ROBUST EIGENVALUE ASSIGNMENT IN DESCRIPTOR SYSTEMS  
VIA OUTPUT FEEDBACK  
Guang-Ren Duan, James Lam, and Guo-Ping Liu  

ABSTRACT  

Based on a recently proposed parametric approach for eigenstructure assignment in descriptor linear systems via output feedback, the robust eigenvalue assignment problem in descriptor linear systems via output feedback is solved. The problem aims to assign a set of finite closed-loop eigenvalues which have minimum sensitivities with respect to perturbations in the closed-loop coefficient matrices, while at the same time, guarantee the closed-loop regularity. The approach optimizes the design parameters existing in the closed-loop eigenvectors to achieve the minimum eigenvalue sensitivities, and use the extra degree of freedom existing in the solution of the gain matrix to further minimize the magnitude of the gain matrix and enhance the robustness of the closed-loop regularity. The approach allows the finite closed-loop eigenvalues to be optimized within desired regions, and is demonstrated to be simple and effective.

KeyWords: Descriptor systems, output feedback, robust pole assignment, eigenvalue sensitivities, eigenstructure assignment.

I. INTRODUCTION

As is well known, solution to the problem of eigenvalue assignment in a multi-variable linear system is generally not unique. This fact was known in the early 70s but has only been fully revealed by recent parametric eigenstructure assignment approaches in [1-12]. The degrees of freedom provided by parametric eigenstructure assignment may be used to achieve some desired system specifications. Such an idea has resulted in many applications of parametric eigenstructure assignment ([1], and [13-16]). By making use of these degrees of freedom in eigenvalue assignment in multivariable linear systems, the closed-loop eigenvalues may be made as insensitive as possible to perturbations in the components of the closed-loop system coefficient matrices. This problem is known, in the literature, as robust pole assignment, and has been extensively studied by many authors for the case of normal linear systems (e.g., [8,17-22]). However, for the case of descriptor systems, this problem has only been investigated by a few researchers ([23-27]). Kautsky and his coauthors ([23,24]) extended their earlier well known techniques in [17] developed for normal linear systems to the case of descriptor systems, and laid a special emphasis on the closed-loop regularity. Syrmos and Lewis ([25]) developed a robustness theory for the generalized spectrum of descriptor linear systems, and presented a compact theory for the robust eigenvalue assignment problem in descriptor linear systems using the concept of chordal metric. Different from the above, Duan and Patton ([26]) studied robust pole assignment in descriptor linear systems via proportional plus partial derivative state feedback. Due to the capacity of the derivative feedback, their work concentrates on the case that the closed-loop system possesses $n$ (= the system order) finite closed-loop eigenvalues. Very recently, a new approach is proposed in [28] for robust