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Full Length Research Paper

DTC torque ripple minimization based on PSO-PID controller

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In conventional direct torque controlled (DTC) induction motor drive, there is usually undesired torque and flux ripple. The given torque is the speed output regulator; therefore, it necessarily continues tuning for adjusting parameters Kp, Ki. In conventional proportional- integral (PI) speed controller, the performance of motor may differ over time that may cause unexpected torque disturbances, causing sluggishness of a control system. Tuning PID parameters are essential to DTC system to improve the performance of the system at a low speeds. In this paper particle swarm optimization (PSO) proposed to correct the parameters (Kp, Ki) of a speed controller in order to minimize torque ripple, flux ripple, and stator current distortion. Firstly, introduce brief description for conventional DTC design and PSO. Secondly, close loop speed controller in DTC for induction motor using PSO technique to provide high performance of accuracy. Finally, simulation results demonstrate that a reduction of torque and flux ripples is achieved in a whole speed range.

Key words: Particle swarm optimization, PID controller, direct torque control.

INTRODUCTION

Today, besides the growth in technology and the immediate improvement in power devices, perfect and reliable parameters are significant for the drawing and development of the high-performance induction motor drive system. However, the practice demands precise parameters of PI- speed controller in direct torque control to reach exceptional performance with high-quality correctness and widespread reasonableness.

Various researchers have done a lot of investigate on optimization parameters of PID controller. PSO has been practical productively in different optimization problems. One of the earliest applications of PSO was in the preparation of feed-forward neural networks (FFNN) (Eberhart and Kennedy, 1995; Zhao et al., 2005).

However, a few researches are still being completed to diminish the electromagnetic torque ripple, and this main problem leads to the increment of the stator current distortion noise (Hong-Hee Lee et al., 2007). Artificial neural networks (ANN) can be used to design mathematical controllers in order to keep on high dynamic performances and toughness and low speeds even when detuning occurs (Sung-Hoe Huh et al., 2005). However, this method is not ideal in on line real time performance. DTC also presents some drawbacks, including large torque ripple, variable switching frequency, and acoustic noises, among others (Buja et al., 2004). It is possible to directly control the stator flux and the electromagnetic torque by the selection of optimal inverter switching modes (Casadei et al., 2002) but this technique encounter problem like variable switching frequency at high sample time. The active vector is obtained from the conventional switching table,

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