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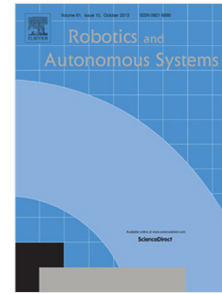
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A Transformable Wheel-legged Mobile Robot: Design, Analysis and Experiment

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Abstract

This paper proposes a new type of transformable wheel-legged mobile robot that could be applied on both flat and rugged terrains. It integrates stability and maneuverability of wheeled robot and obstacle climbing capability of legged robot by means of a wheel-legged transformable mechanism. These two modes can be switched easily with two spokes touching terrain. In this paper, the motion analysis of the proposed robot under wheeled mode, legged mode and transformable mode are carried out after briefly introducing the concept and control system design. Then, the obstacle climbing strategies under wheeled and legged modes are obtained. Finally, a prototype of the proposed robot is designed and manufactured based upon the simulation analysis. And the experiment results validate the effectiveness of the proposed transformable wheel-legged mobile robot.

Keywords: Mobile robot, Transformable wheel-legged robot, Motion analysis, Obstacle avoidance

1. Introduction

As an important branch of service robot, mobile robot has been widely applied and is expected to be used in hazardous and dangerous environment where operators are difficult or cannot reach, such as emergency rescuing, military reconnaissance, aerospace exploration and underground detection [1-2]. Currently, mobile robots can be roughly divided into two types: wheeled and legged robots. Although they have been successfully used in some cases, their applications on rugged and complex terrains are limited. The former is blocked by the wheel radius while the latter is restricted to the complicated control system. Various methods have been proposed to tackle these problems, for instance, special wheel configurations [3-4], passive suspension arrangements [5-7], or specific control strategies [8]. However, it is worth mentioning that either wheeled or legged robots are not suitable for changeable terrains but only for specific ones.

The wheel-legged robot is considered as another alternative solution. This type of robot combines the advantages of wheels and legs, thus improves its maneuverability and passing ability on flat and rugged terrains. Considering this point, the wheel-legged robot has become a research hotspot among academia and industry over the past decades. One of the most popular way to build a wheel-legged robot is based on the traditional wheeled robots. With the improved wheel structure, the wheel-legged robot is able to climb obstacles which are difficult to be surmounted by common wheeled robots. For example, the

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