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Robust Output Trajectory Tracking of Car-Like Robot Mobile

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In this paper, we propose a robust output trajectory tracking based on the differential flatness and the integral sliding mode control of the car-like robot mobile. The trajectory planning and the dynamic linearization are based on the differential flatness property of the robot, whereas the integral sliding mode control is designed to solve the reaching phase problem with the elimination of matched uncertainties and minimization of unmatched one. The effectiveness of the proposed control scheme is demonstrated through simulation studies.

Keywords: Dynamic feedback linearizing, Flatness, Integral sliding mode control, Trajectory tracking, wheeled mobile robot.

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1. Introduction

Wheeled mobile robots (WMRs) have attracted much research due to their theoretically interesting properties and its usefulness in many applications. These robots are a typical example of non-holonomic mechanisms where the constraints imposed on the motions are not integrable resulting from the assumption that there is no slipping of the wheels [1]. The main consequence of a non-holonomic constraint for the WMRs is the no corresponding of each path of the admissible configuration space to a feasible trajectory for the robot. Hence, feasible motion planning of WMRs received considerable attention in the past years. Control of WMRs has also been studied from several points of view, including set point stabilization, trajectory tracking and path following. Among nonlinear control techniques developed for WMRs, we mention: Lyapunov-based nonlinear controllers [2], controls based on backstepping approaches [3], model-based predictive controllers [4], flatness based controls [5], and discontinuous controls [6]. However, for WMRs, the basic limitations in the control design come from their kinematic dynamic as showed in [7].

The flatness property developed by Fliess et al., (1999) [8], as a new concept in automatic, is able to generate a feasible trajectory without integrating the dynamic of the system. Furthermore, the flatness provides a systematic design of linearized endogenous state feedback of the original system. Several real systems had proved to be flat and the flatness appears as a natural property of such systems like Induction Motors, non-holonomic mobile robot, voltage converter, conventional aircraft…etc. The application of the flatness to the control of WMRs is given in [9]–[11].

In the real implementation, it is desired to have an inherently robust control, which provides a fast convergence and good robustness properties with respect to the parameter variation and the external disturbances. The sliding mode control emerges as a robust approach and has been successfully applied to control problems in different real applications [6]. The sliding mode control has many advantages, among them, its finite

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