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STATE AND INPUT ESTIMATION FOR A CLASS OF DISCRETE SINGULAR SYSTEMS WITH MULTIPLE TIME-DELAYS AND UNKNOWN INPUT[1]

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Abstract. This paper considers the problem of state and input estimation for a class of discrete singular system with multiple time-delays and unknown inputs. Under some general assumptions, an equivalent standard discrete-time state space without delay is derived for the purpose of the observer design via one input-state nonsingular transformation. The observer of the discrete singular system with multiple delays can be obtained by designing the observer of the equivalent system.

Keywords. discrete-time linear systems, singular system, time-delay system, state and input estimation, unknown input.

AMS (MOS) subject classification: 93B17, 93C05, 93C41, 93C55

1 Introduction

The problem of observer design for linear systems with unknown inputs has attracted considerable attention in the last two decades. Since disturbances or inputs are undetectable in many circumstances, discussion of the problem is of great importance both in theory and engineering practice . For standard state spaces systems without delays, many excellent results have been given [5,8,15]. Meanwhile, singular systems have comprehensive practical background such as power systems[7,16], social economic systems[12], circuit systems[13], and so on. Great progress[1,2] has been made in the theory and application since 1970s. [18] applied an innovation analysis method together with an output predictor to obtain a unified solution to state estimations. The estimators are derived directly by using the projection theory and innovation analysis method, without the need to transform the singular system into an equivalent nonsingular system in [19]. Because the solution of singular systems includes the derivative and derivatives of high order of inputs and is very sensitive to slight input changes, it is more difficult to reconstruct

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