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SINGULAR CONTROL SYSTEMS

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Abstract. Singular systems are those the dynamics of which are governed by a mixture of algebraic and differential equations. The complex nature of singular systems causes many difficulties in the analytical and numerical treatment of such systems, particularly when there is a need for their control. In that sense the question of their stability deserves great attention. A brief survey of the results concerning the Lyapunov and finite time stability of a particular class of these systems, are presented as the basis for their high quality dynamical investigation.

Keywords. Singular systems, Lyapunov stability, Lyapunov matrix equation, Finite and practical stability

1 Introduction

Singular systems are those the dynamics of which are governed by a mixture of algebraic and differential equations.In that sense the algebrac equations represent the constraints to the solution of the differential part.

These systems are also known as descriptor, semi-state and generalized systems arise naturally as a linear approximation of systems models, or linear system models in many applications such as electrical networks, aircraft dynamics, neutral delay systems, chemical, thermal and diffusion processes, large-scale systems, interconnected systems, economics, optimization problems, feedback systems, robotics, biology, etc..Although singular systems are mostly present in electric and electro-magnetic circuits, in the sequel, will be shown their application in chemical and process technology.

2 Notations and preliminaries

Consider linear singular systems represented, by

$$E\dot{\mathbf{x}}(t) = A\mathbf{x}(t)\,, \quad \mathbf{x}(t_0) = \mathbf{x}_0 \tag{2.1}$$

$$\mathbf{y}(t) = C\mathbf{x}(t)\,, \tag{2.2}$$

or

$$E\dot{\mathbf{x}}(t) = A\mathbf{x}(t) + B\mathbf{u}(t)\,, \quad \mathbf{x}(t_0) = \mathbf{x}_0 \tag{2.3}$$

$$\mathbf{y}(t) = C\mathbf{x}(t)\,, \tag{2.4}$$