Controllability of Second Order Delay Integrodifferential Systems in Banach Spaces

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Abstract. Sufficient conditions for controllability of second order delay integrodifferential systems in Banach spaces are established. The results are obtained by using the theory of strongly continuous cosine family of operators and the Schaefer fixed point theorem.

Key words. Controllability, Second order delay differential system, Schaefer's theorem.

1991 AMS Subject Classification: 93B05

1.Introduction

Controllability of linear and nonlinear systems represented by ordinary differential equations in finite dimensional space has been extensively studied. Several authors have extended the concept to infinite dimensional systems in Banach Spaces with bounded operators. Chukwu and Lenhart [3] have studied the controllability of nonlinear systems in abstract spaces. Naito [7,8] has studied the controllability for semilinear systems and nonlinear Volterra integrodifferential systems. Quinn and Carmichael [11] have shown that the controllability problem in Banach spaces can be converted into one of a fixed-point problem for a single-valued mapping. Balachandran et al [1] established sufficient conditions for controllability of nonlinear integrodifferential systems in Banach spaces.

In many cases it is advantageous to treat the second order abstract differential equations directly rather than to convert them to first order systems. For example Fitzgibbon [4] used the second order abstract differential equations for establishing the boundedness of solutions of the equation governing the transverse motion of an extensible beam. A useful tool for the study of abstract second order equations is the theory of strongly continuous cosine families. We will make use of some of the basic ideas from cosine family theory [13,14]. Motivation for second order systems can be found in [5,6]. Recently, Park et al [10] have discussed the controllability of second order nonlinear systems in Banach spaces with the help of the Schauder fixed point theorem. The purpose of this paper is to study the controllability of second order integrodifferential systems in Banach spaces by using the Schaefer theorem .