International Journal of Innovative Computing, Information and Control
Volume **7**, Number **1**, January **2011**

ICIC International ©2011 ISSN 1349-4198
pp. 151–160

STABILIZATION OF SIMULTANEOUS LINEAR MULTIVARIABLE SYSTEMS WHILE IMPROVING TIME-RESPONSE USING GENETIC ALGORITHMS

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Received May 2009; revised September 2009

Abstract. *In this paper, a new approach is presented to stabilize a collection of controllable linear multivariable systems simultaneously while improving time-responses using Genetic Algorithms (GAs). First, a set of nonlinear equalities and inequalities are generated using similarity operations with respect to stability constraints. Second, a fitness function is proposed to solve the mentioned set by GAs for eigenvalues assignment in a prescribed region. In the next step, to achieve time-response improvement of systems, some terms are added to the primary fitness function. These terms are obtained by using a relationship between frequency response and time parameters. Then, the presented method is evaluated in a challenge example to show the superiority of our method to the existing methods in term of the norm of feedback matrix, rise-time and overshoot.*

Keywords: Genetic algorithms, Simultaneous control, Stabilization, Time-response improvement

1. **Introduction.** The problem of simultaneous stabilization of time invariant linear systems

$$\begin{aligned} \dot{x}_k(t) &= A_k x_k(t) + B_k u_k(t), \quad k = 1, 2, \dots, p \\ y_k(t) &= C_k x_k(t) \end{aligned} \tag{1}$$

is to find an output feedback controller matrix K with the feedback law $u_k = Ky_k(t)$, such that the eigenvalues of all closed loop systems $A_{kc} = A_k + B_k K C_k$ for all $k = 1, 2, \dots, p$ lie in the left hand side of the complex plane in a prescribed bounded region.

Investigation into this problem was first introduced by Saeks and Murray [1], based on the work in [2]. In the case of two plants, the simultaneous stabilization problem reduces to a well-known problem [3] and a proper stable controller is found to stabilize both plants. However, simultaneous stabilization of more than two plants, in general, is difficult [4]. An analytical solution to the simultaneous stabilization problem is NP-hard [5] and so no analytical algorithm can be devised to lead to a simple or rapid solution. Furthermore, the numerical methods are replaced instead of the analytical methods. Such approaches have focused in two main areas. The first deals with the solution to the simultaneous stabilization problem itself, in which the solution to the