SUMMARY OF Ph.D. DISSERTATION

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Title

Decoupling Identification Method of Two-link Two-inertia System for Robot Motion Control

Abstract

This thesis proposes a decoupling identification method of a two-link two-inertia system modeled for motion control of the main two axes of a SCARA (Selective Compliant Assembly Robot Arm)-type or PUMA (Programmable Universal Manipulation Arm)-type robot.

In the first chapter, two purposes of the decoupling identification method are described. One purpose is estimation of physical parameters such as joint-spring coefficients, motor inertias, link inertias, and joint-friction coefficients in order to realize high-speed and highly precise motion control while suppressing vibration of a robot arm. The other purpose is to show an example of application of the multi-input multi-output state-space system identification theory, using the nonlinear structure of a robot arm and the device of a sensor system for measurement.

In the second chapter, previous studies in this field are surveyed, and the novelty of the decoupling identification method is verified.

In the third chapter, frequency response identification and physical parameter estimation of a single-input and single-output mechanical resonance system are described for preparation of the decoupling method.

In the fourth chapter, the decoupling identification method is described for the two-link two-inertia system. The decoupling identification method using link accelerometer signals enables the two-link two-inertia system to be divided into two linear one-link two-inertia systems. The physical parameters are estimated through the identified one-link two-inertia systems. Experimental results using a planar two-link robot arm showed the accuracy of the decoupling identification method.

In the fifth chapter, the decoupling identification method with closed-loop-controlled elements is described. Although the method was prepared as open-loop identification, it was verified that the method also worked as closed-loop identification. Therefore, it is applicable to a PUMA-type vertical two-link robot arm that needs to maintain the link-posture under gravity.

In the sixth chapter, this thesis is summarized.