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COMPARING A SINGULAR LINEAR DISCRETE TIME SYSTEM TO NABLA DIFFERENCE EQUATIONS OF FRACTIONAL ORDER

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Abstract: In this article we focus our attention on the relation between a singular linear discrete time system and a singular linear system of fractional nabla difference equations whose coefficients are square constant matrices. By using matrix pencil theory, first we give necessary and sufficient condition to obtain a unique solution for the continuous time model. After by assuming that the input vector changes only at equally space sampling instants, we shall derive the corresponding discrete time state equation which yield the values of the solutions of the continuous time model which will connect the initial system to the singular linear system of fractional nabla difference equations.

Keywords: linear state space equations, pencil, discrete time system, matrix differential equations, fractional.

1 Introduction

Many authors have studied singular continuous, see [5, 8, 9, 40, 43, 44, 46, 48, 50, 51, 52, 55] & discrete time systems, see [1, 10, 11, 12, 13, 14, 15, 16, 17, 41, 42, 49, 58, 59, 62]. There are also many interesting results with applications in macroeconomics, see [3, 32, 33, 34, 35, 36, 60], and in engineering problems such as materials science, see [4, 28, 37, 38], electrical power systems, see [31, 56, 57]. Many of these results have already been extended to systems that use the fractional nabla operator, see [19, 21, 22, 23, 24, 25, 26, 29] as well as other constructed fractional operators continues & discrete, see [2, 18, 20, 54], that are useful for applications in engineering and physics, see [45, 47, 53]. The study of singular systems often requires optimization techniques, see [7, 27, 30]. In this article, our purpose is to study the relation between a singular linear discrete time system and a singular linear system of fractional nabla difference equations whose coefficients are square constant matrices, into the mainstream of matrix pencil theory. We consider the singular matrix equation

$$FY'(t) = GY(t) + BV(t) \tag{1}$$