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STABILITY THEORY FOR FIRST ORDER NONLINEAR MATRIX DIFFERENTIAL EQUATIONS

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Abstract. In this article an attempt has been made to study the stability theory for first order nonlinear matrix differential equations (MDEs). We first develop the comparison result and then study the various stability results for first order nonlinear MDEs using Lyapunov function. Our results are also illustrated by some numerical examples.

Keywords. Matrix differential equation, Class of functions, Lyapunov function, Lipschitz condition, Comparison result, Stability Criteria.

AMS (MOS) subject classification: 34A12, 34A34

1 Introduction

Solving a system of first-order differential equations is generally more straightforward than solving an equivalent higher-order differential equation. Consequently, matrix differential equations offer an efficient and systematic framework for handling such systems. MDEs provide a powerful tool for representing and solving multiple first-order equations simultaneously, there by avoiding the complexity associated with a single higher-order equation.

Matrix differential equations play a crucial role in various fields, including engineering, control systems, physics, biology, medicine, finance, ecology, and mechanical systems. The basic theory of first order nonlinear MDEs along with the existence and uniqueness of solution was established in [9, 10], based on the concepts introduced in [1]. It is well known that, the stability theory of nonlinear differential equations deals with the behavior of the solutions of MDE w.r.t small changes in initial conditions. Among the available techniques, Lyapunov's second method is one of the most effective technique for studying the stability of nonlinear differential equations [2, 3]. Further, the