A New Approach for Eigenvalue Assignment in Descriptor Systems with Output Feedback Matrix

Sakineh Bigom Mirasadi* Hojjat Ahsani Tehrani
University of Shahrood Shahrood University

Abstract

In this paper, we present a new method for eigenvalue assignment in descriptor systems based on matrix inverse eigenvalue problem. First a descriptor system is changed to standard system with output feedback by defining the input vector as a multiple of the output-derivative feedback, then using the matrix inverse eigenvalue problem, output feedback matrix K is calculated such that eigenvalues of closed-loop system are desirable and prescribed. A simple algorithm and an example is given to illustrate the results.

Keywords: Eigenvalue assignment, Matrix inverse eigenvalue problem, Descriptor systems, Null space
Mathematics Subject Classification [2010]: 93C05, 93B60

1 Introduction

Eigenvalue assignment techniques to improve the dynamic response of linear systems are one of the most important problems in the modern control theory. Many approaches have been proposed for this problem like [2, 5, 6]. Descriptor systems describe a physical system more than other models of linear systems. Applications of descriptor systems can be found in various fields such as electrical circuit networks, robotic systems, chemical processes, economics. Bunse (1992), Duan and Wang (2005) and Darouach (2006) studied on descriptor systems respectively in [1, 4, 3].

In this paper we investigate a new method for eigenvalue assignment in descriptor systems with output-derivative feedback matrix. Many authors investigate approaches to solve this problem, but the method that we have in this paper based on the matrix inverse eigenvalue problem is much useful. The first superiority of this method is, we do not need some certain conditions like in [5] or any restrictions for eigenvalues like amount or multiplicity. Also we do not deal with nonlinear equations which solving them is so difficult and time-consuming, especially for large system and it is the next advantage of this method.

Consider the linear time invariant controllable and observable sysytem of the form

$$E\dot{x}(t) = Ax(t) + Bu(t), \quad x(0) = 0 \tag{1a}$$
$$y(t) = Cx(t) \tag{1b}$$

*Speaker