

# OBSERVER DESIGN FOR NONSQUARE DESCRIPTOR SYSTEMS WITH UNKNOWN INPUTS VIA A NONSINGULAR TRANSFORMATION

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**Abstract.** In this paper, the problem of inputs decoupled observer design for nonsquare descriptor systems with unknown inputs is investigated via a transformation. Based on the constructive characteristic of descriptor systems and some general assumptions, a nonsingular transformation of the input-state pair of descriptor systems is introduced, which transforms the nonsquare descriptor system with unknown inputs into a standard state-space system with its inputs exactly known. It provides a new and simpler method to construct the observer for nonsquare descriptor systems with unknown inputs by using traditional methods for standard state-space systems. The sufficient conditions for the existence of the observer for nonsquare descriptor systems with unknown inputs are also given. With these, a unified design procedure for two classes of observers named Luenberger observer and the finite time observer is derived in this paper. Study on examples with simulations shows that the observer design method proposed in this paper works very well.

**Keywords.** Nonsquare descriptor systems, unknown inputs estimation, nonsingular transformation, observer.

## 1 Introduction

The problem of observer design for linear systems with unknown inputs (UI) has received considerable attention in the last three decades. This problem is of great importance in theory and practice, since there are many situations where disturbances or partial inputs are not measurable. Recently, much work has been devoted to the observer design for standard state-space systems with UI (Kudva *et al.* 1980,