

Jitnapa Soontrajarn 2012: Input Shaping to Reduce Vibration in Human-Operated Very-Flexible-Link Robot Manipulator. Master of Engineering (Mechanical Engineering), Major Field: Mechanical Engineering, Department of Mechanical Engineering. Thesis Advisor: Mr. Withit Chatlatanagulchai, Ph.D. 60 pages.

Robot manipulator that is made from flexible material has natural frequencies in the low range. It must be moved slowly to avoid exciting the natural frequencies causing violent vibration that can damage the payload and the flexible structure of the manipulator. However, slow movement of the manipulator results in productivity reduction. Currently, there are many methods in reducing the vibration of the robot manipulator. Increasing mass, using smart materials, and reference input shaping to avoid exciting the natural frequencies can reduce vibration. However, increasing mass and using smart materials add more weight to the manipulator, are costly, and require longer installation time.

This research reduces vibration by shaping the reference input to the manipulator system. To design the input shaper, the natural frequencies and damping ratios are obtained from experiments. The manipulator movement, using the input shaper and a proportional-integral (PI) controller, is compared to that using the PI controller alone. The experimental manipulator is made from a sixty-centimeter steel ruler. The deflection of the tip under vibration is measured by strain gauges. The natural frequencies are obtained from an accelerometer. The robot manipulator moves in the horizontal plane about a fixed rotating point. The manipulator is moved by torque from a motor. An encoder measures the angular position. By comparing the manipulator movements with and without the input shaper, there is significantly less manipulator vibration when the input shaper is used comparing to when the PI controller is used alone without the input shaper. Less vibration also results in less settling time to the final position.

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