Stability of Dynamic Systems on the Time Scales

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Abstract: The paper dwells on the problems of stability of dynamical systems on a time scale. The paper is divided into the following sections: local existence and uniqueness, dynamic inequalities, existence of extremal solutions, comparison results, linear variation of parameters, nonlinear variation of parameters, global existence and stability, comparison theorems, stability criteria, etc.

Keywords: Dynamical systems on a time scale; stability.


1 Introduction

In both natural and engineering systems the lowest level is usually characterized by continuous variable dynamics and the highest by a logical decision making mechanism. The interaction of these different levels, with their different types of information, leads to a hybrid system. Many complicated control systems today (e.g. those for flight control, manufacturing systems, and transportation) have vast amount of computer code at their highest level. More pervasively, programmable logic controllers are widely used industrial process control. Virtually all control systems today issue continuous variable controls and perform logical checks that determine the mode, and hence the control algorithms the continuous variable system is operating under at any given moment.

Hybrid control systems are control systems that involve both continuous systems that involve both continuous and discrete dynamics and continuous and discrete controls. The continuous dynamics of such a system is usually modeled by a controlled vector field or difference equation. Its hybrid nature is expressed by a dependence on some discrete phenomena, corresponding to discrete states, dynamics and controls. The prototypical hybrid systems are digital controllers, computers, and subsystems modeled as finite automata coupled with controllers and plants modeled by partial or ordinary differential equations or difference equations. Thus such systems arise whenever one mixes logical decision making with continuous control laws. More specifically, real world examples