Abstract

This thesis presents the comparative study of PI, Fuzzy and hybrid Fuzzy-PI controller for controlling the speed of brushless dc (BLDC) motor. The control structure of the proposed drive system is described. The simulation results of the drive system for different operation modes are evaluated and compared. Although conventional PI controllers are widely used in the industry due to their simple control structure and ease of implementation, these controllers pose difficulties when there are some control complexity such as nonlinearity, load disturbances and parametric variations. Moreover PI controllers require precise linear mathematical models.

A fuzzy controller offers better speed response for start-up while PI controller has good compliance over variation of load torque but has slow settling response. The Fuzzy Logic (FL) approach applied to speed control leads to an improved dynamic behaviour of the motor drive system and an immune to load perturbations and parameter variations

Hybrid controller has an advantage of integrating of these two controllers for better control performances. MATLAB/Simulink is used to carry out the simulation**.** BLDC motor can be modelled in the 3-phase abc variables which consist of two parts. One is an electrical part which calculates electromagnetic torque and current of the motor. The other is a mechanical part, which generates revolution of the motor.

Keywords- PI, Fuzzy, Hybrid Controller, BLDC Motor and Speed control.

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List of Acronyms

PMBLDCM	Permanent magnet brushless dc motor
PI	Proportional integral
FLC	Fuzzy logic controller
PMSM	Permanent magnet synchronous motor
PWM	Pulse width modulation
VSI -	Voltage source inverter
RPM	Revolution per minute
emf	Electromotive force
dc	Direct current

List of Symbols used

R_s -	Stator resistance per phase
L -	Stator inductance per phase
M -	Mutual inductance between phases
ω_m -	Angular speed of the motor
θ_r-	Angular position of the rotor
λ_m	Flux linkages
J	Moment of inertia
B	Damping constant
T_e	Electromagnetic torque
T_L	Load torque
K_P	Proportional constant
K_I	Integral constant
e(t)	Speed error
µ	Member ship function
ia	Stator phase currents
e_a ,e_b, e_c	Motor phase back emfs
v_{as}, v_{bs},v_{cs}	Stator phase voltages
$\frac{d}{dt}$	derivative operator
$f_{as}(\theta_r), f_{bs}(\theta_r), f_{cs}(\theta_r)$	Trapezoidal unit functions
V	Volts

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3. Design of a PI Speed Controller Scheme

4. Fuzzy Logic Control Scheme

5. Introduction to hybrid fuzzy PI controller

6. Conclusion and further scope of work