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Observer Design for Descriptor Systems with Lipschitz Nonlinearities: an LMI Approach

M. K. Gupta[1], N. K. Tomar[1]* and S. Bhaumik[2]

[1] *Department of Mathematics, Indian Institute of Technology Patna 800013, India.*
[2] *Department of Electrical Engineering, Indian Institute of Technology Patna 800013, India.*

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Abstract: In this paper, a method is proposed to design asymptotic observers for a class of semilinear descriptor systems satisfying the complete detectability condition on the corresponding linear part. The method is based on the properties of restricted system equivalent, derived here from a given descriptor system by means of simple matrix theory. Using restricted system equivalent form, coefficient matrices of the proposed observer have been synthesized by linear matrix inequality (LMI) approach based on the Lyapunov stability theory.

Keywords: *descriptor system; Lipschitz continuity; observer design; detecability.*

Mathematics Subject Classification (2010): 93C10, 93C35, 93D20.

1 Introduction

In the last three decades, considerable amount of research was focused on the analysis, design, and numerical simulation techniques for descriptor systems, which arise in modeling of many real and practical systems, e.g. electrical network analysis, power systems, constrained mechanics, economic systems, chemical process control, see, [1–7] and the references therein. Depending on the area, descriptor systems are termed by a variety of names, *viz.* differential algebraic equations (DAEs), singular, implicit, generalized state space, noncanonic, degenerate, semi-state and nonstandard systems. In this paper, we consider the following semilinear system:

$$E^*\dot{x} = A^*x + B^*u + D^*f(Hx, u, t), \tag{1a}$$

$$y = Cx, \tag{1b}$$

* Corresponding author: mailto:nktomar@iitp.ac.in