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Design and Implementation of a Two Stage Controller for Ball and Beam System Using FPGA

Abstract- *The ball and beam is, in fact, a standout amongst the essentially vital models, which are generally utilized for educating the control system because its simplicity to be built, modeled, and controlled. This system involve a ball roll on a beam and since the angle of the beam manipulate by servo motor, so the purposes of this paper is to design two stages controller to stabilize the ball position along the beam by varying the angle of beam. The First controller stage is Proportional-Integral-Derivative (PID) for servo motor. The second stage of the controller is Proportional-Derivative (PD) to control the ball and beam plant. The Matlab simulation results illustrate the efficiency of this controller. Furthermore, this paper presents the complete hardware Field Programmable Gate Arrays (FPGA) design with real time implementation for the suggested controller. This controller utilized 1% of occupied slices when implement on Spartan-3A DSP 3400A Xilinx kit with 70.265 ns minimum time required to complete the controller function. The experimental tests shows that the suggested two stages controller satisfy the functional requirements results.*

Keywords- *ball and beam system; discrete PID; FPGA design; PD controller; PID controller; servo motor.*

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