

NONUNIFORM STABILITY AND BOUNDEDNESS CRITERIA FOR FIRST ORDER NONLINEAR MATRIX DIFFERENTIAL EQUATIONS

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Abstract. In this paper, an attempt has been made to study the nonuniform stability and boundedness criteria for the solutions of first order nonlinear matrix differential equations (MDEs), using the method of perturbed Lyapunov functions, under weaker assumptions.

Keywords. Matrix differential equation, Lyapunov function, Equi-stability, Uniform stability, Nonuniform stability, Boundedness.

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1 Introduction

Matrix differential equations play a vital role in modelling complex dynamical processes across engineering, applied mathematics, control theory, and related disciplines. The fundamental theory of nonlinear MDEs along with the existence and uniqueness of solution was established in [9, 10, 11], based on the concepts introduced in [1]. It is well known that the stability theory of nonlinear differential equations focuses on understanding how solutions react to slight variations in initial conditions. Also Lyapunov's second method is one of the most effective technique for studying the stability of nonlinear differential equations [2]. Further, the Lyapunov function can be utilized to define a generalized distance and can be employed to study various qualitative and quantitative properties of dynamic systems. Also, Lyapunov function serves as a vehicle to transform a given complicated differential system into a relatively simpler system and as a result, it is enough to study the properties of solutions of the simpler system.

Utilizing the concepts in [3, 4, 5, 8], the authors studied various stability definitions and also developed stability results of first order nonlinear MDEs in [12]. In this paper, using the approach in [6, 7], we propose to study the