Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **22 (2015)** 163-197

EXISTENCE AND UNIQUENESS OF SOLUTIONS OF GENERAL IMPULSE EXTENSION EQUATIONS WITH SPECIFICATION TO LINEAR EQUATIONS

K.E.M. Church and R.J. Smith?

Department of Mathematics and Statistics
University of Ottawa, Ottawa, Canada

Abstract. Analogues of the classical existence and uniqueness of solutions are proven for impulse extension equations. An exposition on matrix solutions, their properties and Floquet's theorem for periodic linear systems is provided, including applications to stability. Where applicable, comparison is made to the analoguous results from impulsive differential equations.

Keywords. Impulsive differential equation, impulse extension, predictable set, matrix solution, fundamental matrix, periodic solution, Floquet's theorem.

AMS (MOS) subject classification: 34A36, 34A37.

1 Introduction

Impulsive differential equations have a host of applications to both biological and physical problems [8, 12, 15, 18, 19, 24, 25, 27, 28]. Classic monographs on the subject (see, for example, [13, 23]) preface the exposition of the theory by writing that it is often natural to assume that sufficiently short perturbations in the system occur instantaneously, since their length is negligible in comparison with the duration of the process. A key part of the study of these equations is the existence, uniqueness and stability of their periodic solutions.

In the past few decades, many advances have been made in the theory of impulsive differential equations (see [7, 14, 17, 22, 26, 29] among others) and impulsive semidynamical systems ([2, 3, 4, 16]). The theory has therefore undergone extensive research; as such, scientists and those in industry have many tools with which to analyze mathematical models formulated in terms of impulsive differential equations.

In modelling with impulsive differential equations, the standing hypothesis is that these models can accurately describe continuous phenomena if the the impulse effects occur during "short" periods of time in comparison the overal dynamic process, to such a degree that they can be assumed to occur