

Variable Structure MRAC For a Class of MIMO Systems

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Abstract

A Variable Structure Model Reference Adaptive Controller using state variables is proposed for a class of multi input–multi output systems. Adaptation law is of variable structure type and switching functions is designed based on stability requirements. Global exponential stability is proved based on Lyapunov criterion. Transient behavior is analyzed using sliding mode control and shows perfect model following at a finite time.

Key-Words: adaptive control, model reference, variable structure, MIMO system.

Introduction

Model Reference Adaptive Controller with conventional continuous adaptation laws has been investigated extensively in the literatures in two main branches: one assuming full state accessibility [7], and the other assuming accessibility of input and output [7]. Continuous adaptation laws are in the form of pure integral actions and have some problems such as:

- I. Transient behavior is difficult to analysis.
- II. Only global (but not asymptotic) stability has been guaranteed.
- III. Undesirable transient responses and tracking performance.
- IV. Lack of robustness.

The variable structure systems (VSS) have been studied in great details in the literatures [4, 6, 8]. The basic concept of the variable structure control is that of sliding mode control. switching control functions are generally designed to generate sliding surfaces, or sliding modes, in the state space [8]. When this is attained, the switching functions keep the trajectory on the sliding surfaces and the closed loop system becomes insensitive, to a certain extent, to parameter variations and disturbances.

Some authors have applied the variable structure control (VSC) to adaptive control, for full states accessible systems [1, 5], and for only input – output measurable systems [2, 3]. A tutorial account of VSC is presented by Hung [4].

In this article, we proposed a design and analyze a variable structure model reference adaptive controller for a class of multi input multi variable systems. The control law and the general structure of switching functions (adaptation laws) are designed based on stability criterion. Exponential stability is assured and exponential attractiveness to the origin is independent of sliding mode be reached. Then the magnitudes of

switching functions are chosen based on reaching conditions for sliding mode. Realization procedure will be easy to perform and the controller has good transient behavior and is insensitive with respect to input disturbances and parameter variations.

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