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Integrator backstepping for uncertain nonlinear systems with non-smooth dynamics ☆

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Abstract

We solve the problem of global input-to-state stabilization with respect to external disturbances for a class of nonlinear systems with unknown parameters. For this class, the classical backstepping framework is not applicable and needs to be redesigned because of the following obstacles: (a) the systems under consideration are not in strict-feedback form, are not feedback linearizable and their input-output maps are not invertible, and (b) the dynamics is non-smooth and the trajectories starting from an initial point are not necessarily uniquely defined.

Keywords: nonlinear systems, stability, backstepping

1. Introduction

Design of controllers, when the dynamics of a system has some unknown parameters (adaptive control) or it is affected by some external disturbances (robust control), is important in many applications. For the triangular form (TF) systems introduced in [12]

$$\dot{x}_1 = f_1(t, x_1, x_2), \quad \dot{x}_2 = f_2(t, x_1, x_2, x_3), \ \ldots, \ \dot{x}_n = f_n(t, x_1, \ldots, x_n, u),$$

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