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Title:

Stabilization of Chaotic Dynamics in PM DC Drive System

Abstract:

Electrical motors are widely used in different applications; industrial applications or household or office equipment. In such applications, the speed and the current of the electrical motor are controlled to get optimum operation of the motors. The combination of the motor, power converters, and the controllers called electrical drive. The nominal operation of a permanent magnet (PM) DC drive system is continuous wave with some periodic ripple at same pulse-width modulation (PWM) frequency. Because the switch effects, the system is nonlinear and the periodic orbit can be loss it is stability when any system parameter is varied, this leads to appear a quasi-periodic and chaotic behaviors. In this thesis, the nonlinear dynamics has been investigated in PM DC motor drive with proportional (P) and proportional-integral (PI) controllers. The most common methods to stability analysis of periodic orbit are Poincare map technique and Monodromy matrix approach.

In this thesis, the stability of periodic orbit is analyzed by using Monodromy matrix for three parameters variation; proportional gain, supply voltage and load torque. The analytical results are showed a good agreement with simulation results. Two methods are proposed for stabilization of chaos in PM DC motor drive, one of them is used for stabilization of chaos to periodic orbit by using continuous perturbation. The second one is used nonlinear controller; sliding mode control (SMC), to chaos control to the fixed point. The experimental investigation of the nonlinear dynamics in PM DC motor drive with P and PI controllers has been achieved. The two proposed of chaos control methods have been implemented by using Arduino Due microcontroller. For the first time, the practical stabilization of chaos in drive system has been achieved by using digital filter. Also, by using SMC method for stabilization of chaos in PM DC motor drive. For the first time, it is noted that when the system in chaotic dynamics, the vibration of the motor is increased approximately 400% compare with the system in periodic dynamical behavior.