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Abstract
The main purpose of this thesis is to use a Field Programmable Gate Array (FPGA) and an embedded NiosII processor to develop a digital motion controller IC for XYZ table, which is driven by three PMSMs (Permanent Magnet Synchronous Motors). The motion controller IC includes two modules. The first module, which performs three PMSM's position servo controllers for XYZ table, is implemented by hardware in FPGA. Each Intellectual Property (IP) for position servo controller includes a Self-Tuning neural-PID Controller circuit, Quadrature Encoder Pulse (QEP) capture circuits, Space Vector Pulse Width Modulation (SVPWM) circuits, current read circuit and current vector control circuit. This IP is designed by VHDL language. The second module, which performs the motion trajectory planning for XYZ table, is implemented by software in Nios II processor. The motion trajectory evaluated in this thesis includes the step response, sinusoid response, point to point motion control tracking, circle trajectory tracking, window trajectory tracking, star trajectory tracking and spiral trajectory tracking, etc. The program in Nios II processor is coded using C language. Therefore, to build up a fully digital motion controller for XYZ table, such as three current controllers for PMSM, three position/speed controllers and one trajectory planning, are all implemented by a single FPGA chip. Finally, an experimental system constructed by an FPGA experimental board, one peripheral circuit (two QEP circuirs for linear encoder, four A/D converters, six limit switch circuits), three inverters and one XYZ table is set up to demonstrate the correctness and effectiveness of the proposed motion control IC of XYZ table.
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