後退式階層策略實現移動式機械人之適應追蹤控制

Based on Hierarchical Strategy of Adaptive Tracking Control of Mobile Robots Using Backstepping Design

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Abstract

A hierarchical control architecture, divided into upper and lower control levels, for the trajectory tracking control of mobile robots is proposed in this paper. The objective of the upper control level is to navigate the mobile robot on the desired trajectories by means of the kinematic model. A control law based on backstepping techniques is synthesized to make the posture error asymptotically stable. On the lower control level, the dynamic model of the robot is adopted from practical viewpoint. In order to guarantee the global asymptotic stability and demanded performance, a time-varying adaptive tracking control is designed such that the generalized velocities can converge to the upper control level's inputs. A hybrid controller is developed to incorporate the kinematic controller into the dynamic controller to deal with uncertain dynamic parameters of the mobile robot. Simulation results are utilized to illustrate the effectiveness of the proposed control algorithm.

Keywords: Hierarchical Architecture, Mobile Robot, Trajectory Tracking, Backstepping, Kinematic Model, Dynamic Model, Adaptive Control, Time Varying Feedback.

摘　　要

針對移動式機械人的軌跡追蹤問題，本文提出階層式控制架構，將控制器的設計分為低階實體層與高階決策層來處理。決策層的工作目標在導引機械人之軌跡追蹤，採用運動模型進行控制器之設計。基於後退式的理念，以系統化的設計程序建立了全局漸近穩定之時變回授律。至於實體層的設計乃由實務的觀點出發，以動力模型為基礎，建立適應控制法則使得機械人的廣義速度收斂