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VARIATION OF PARAMETERS AND HÖLDER-TYPE STABILITY IN DIFFERENTIAL SYSTEMS WITH INITIAL TIME DIFFERENCE

Coskun Yakar[1] and Dilara Karslioglu[2*]

*Corresponding author E-mail: dilara.karslioglu@yeditepe.edu.tr
[1]Department of Mathematics
Gebze Technical University, Kocaeli, Turkey

[2]Department of Mathematics
Yeditepe University, Istanbul, Turkey

Abstract. In this study, we explore the connection between perturbed and unperturbed differential systems that exhibit variations in both their initial conditions and the starting time. Through the application of variation of parameters methods, we construct integral representations that reveal this relationship. To formulate Hölder-type stability criteria in the presence of an initial time shift in nonlinear differential systems, it is essential to employ the variational framework derived from the unperturbed model.

Keywords. Differential equations, initial time difference, Hölder stability, variation of parameters, stability analysis.

AMS (MOS) subject classification: 34D10, 34D20, 34D99.

1 Introduction

The variation of parameters formula (VPF) has long been recognized as a valuable analytical approach within the qualitative study of nonlinear differential equations, particularly due to its effectiveness in examining the characteristics of their solutions. Recent studies, as referenced in [1–3], have initiated a line of research focusing on nonlinear systems and initial value problems in the absence of an initial time difference (ITD), along with the development of related theories involving differential inequalities. In the forthcoming sections, we derive VPF-based formulations that establish links between unperturbed systems with differing initial data, as well as between unperturbed and perturbed models under non-identical initial conditions.

The dynamic properties of differential equations have been the subject of substantial qualitative analysis. In particular, initial value problems influenced by spatial perturbations—while maintaining a fixed initial time—have been widely studied, as discussed in [1–3, 6, 7]. More recently, researchers have turned their attention to systems characterized by both spatial deviations and discrepancies in the initial time. This line of inquiry is commonly