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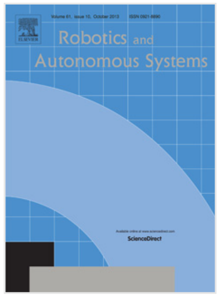

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An Experimental Study on the Vision-based Control and Identification of Planar Cable-Driven Parallel Robots

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Abstract

This paper presents the implementation of a vision-based position control for planar cable-driven parallel robots. The main contribution of this paper contains three objectives. First, a method is used toward kinematic modeling of the robot using four-bar linkage kinematic concept, which could be used in online control approaches for real-time purposes. In order to ensure positive tension in cables, as a basic essential property, static and dynamic equations of robot are also obtained. Second, in order to track the position of End-Effector, an online image processing procedure is developed and implemented. Finally, as the third contribution, different control approaches are applied in order to validate the model with plant and obtain the most promising controller. As classic controller, pole placement approach is suggested and results reveal weaknesses in modeling the uncertainties. Due to the latter incapability, sliding mode controller is utilized and experimental tests represent effectiveness of this method. However, the chattering phenomenon in the beginning of the robot operation is the main insufficiency of this controller. Hence, in order to present a more accurate controller, adaptive sliding mode controller working alongside with an identification method on the model is applied. The provided identification procedure is based on Recursive Least Square approach, which rebates the effects of uncertainties in the parameters of the model. Moreover, results of these controllers confirm accommodation between the model and robot. The proposed procedure could be well applied for any kind of planar cable-driven parallel robot.

Keywords: Cable-driven Parallel Robots, Pole placement controller, Addaptive sliding mode controller, Vision, Control and System Identification.

1. Introduction

Recently, Cable-Driven Parallel Robots (CDPR) have made tremendous inroads into many industrial fields. They are categorized as a subset of parallel robots in which the End-Effecter (EE) is kept uptight using cables instead of rigid links. This reposition in the structure, empowers these robots to endure high values of payload to weight ratio, i.e., they could carry much more loads than their weight, while they are faster than conventional parallel robots [1]. Moreover, they generate larger workspace [2, 3], their shape and size could be adapted while their manufacturing costs are much lower than rigid link robots [4]. Among all these benefits, keeping cables tight is one of the fundamental challenges in CDPR. On the other hand, cables can only exert tension and cannot push the EE. Moreover, bending and

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