Design of an FPGA-based fuzzy sliding-mode controller for light tracking systems

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Abstract

Human beings to face with oil and coal depletion of fossil fuels. With the development of society, energy saving and environmental protection have become a topical issue. The sun energy using is in the rapid development and application; however, the amount of power produced by a sun tracker depends upon the amount of sun light. This paper proposes a fuzzy sliding-mode controller (FSMC) with a time-varying sliding surface to control a light tacking system via the sliding-mode control approach. The proposed FSMC system is composed of a fuzzy controller and a slope regulator. The fuzzy controller infers the control action to control the system states to reach the sliding surface without large overshoot, and the slope regulator tunes the slope of the sliding surface to govern small convergence time of the system trajectories. Thus, the proposed FSMC system can achieve satisfactory tracking performance with fast transient response and good robustness. Finally, the proposed FSMC system is implemented based on a field programmable gate array chip for low-cost and high-performance industrial applications. The experimental results show the proposed FSMC can achieve favorable tracking performance for the light tracking system even under a payload onto the platform of the light tracking system.

Keyword：FPGA; light tracker; fuzzy control; sliding-mode control