

本期目录 | 下期目录 | 过刊浏览 | 高级检索

[打印本页] [关闭]

微纳技术与精密机械

七自由度冗余机械臂避障控制

姜力, 周扬, 孙奎\*, 刘宏

哈尔滨工业大学 机器人技术与系统国家重点实验室, 黑龙江 哈尔滨 150080

摘要: 基于冗余机械臂零空间的自运动特性, 提出了一种新的七自由度冗余机械臂避障控制方法。该方法引入臂平面和避障面来参数化表达冗余机械臂的零空间运动; 基于这种描述, 利用人工势场法实现碰撞检测; 根据检测结果得出的虚拟排斥力推导零空间运动方程, 改进具有位置内环的逆动力学控制方法, 使机械臂避障时的动态性能具有类似质量-阻尼系统的物理特性。该方法可以在控制末端执行器运动的同时实现冗余机械臂避障。为了验证所提出方法的性能, 利用在轨自维护实验平台完成了实验。实验结果表明, 机械臂与障碍物的最近距离大于40 mm, 末端执行器位置动态误差小于10 mm, 稳态误差小于2 mm。这些结果显示, 所提出的方法通过合理地自运动行为实现了冗余机械臂的避障控制, 而且在避障过程中不影响末端执行器的操作。

关键词: 自运动 冗余机械臂 避障 动力学控制

Obstacle avoidance control for 7-DOF redundant manipulators

JIANG Li, ZHOU Yang, SUN Kui\*, LIU Hong

State Key Laboratory of Robotics and System,  
Harbin Institute of Technology, Harbin 150080, China

Abstract: A new scheme of obstacle avoidance based on the self-motion of a null space was proposed to control 7-degree-of-freedom(DOF) redundant manipulators. By introducing an arm plane and an obstacle avoidance plane, the representation of the null space motion was parameterized. Based on this formulation, the collisions were detected by the artificial potential field method. With computing virtual repulsion forces, an equation of the null space motion was derived. Then, the inverse dynamics control with an inner position loop was modified to allow the manipulators to show physical meaningful behaviors of a mass-damper system, by which the control of end-effector motion and the obstacle avoidance of manipulator could be achieved at the same time. An experiment on a self-servicing experimental platform was carried out to demonstrate the performance of the proposed scheme. The experimental results show that the closest distance between the manipulator and the obstacle is greater than 40 mm, the dynamic error of the end-effector position is less than 10 mm, and the steady-state error is less than 2 mm. These results indicate that the proposed scheme realizes the obstacle avoidance by proper behaviors of the null space motion, and minimizes the effect on the end-effector during the avoidance.

Keywords: self-motion redundant manipulators obstacle avoidance dynamics control

收稿日期 2013-02-25 修回日期 2013-04-15 网络版发布日期 2013-07-15

基金项目:

仿人多指手的多维指尖力感知和同步控制

通讯作者: 孙奎

作者简介: 孙奎(1974-), 男, 黑龙江哈尔滨人, 博士, 讲师, 2008年于哈尔滨工业大学获得博士学位, 主要研究方向为冗余机器人运动学和动力学算法, 以及空间机器人技术。

作者Email: hackerchou@126.com

参考文献:

本刊中的类似文章

1. 张芳, 颜国正, 林良明. 面向多机器人路径规划的一种基于模糊模型的再励函数结构[J]. 光学精密工程, 2002,10(2): 148-153

Copyright by 光学精密工程