Bounded Tracking Control of a Wheeled Mobile Robot

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Abstract

The stabilization problem for nonholonomic systems has recently attracted considerable attention of many researchers, see the survey paper [3] and referenced cited 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]. A particular example of a nonholonomic system is the kinematic model of a two wheel mobile robot:

$$\dot{x} = \nu\cos(\theta) \qquad \dot{y} = \nu\sin(\theta) \qquad \dot{\theta} = \omega$$

Apart from the stabilization problem, the from an engineering point of view very interesting tracking problem for mobile robots has been addressed quite rarely. We consider the problem of tracking a desired trajectory (x_d, y_d, θ_d) while keeping the applied inputs within in advance specified bounds, that is $|\nu(t)| \leq \nu_{max}$ and $|\omega(t)| \leq \omega_{max}$ for all $t \geq 0$.

Using Lyapunov's direct method we were able to show semi-global convergence to the reference trajectory while satisfying the input constraints. This result will be illustrated by means of some simulation examples.

References

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