Adaptive Tracking Control of a Wheeled Mobile Robot

A.A.J. Lefeber and H. Nijmeijer
Department of Applied Mathematics, University of Twente
P.O.Box 217, 7500 AE Enschede, The Netherlands. Fax: +31 53 4340733
Email: {A.A.J.Lefeber,H.Nijmeijer}@math.utwente.nl

Abstract

The stabilization problem for nonholonomic systems has attracted considerable attention of many researchers, see the survey paper [4] and references therein. A major obstacle to the asymptotic stabilization of these systems is that there is no smooth, nor even continuous, time-invariant state-feedback stabilizing control law since these systems fail to satisfy Brockett's necessary condition for feedback stabilization [1].

Only recently, the from an engineering point of view very interesting tracking problem has been addressed in [2, 3] and references therein. Under appropriate assumptions, given a feasible desired trajectory $x_d(t)$ a time-varying control law has been constructed such that the trajectory of the actual system approaches the reference tracjectory, i.e. $\lim_{t\to\infty} |x(t)-x_d(t)| = 0$.

In this talk we will consider the *adaptive* tracking problem for a particular example of a nonholonomic system, namely a simple kinematic model of a mobile robot:

$$\begin{aligned} \dot{x} &= u_1 \cos(\theta + \phi) \\ \dot{y} &= u_1 \sin(\theta + \phi) \\ \dot{\phi} &= u_2 \\ \dot{\theta} &= \frac{1}{L} u_1 \sin \phi \end{aligned}$$

Here L is the length of the mobile robot, a parameter that is assumed to be unknown. Therefore, in contrast to [2, 3] it is not possible to formulate the problem as tracking of a desired trajectory $(x_d, y_d, \phi_d, \theta_d)$. This is due to the fact that by specifying a desired trajectory $(x_d, y_d, \phi_d, \theta_d)$ we need to know L exactly.

References

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