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A GENERALISED LINEAR SYSTEM OF DIFFERENCE EQUATIONS WITH INFINITE MANY SOLUTIONS

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Abstract: In this article we study a class of generalised linear systems of difference equations with given non-consistent initial conditions and infinite many solutions. We take into consideration the case that the coefficients are square constant matrices with the leading coefficient singular. We provide optimal solutions and numerical examples to justify our theory.

Keywords: singular, system, difference equations, linear, discrete time system.

1 Introduction

Many authors have studied generalised discrete & continuous time systems, see [1-27], and their applications, see [28-37]. Many of these results have already been extended to systems of differential & difference equations with fractional operators, see [38-47]. We consider the generalised discrete time system of the form

$$FY_{k+1} = GY_k + V_k, \quad k = 1, 2, ..., \tag{1}$$

and the known initial conditions (IC)

$$Y_0. \tag{2}$$

Where $F, G \in \mathbb{R}^{r\times m}$, $Y_k \in \mathbb{R}^m$, and $V_k \in \mathbb{R}^r$. The matrices F, G can be non-square ($r \neq m$) or square ($r = m$) with F singular (det$F$=0).

Generalised linear systems of difference equations with given initial conditions don't always guarantee to have unique solution. In the case where there exist solutions and they are infinite, we require optimal solutions for the system. The aim of this paper is to generalise existing results regarding the literature. An explicit and easily testable formula is derived of an optimal solution for the system.