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NON-LYAPUNOV STABILITY OF LINEAR SINGULAR SYSTEMS: A QUITE NEW APPROACH IN TIME DOMAIN

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Abstract. The main features of Non - Lyapunov stability concept have been extended to the linear regular time-invariant singular systems operating in free regime. In comparison to the previous results, based on Lyapunov-like concept and matrix measure approach a quite new idea has been applied yielding the sufficient conditions of this type of stability for above mentioned class of systems. Brief discussion on derived results is given.
Definition and corresponding theorem were stated and proved for a general class of autonomous linear singular systems, which guarantee theirs finite time stability on time - invariant sets in state space. Presented results need not calculation of so called Drazin inverse, what enables one to get the easiest form of solutions as well the quick check of results derived. In comparison with the previous results this one is less conservative what can be shown by numerical examples.

Keywords. Singular control systems, Non - Lyapunov stability, Finite - time stability,

1 Introduction

In practice one is not only interested in system stability (e.g. in sense of Lyapunov), but also in bounds of system trajectories. A system could be stable but completely useless because it possesses undesirable transient performances. Thus, it may be useful to consider the stability of such systems with respect to certain sub-sets of state-space, which are a priori defined in a given problem. Besides that, it is of particular significance to concern the behavior of dynamical systems only over a finite time interval.

These boundness properties of system responses, i. e. the solution of system models, are very important from the engineering point of view. Realizing this fact, numerous definitions of the so-called technical and practical stability were introduced. Roughly speaking, these definitions are essentially based on the predefined boundaries for the perturbation of initial conditions and allowable perturbation of system response. In the engineering applications of control systems, this fact becomes very important and sometimes crucial, for the purpose of characterizing in advance, in quantitative manner, possible deviations of system response.