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微纳技术与精密机械

数字驱动系统死区效应的双刷新补偿

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摘要： 针对死区效应会导致永磁同步直线电机相电流失真、推力波动,从而限制其在精密气浮工作台等高精度、低频轻载场合应用的问题,提出了一种根据相电流极性改变驱动器输入信号脉冲宽度来补偿死区效应的方法,双刷新补偿法(DUDTC)。首先,分析了死区效应引起的驱动器输出信号脉冲宽度变化,给出了脉宽调制(PWM)信号上升沿和下降沿的补偿与相电流极性间的关系;然后,在Matlab/Simulink中对死区效应的影响和双刷新补偿法的作用进行仿真;最后,在直线气浮工作台系统中实现了双刷新补偿法。实验显示,该方法相位延迟仅0.5个伺服周期,在电机速度开环和闭环下均使相电流畸变减小,波形正弦化。结果表明,双刷新补偿法能有效改善直线电机电流环性能,且代码量少、移植性好,适用于各类数字开关驱动系统。

关键词： 死区补偿 永磁同步直线电机 精密工作台 电流环

Double updating dead-time compensation for digital drive system

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Abstract: Dead-time effect results in distorted currents and force pulsations of Permanent Magnetic Linear Synchronous Motors(PMLSM),which limits the uses of precision stages in conditions of high accuracy, low frequency and lighter loadings. To compensate the Dead-time effect, this paper proposed a Double Updating Dead-time Compensation (DUDTC) method to correct each input pulse width of the motor driver according to phase current polarity. Firstly, the effect of dead-time on driver output pulses was analyzed and the correlation between correction of Pulse Width Modulation(PWM) and phase current polarities was given. Then, the method was evaluated through simulations in Matlab/Simulink and experiments in a linear-stage system. The results indicate that the phase error of DUDTC is only 0.5 servo periods and its phase current distortions is reduced. The DUDTC shows less codes and good portability, and is an efficient method to compensate the dead-time effect in digital drive systems.

Keywords: Permanent Magnetic Linear Synchronous Motor(PMLSM) dead-time compensation precision stage current loop

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