

基于模型退化的平面四连杆欠驱动机械系统位置控制

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Position control for planar four-link underactuated mechanical system based on model degeneration

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摘要

图/表

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摘要

针对第2关节为被动的平面四连杆欠驱动机械系统, 提出基于模型退化的分阶段控制策略. 首先, 建立系统的数学模型, 并通过控制第1杆维持初始状态, 使系统模型退化; 然后, 根据第1关节为被动的平面连杆系统的积分特性, 得到系统角度约束关系, 基于角度关系和目标位置, 利用粒子群优化算法获得驱动杆的目标角度; 最后, 基于Lyapunov函数分阶段设计控制律, 实现系统从初始位置到目标位置的控制目标. 仿真结果验证了所提出控制策略的有效性.

关键词: 平面欠驱动机械系统, 模型退化, 位置控制, 粒子群优化算法

Abstract:

A piecewise control strategy is proposed for the planar four-link underactuated system with a passive second joint. Firstly, a mathematical model of the system is built, and it is degenerated by controlling the first link maintaining at the initial state. Then, the angle constraint relationships are obtained by employing the integral characteristics of the planar link system with a first passive joint. The target angles of actuated links are calculated by using particle swarm optimization algorithm based on the angle constraint relationships and target position. Finally, the controllers designed by employing Lyapunov functions achieve the control objective from an initial position to a target position. Simulation results show the effectiveness of the proposed control method.

Key words: planar underactuated mechanical systems model degeneration position control PSO Algorithm

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