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DESIGN AND IMPLEMENTATION OF DSP-BASED HYBRID CONTROLLER FOR SOME MOTION APPLICATIONS

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ABSTRACT

This paper describes the design and implementation of a DSP-based hybrid controller for high precision control applications such as accurate positioning tables, micromechanisms, ultra-precision machining, assembly robots, micro devices and the list could continue. Precise motion control is difficult to achieve because the physical components of the control system may suffer from many factors such as nonlinearities, frictions, internal inertia, and time delay. To achieve the desired motion control, these factors must be accurately compensated. Several control techniques such as proportional integrator derivative (PID) and Fuzzy logic (FL) controller have been suggested in the literature for solving the above problems. For instance, the PID that is used in many industrial controls performs unsatisfactorily for some applications due to the aforementioned problems. Though the FL controller (FLC) presents improved performance over that of PID, there are still some drawbacks, which limit its overall desirability. A hybrid system involving both the PID and FL controller is proposed in this paper. This system combines the advantages of both controllers so as to attain an improved performance, that is, the fuzzy system is designed to supervise the PID controller in order to minimize the tracking error due to friction and disturbances or any other uncertainties in the system. The TI DSP, TMS320C24X will be used in the implementation of this system since it has fast computational time and the ability to produce a good accurate tracking with minimum time delay and as such the hybrid system is expected to produce a fast response and smooth motion control.

Keywords: Hybrid system, Fuzzy logic controller, PID, Positioning tables, digital signal processor.

1. INTRODUCTION

The motion control problem of mechanical systems has been a heavily researched area due to both the challenging theoretical nature of the problem and its practical importance. The need for accuracy combined with speed is encouraging the adoption of novel drive concepts for positioning table systems [1-5]. High precision at high