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Motion Control of Robotic Arm with Command Shaping Method

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ABSTRACT

In the manufacturing industry, lots of rapid point-to-point motion is required while the residual vibration is unfavorable. Residual vibrations caused by flexible elements are limiting the performance of mechanical system, especially when the system needs to make rapid point-to-point motion. As proved in earlier studies, avoiding natural frequencies of the mechanical system reduces the residual vibrations. This work is based on a non-linear, two-link flexible jointed robot with configuration dependent resonance. Command shaping method consisting different combinations of base functions and weighting factors are compared in this work. The compatibility of command shaping with classical feedback control structure allows a computationally effective method for real time implementation. By measuring the acceleration after the input stops, the residual vibration is analyzed. The best case would be the one with the least peak-to-peak residual acceleration and reasonable peak acceleration during the motion. Experimental results show that the residual vibrations can be reduced considerably after the implementation of command shaping method. As verified in this work, command shaping method is a practical way to control motion with flexible elements without exciting the system's natural frequencies and demanding significantly more computation capability.

KEYWORDS

Command shaping, motion control, vibration control, flexible-joint robot

REFERENCES

Meckl, P. H., and Seering,W. P., 1985. "Minimizing Residual Vibration for Point-to-Point Motion". *Journal of Vibration, Acoustics, Stress, and Reliability in Design, 107, pp. 378–382.*

Beazel, V. M., and Meckl, P. H., 2005. "Command Shaping Applied to Nonlinear Systems with Configuration-Dependent Resonance". *In Proceedings of the 2005 American Control Conference, pp. 539–544*