

摘 要

机器人是当下最热门的研究领域，也是最具发展前景的应用领域之一。大多数机器人的功能实现，依赖于灵活的底盘系统。基于麦克纳姆轮技术的全向移动底盘可以实现前行、横移、斜行、旋转及其组合等运动方式。这种全向移动的特性是因为麦克纳姆轮具有独特的结构，成角度的周边轮轴把一部分的机轮转向力转化到一个机轮法向力上面。依靠各自机轮的方向和速度，这些力的最终合成在任何要求的方向上产生一个合力矢量从而保证了这个平台在最终的合力矢量的方向上能自由地移动，而不改变机轮自身的方向。在它的轮缘上斜向分布着许多小辊子，故轮子可以横向滑移。小辊子的母线很特殊，当轮子绕着固定的轮心轴转动时，各个小辊子的包络线为圆柱面，所以该轮能够连续地向前滚动。麦克纳姆轮结构紧凑，运动灵活，是很成功的一种全方位轮。有 4 个麦克纳姆轮进行组合，可以更灵活方便的实现全方位移动功能。

本文以麦克纳姆轮全向移动底盘为研究对象，通过前期调研国内外研究现状，分析研究了麦克纳姆轮底盘的优缺点，详细介绍了从结构设计到软件配置的系统开发流程，主要开展了以下工作：

- 1) 分析研究传统汽车悬挂系统的优缺点，设计一款适用于麦克纳姆轮底盘的悬挂，设计并制作一个麦克纳姆轮底盘。
- 2) 设计一款用于控制麦克纳姆轮底盘的主控板。
- 3) 基于 FreeRTOS 实时操作系统进行嵌入式系统的程序设计与开发。
- 4) 测试底盘运动性能，分析问题并提出改进方法。

通过以上工作，改善了麦克纳姆轮全向移动底盘的越野性能和控制效果，使其应用范围更广。

关键词：麦克纳姆轮；底盘悬挂；全向移动；嵌入式开发

ABSTRACT

Robots are currently the hottest research field and one of the most promising applications. The functional realization of most robots relies on a flexible chassis system. An omnidirectional mobile chassis based on Mecanum wheel technology enables forward, traverse, skew, rotation, and combinations thereof. This omnidirectional movement is characterized by the unique structure of the Mecanum wheel, which converts a portion of the wheel steering force to a wheel normal force. Depending on the direction and speed of the respective wheels, the final synthesis of these forces produces a resultant force vector in any desired direction to ensure that the platform can move freely in the direction of the final resultant force vector without changing the direction of the wheel itself. . There are many small rollers distributed diagonally on its rim, so the wheels can slide laterally. The busbar of the small roller is very special. When the wheel rotates around the fixed wheel axle, the envelope of each small roller is a cylindrical surface, so the wheel can continuously roll forward. The Mecanum wheel is a compact, sporty and versatile wheel. There are 4 Mecanum wheels combined to make all-round mobility more flexible and convenient.

This paper takes the Mecanum wheel omnidirectional mobile chassis as the research object. Through the preliminary research on the research status at home and abroad, this paper analyzes the advantages and disadvantages of the Mecanum wheel chassis, and introduces the system development process from structural design to software configuration in detail. The following work is mainly carried out:

- 1) Analyze the advantages and disadvantages of the traditional car suspension system, design a suspension suitable for the chassis of the Mecanum wheel, design and manufacture a Mecanum wheel chassis.
- 2) Design a main control board for controlling the chassis of the Mecanum wheel.
- 3) Program design and development of embedded system based on FreeRTOS real-time operating system.
- 4) Test chassis motion performance, analyze problems and propose improvements.

Through the above work, the off-road performance and control effect of the Mecanum wheel omnidirectional mobile chassis have been improved, and the application range is wider.

KEY WORDS: Mecanum wheel; Chassis suspension; Omnidirectional movement; Embedded development

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