

Control of flexible mechanical manipulators : a case study

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Control of flexible, mechanical manipulators : a case study

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Abstract

In order to perform practical research on the feasibility of controllers for flexible manipulators, an XY-table with flexible transmissions and joints has been designed and built. The control objective is to make its end-effector, which can move in a 2-dimensional plane of $1 \times 1 \text{ m}^2$, track some desired path as accurately as possible. Possibilities have been provided in the design to modify masses of slides and stiffnesses of the transmissions and a few joints. The control of this manipulator requires at least the measurement of both servomotor positions and the measurement of the X- and Y-coordinate of the end-effector. The end-effector positions are directly measured by an optical laser-measurement system. Two laserbeams are directed at a reflector, mounted on the end-effector, and the position can be calculated from the laserbeam angles. The position measurement accuracy is 0.05 mm and with an AT-compatible personal computer, it is possible to process more than 1000 measurements per second. The control algorithm uses the position and velocity feedback from the measurement system, as well as the servomotor positions and velocities. This form of state feedback is necessary to accurately control the position of the end-effector and maintain the system stability.

In the lecture, some realization aspects of the XY-table and the optical measurement system are discussed. Moreover some results, obtained with a state feedback algorithm for this flexible manipulator are given.