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A Cradle of Future Leaders in Robotics

An Application of Sliding Mode Control for a SCARA Manipulator

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In general, a dynamic model of a robotic manipulator is highly nonlinear and strongly coupled. Furthermore, its parameters depend on its unknown and variable payload. A nonlinear controller as an Input–Output State Feedback Linearization, used to linearize a system to get a linear model, may fail to achieve desired tracking performance with the presence of uncertainty. In this case, a Variable Structure Systems (VSS) using the Sliding Mode Control (SMC) could be implemented to solve such a control problem.

The fundamental concept of this Sliding Mode Control (SMC) is to drive error signals to an intersection of sliding planes, after which error will slide to zero, as shown in Figure 1. Such a nature indicates that SMC controllers eliminate nonlinear coupling of each joint by forcing the system into the sliding mode. The system is robust and insensitive to parameter changes, variable payloads and external disturbances, given that initial bounds are specified. A property of this algorithm is discontinuous, causing high oscillations, known as the chattering, in input signals to controllers. This effect could be alleviated by implementing continuous functions.

This research, being financially supported by the National Research Council of Thailand, aims at designing an SMC algorithm controlling continuous paths of our SCARA robot. The corresponding controller uses the VSS and a Lyapunov Function to satisfy Lyapunov stability criteria. Figure 2 exhibits a block diagram of the SMC algorithm.

The research plan is as follow:

- Study the dynamic model of our SCARA robot.
- Design and simulate a sliding mode control algorithm.
- Implement and compare the experimental results to the classical PD and nonlinear controllers.

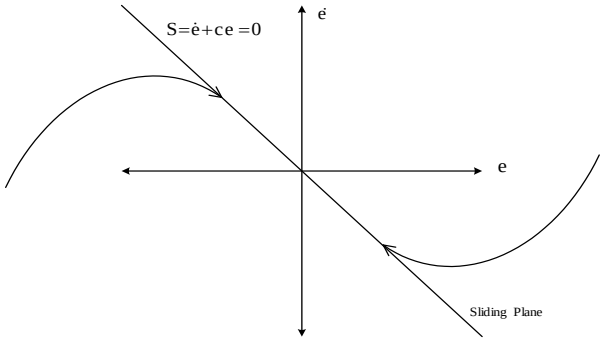
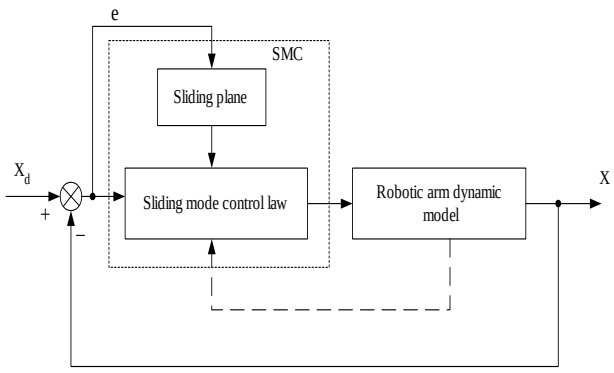


Figure 1. Sliding motion in the state space

Figure 2. SMC algorithm of our SCARA robot



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