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STATE FEEDBACK H_2 OPTIMAL CONTROLLERS UNDER REGULATION CONSTRAINTS FOR DESCRIPTOR SYSTEMS

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Abstract. *This paper is concerned with a non-standard multi-objective state feedback control problem for continuous descriptor systems. In this problem, an output is to be regulated asymptotically with presence of an infinite-energy exo-system, while a desired H_2 performance from a finite external disturbance to a tracking error has also to be satisfied. Thanks to the descriptor framework, not only unstable but also nonproper behaviors can be treated. A parametrization of all optimal dynamic and static controllers solving the proposed multi-objective control problem is given. Moreover, an application to the non-standard LQR problem is investigated. A numerical example shows the efficiency of the proposed results.*
Keywords: Asymptotic regulation, Controller parametrization, Descriptor systems, H_2 optimal control

1. **Introduction.** Descriptor (or singular) systems have been attracting the attention of many researchers over recent decades due to their capacity to preserve the structure of physical systems and describe non-dynamic constraints and impulsive behaviors [1, 2]. These systems arise in large-scale systems networks [3], circuits [4], boundary control system [5] and power systems. A number of control issues have been successfully extended to descriptor systems and the related results have been reported, for instance, in [1, 2, 6, 7, 8, 9, 10, 11, 12] and the references therein.

On the other hand, the regulation problem (or asymptotic tracking/rejection problem) plays an essential role in control theory, and has been studied by many scholars. The seminal result, known as the *Internal Model Principle*, was developed in the 1970s [13, 14] to deal with such a problem. Based on this principle, exact asymptotic rejection is achieved by a structured controller containing a copy of the dynamics of the exo-system. Moreover, extensions of this scheme have been considered by integrating other performance objectives, for instance, H_2 and H_∞ performance. Such multi-objective problems have been extensively investigated in the literature; e.g., see [15, 16, 17, 18, 19] and the references therein. An alternative method for solving these problems consists in reformulating the problems through the use of unstable weighting filters [20, 21]. Moreover, the regulation problem for descriptor systems has also been studied. For example, in [2], the author has provided a solution to this problem in terms of a set of nonlinear matrix equations depending on system parameters and some other parameters. In [22], via solving a generalized Sylvester eqaution, Lin and Dai have investigated the regulation problem for the special case where the measurement output is identical to the vector to be regulated. However, to the best of the authors' knowledge, little attention has been paid to the performance control problem under regulation constraints for descriptor systems, except for the results