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ROBUST H_∞ CONTROL FOR A CLASS OF CASCADE SWITCHED NONLINEAR SYSTEMS

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Abstract. This paper focuses on the problem of robust H_∞ control for a class of cascade switched nonlinear systems with norm-bounded time-varying uncertainties. Sufficient conditions for the solvability of the robust H_∞ control problem and design of both switching laws and hybrid state feedback controllers are presented via the single Lyapunov function approach and the multiple Lyapunov functions approach respectively. As a direct application, a hybrid state feedback strategy is proposed to solve the robust H_∞ control problem for nonlinear systems when no single controller is effective.

Keywords. Cascade switched nonlinear systems, robust H_∞ control, single Lyapunov function, multiple Lyapunov functions.

AMS (MOS) subject classification: 93C15, 93D15, 93D05.

1 Introduction

Recently, considerable attention has been paid to switched systems for their theoretical significance and practical applications [see 1-3 and the references cited therein]. Many systems encountered in engineering practice exhibit switching between several subsystems depending on various environmental factors [4-7]. The motivation for studying switched systems also arises from the fact that the methods of intelligent control design are mainly based on the idea of controller switching [8].

The studies of switched systems mainly focus on the stability issue [9-16]. The existence of common Lyapunov function for all subsystems gave a necessary and sufficient condition for a switched system to be asymptotically stable under arbitrary switching law [3]. A number of techniques have been proposed to assure such a Lyapunov function [9, 10]. But most switched systems in practice may not exist or be difficult to find such common Lyapunov function, yet still may be asymptotically stable under some properly chosen switching law. A typical methodology frequently used is the single Lyapunov