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ON LYAPUNOV THEOREMS FOR DESCRIPTOR SYSTEMS

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Abstract. In this paper, based on the definition of pseudo-observability for a descriptor system, the relationship between observability and admissibility is established by means of a generalized Lyapunov equation. The H_2 norm of the system is computed using this Lyapunov equation. A static output feedback is designed which guarantees the admissibility of the resulting closed-loop system. Two examples are given to illustrate the main results in this paper.

Keywords. Descriptor systems, pseudo-observability, pseudo-controllability, admissibility, Lyapunov equations.

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1 Introduction

For a standard state space system of the form

$$\begin{aligned} \Sigma_0: \qquad \dot{x}(t) &= Ax(t) + Bu(t), \\ y(t) &= Cx(t), \end{aligned}$$

where $x \in \mathbb{R}^n$, $u \in \mathbb{R}^m$, $y \in \mathbb{R}^p$ are state, control input and measured output, respectively; A, B, C are all constant real matrices of compatible sizes, the following result is well-known.

Proposition 1 *For the system Σ_0, when any two of the following statements hold, the third is true:*

- *Σ_0 is observable.*
- *Σ_0 is asymptotically stable.*
- *There exists a symmetric positive definite matrix $V > 0$ satisfying the following Lyapunov equation*

$$A^T V + VA = -C^T C. \tag{1}$$