelligent Controller For Interior Permanent-Magnet Synchronous Motor Drives

Uddin, MN; Abido, MA; Rahman, MA

IEEE-INST ELECTRICAL ELECTRONICS ENGINEERS INC, IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS; pp: 68-76; Vol: 40

King Fahd University of Petroleum & Minerals

http://www.kfupm.edu.sa

Summary

A hybrid neuro-fuzzy scheme for online tuning of a genetic-based proportional-integral (PI) controller for an interior permanent-magnet synchronous motor (IPMSM) drive is presented in this paper. The proposed controller is developed for accurate speed control of the IPMSM drive under various system disturbances. In this work, initially different operating conditions are obtained based on motor dynamics incorporating uncertainties. At each operating condition a genetic algorithm is used to optimize the PI controller parameters in a closed-loop vector control scheme. In the optimization procedure a performance index is developed to reflect the minimum speed deviation, minimum settling time and zero steady-state error. A fuzzy basis function network (FBFN) is utilized for online tuning of the PI controller parameters to ensure optimum drive performance under different disturbances. The proposed FBFN-based PI controller provides a natural framework for combining numerical and linguistic information in a uniform fashion. The proposed controller is successfully implemented in real time using a digital signal processor board DS 1102 for a laboratory 1-hp IPMSM. The effectiveness of the proposed controller is verified by simulation as well as experimental results at different dynamic operating conditions. The proposed controller is found to be robust for applications in an IPMSM drive.

References:

1. *DSPACE GMGH, 1996, DIG SIGN PROC CONTR
2. *MATH WORKS INC, 1997, MATLAB SIM US GUID

3. ABIDO MA, 1998, IEEE T POWER SYST, V13, P1323
4. BLASCHKE F, 1972, SIEMENS REV, V39, P217
5. BOSE BK, 1997, IEEE T IND ELECTRON, V44, P270
6. BOSE BK, 2002, MODRN POWER ELECT AC, CH9
7. BUJA GS, 1994, IEEE T IND ELECTRON, V41, P663
8. CERRUTO E, 1997, IEEE T POWER ELECTR, V12, P1028
9. GOLDBERG DE, 1989, GEN ALGORITHMS SEARC
10. JAHNS TM, 1987, IEEE T IND APPL, V23, P681
11. KRISHNAN R, 2001, ELECT MOTOR DRIVES, CH9
12. MORIMOTO S, 1994, IEEE T IND APPL, V30, P1632
13. NOVOTNY DW, 1997, VECTOR CONTROL DYNAM, CH7
14. RAHMAN KM, 1997, IEEE T POWER ELECTR, V12, P964
15. RAHMAN MA, 1996, IEEE T IND ELECTRON, V43, P256
16. RUBAAI A, 2002, IEEE T IND APPL, V38, P441
17. SLEMON GR, 1992, ELECT MACHINES DRIVE, P503
18. SNEYERS B, 1985, IEEE T IND APPL, V21, P398
19. UDDIN MN, 2000, IEEE T IND APPL, V36, P1531
20. UDDIN MN, 2000, J ADV COMPUTATIONAL, V4, P212
21. UDDIN MN, 2002, IEEE T ENERGY CONVER, V17, P79
22. UDDIN MN, 2002, IEEE T IND APPL, V38, P1219, DOI 10.1109/TIA.2002.802990
23. WANG LX, 1992, IEEE T NEURAL NETWOR, V3, P807

For pre-prints please write to: mnuddin@mail.lakeheadu.ca; rahman@engr.mun.ca