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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 realize a motion control IC for robot manipulator used at wafer loading/uploading condition. The robot manipulator has three-axis, and each axis is driven by a PMSM (Permanent Magnet Synchronous Motor) which is manufactured by the Mitsubishi Corporation. The proposed 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 the motion trajectory controller for the robot manipulator. The program developed in Nios II processor uses C language. The position control loop is adopted by the fuzzy controller and the speed control loop is used by a PI controller. The second module is presented to implement three PMSM's current vector controllers by hardware, and the VHDL (VHSIC Hardware Description Language) is applied to describe the controller behavior. Main current vector controller includes PI controller circuit, coordinate transformation circuit, SVPWM (Space Vector Pulse Width Modulation), current comparator circuit, absolutely encoder comparator circuit and decode, etc. Therefore, a fully digital motion controller for robot manipulator, such as three current vector controllers, 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 three-axis robot manipulator, one peripheral circuit (one absolutely encoder signal comparator, two parallel type A/D converters), three inverters is set up to demonstrate the correctness and effectiveness of the proposed SOPC-based motion control IC of robot manipulator.
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