Takat Benjalersyarnon 2010: Balancing of Two-Stage Inverted Pendulum by Optimal Control Method. Master of Engineering (Mechanical Engineering), Major Field: Mechanical Engineering, Department of Mechanical Engineering. Thesis Advisor: Mr. Withit Chatlatanagulchai, Ph.D. 90 pages.

Inverted pendulum system is a system that consists of a mass, a rod, a cart, and a direct-current motor, for controlling the position of the cart and the other parts. Balancing the inverted pendulum is a difficult problem because the inverted pendulum has non-linear model, is unstable, and has fewer number of input signals than its degrees of freedom.

This research presents controller design of a two-stage inverted pendulum by using the linear quadratic regulator (LQR) technique. To design the controller, a mathematical model of the pendulum is created. The model is used in finding suitable gains via computer programming. Then, the resulting gains are validated by computer simulation and real hardware implementation.

The results show that the performance of the control system depends on the selection of weighted variables. The experimental results confirm that the performance of the control system is acceptable. The two-stage inverted pendulum can actually be balanced. Adding an integral to the system improves the ability in controlling the cart position. However, there are some limitations on the actual experimental equipments. As a result, the system cannot tolerate much disturbances because they exceed the limitation of the equipments.

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