

论文与报告

欠驱动三连杆机械臂能量解耦控制策略

赖旭芝, 张镇, 吴敏

1. 中南大学信息科学与工程学院 长沙 410083

收稿日期 2010-6-8 修回日期 2010-9-1 网络版发布日期 接受日期

摘要

针对第二关节为被动的欠驱动三连杆机械臂提出一种能量解耦控制策略. 首先, 将整个运动空间分为摇起区和平衡区, 为了实现快速摇起控制, 进一步将摇起区分为摇起子区间一和摇起子区间二; 其次, 基于Lyapunov函数设计控制律, 使第三杆相对于第二杆处于自然伸展的状态, 即使第三杆角度和角速度收敛为零, 从而解除能量控制与第三连杆姿态之间的耦合; 接着, 在摇起子区间二, 增加系统能量使系统摇起至平衡区附近; 然后, 基于LQR (Linear quadratic regulator)的平衡控制律将系统稳定在竖直向上平衡点; 最后, 用仿真结果验证该控制策略的有效性.

关键词 [欠驱动机械臂](#) [Lyapunov function](#) [能量解耦](#) [LQR](#)

分类号

Energy Decoupling Control Strategy for Three-link Underactuated Manipulator

LAI Xu-Zhi, ZHANG Zhen, WU Min

1. School of Information Science and Engineering, Central South University, Changsha 410083

Abstract

An energy decoupling control strategy is presented for the underactuated three-link manipulator with a passive second joint. Firstly, the motion space is divided into swing-up area and balance area, furthermore, the former is divided into swing-up subspace 1 and swing-up subspace 2 so as to swing up control rapidly. Secondly, a control law based on Lyapunov function is employed to make the third link stretch in a natural way, that is, the angle and angular velocity of the third link converge to zero, which can decouple the energy and the states of the third link in the swing up process. Next, another control law is designed to increase the energy in the swing-up subspace 2 to make the system swing up to the balance area. Then, a balancing control law based on linear quadratic regulator (LQR) stabilizes the system at the upright equilibrium. Finally, some simulation results demonstrate the validity of this method.

Key words [Underactuated manipulator](#) [Lyapunov function](#) [energy decoupling](#) [linear quadratic regulator \(LQR\)](#)

DOI: 10.3724/SP.J.1004.2011.00067

通讯作者 吴敏 min@csu.edu.cn

作者个人主页 [赖旭芝](#); [张镇](#); [吴敏](#)

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