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Abstract
The thesis studies to apply an SOPC (System on Programmable Chip) technology, which is composed of an ALTERA FPGA (Field Programmable Gate Arrays) chip and an embedded soft-core Nios II processor, to develop a motion controller for XYZ table. Each axis of XYZ table is driven by PMSM (Permanent Magnet Synchronous Motors). The motion control IC has two modules. The first module is an embedded soft-core Nios II processor which is used to realize the process controller, the servo controller and motion trajectory of XYZ table by software. The position control loop is adopted by fuzzy controller and the speed control loop is used by P (proportion) controller. The second module uses VHDL(VHSIC Hardware Description Language) to model and implement the current vector controller of three PMSMs by digital hardware in FPGA. Each current loop controller includes PI controller circuit、coordinate transformation circuit、SVPWM(Space Vector Pulse Width Modulation)、current comparator circuit、rotary encoder comparator circuit、linear encoder comparator circuit, etc. Therefore, to build up a fully digital motion controller for XYZ table, such as three current controllers of PMSM, three position/speed controller 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 (three QEP circuirs for linear encoder, three serial type A/D converters, six limit switch circuits), three inverters and one XYZ table is set up to evaluate the correctness and effectiveness of the proposed SOPC-based XYZ motion control system.
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