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STABILITY OF IMPULSIVE DELAY DIFFERENCE EQUATIONS AND ITS APPLICATIONS IN NUMERICAL METHOD

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Abstract. In this paper, the exponential stability of impulsive delay difference equations is studied and the stability of the Euler method is considered for a linear impulsive delay differential equation. Using the Lyapunov function and Razumikhin technique, criteria for exponential stability of impulsive delay difference equations are established. As an application, the Euler method for impulsive delay differential equations is considered. By means of the results we got for impulsive delay difference equations, we obtain sufficient conditions which guaranteeing the exponential stability of the Euler method. Finally, an example is given to illustrate the results.

Keywords. Impulsive delay difference equations; Impulsive delay differential equations; Exponential stability; Lyapunov-Razumikhin technique; Euler method.

AMS (MOS) subject classification: 39A30; 65L20.

1 Introduction

Impulsive effects widely exist in many scientific fields, such as biology, control science, economics, physics and so on. Impulsive differential equations(IDEs) and impulsive delay differential equations(IDDEs) have been studied by many authors[2,4,6,8−13,15]. However, the numerical methods for IDEs and IDDEs were seldom considered[5,7]. It is important to investigate the numerical methods for IDEs and IDDEs, because, most of the time, it is hard to get explicit solutions for these equations.

Difference equations arise in the description of discrete events. They are important tools in scientific research. The theories of difference equations are abundant, see [3,14] and the references therein. Moreover, when we consider the numerical methods for differential equations by finite difference method, it is natural to deal with the difference equations.

In terms of the above reasons, we know that it is necessary to study the properties of impulsive delay difference equations and investigate the numerical methods for IDDEs. There are few papers on impulsive delay difference equations [16] and, to our best knowledge, there is no paper on the