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Short paper

Optimal Trajectory Planning for Minimum Vibration of Flexible Redundant Cooperative Manipulators

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Abstract

The optimal path planning for two flexible cooperating manipulators carrying a solid object on a prescribed tip trajectory has been studied using kinematic resolution. The formulation has been derived using the Pontryagin minimum principle that results in a two-point boundary value problem. Also, a numerical technique based on converting the abstract optimization to parametric optimization problem has been proposed. The problem has been solved and compared for globally minimized elastic deformation of flexible links and joints as well as minimization of joints velocities while the end-effector moves along the specified path.
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Keywords

Trajectory planning, redundancy, flexibility, cooperative manipulator

1. Introduction

Most industrial robots are composed of heavy and stiff links to satisfy the required accuracy in robot motion. These links have inherently large inertia, and in turn require more time and power to complete the motion. Hence, most existing manipulators have a very low payload to total weight ratio. To increase productivity by fast motion and to reduce energy consumption, robot arms are required to have light and, consequently, flexible structures. Flexibility in joints is another important problem that exists in almost all robotic systems. The vibration produced by these flexible joints and arms causes difficulty in the robot motion, and leads to error in motion of the manipulator tip, especially when it reaches the desired end point. Thus, an effective method should be employed to reduce this undesired vibration.

The capability of cooperative robot systems to perform complicated, accurate and high performance functions not expected of single robots, such as a high

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