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ROBUST IMPULSE-ELIMINATING CONTROL FOR DESCRIPTOR SYSTEMS

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Abstract. In this paper, problems concerning robust impulse elimination for descriptor systems are considered. First, the concept of impulse margin is studied and based on which an upper bound is provided for the size of unstructured perturbations such that the descriptor system is guaranteed to be impulse-free. It is established that an arbitrarily large impulse margin may be specified provided that the descriptor system is both controllable and observable at infinity in the sense of Rosenbrock. This gives a new interpretation on controllability (observability) at infinity for descriptor systems as a counterpart of the arbitrary finite pole assignment of R-controllable descriptor systems. Then an output-feedback controller is synthesized to eliminate the impulses. It is also shown that a stabilizing state feedback controller can be designed after the impulses are eliminated with a specified perturbation margin against impulsive behaviour. Numerical optimization procedures are provided for maximizing or achieving a certain impulse margin of a descriptor system. Finally, a numerical example is given to illustrate the methodology presented in the paper.
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1 Introduction

It is well known that impulsive behavior is a special feature of continuous-time descriptor systems [1, 4]. A significant amount of research works on descriptor systems have been focused on investigating such behavior and its connections to control problems. In this respect, many results related to impulse controllability/observability [3], impulsive decentralized fixed modes [2], impulsive decentralized controllability/observability [12] and their applications to control system design have been obtained. In controlling an impulsive descriptor system, the undesirable impulses, if exist, are invariably eliminated by feedback whenever possible. If a descriptor system is impulse controllable/observable, one can find a state-feedback/output-injection control to eliminate the impulses [4]. Since almost any practical systems are subjected to some uncertainties [5], which may take the form of structured or unstructured perturbations on the nominal systems, robust performance