International Journal of Innovative
Computing, Information and Control
Volume **7**, Number **7(B)**, July **2011**

ICIC International ©2011 ISSN 1349-4198
pp. 4183–4194

A DESIGN METHOD OF EXTENDED GENERALIZED MINIMUM VARIANCE CONTROL BASED ON STATE SPACE APPROACH BY USING A GENETIC ALGORITHM

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Received April 2010; revised September 2010

Abstract. *This paper explores a selection method of the design parameter introduced in the extended Generalized Minimum Variance Control (GMVC) based on state space approach by using a genetic algorithm. Its parameter can design the controller poles to be stable without changing the closed-loop poles. That is, a strongly stable system can be obtained. And the genetic algorithm is applied to calculate the design parameter and give the stable controller poles.*
Keywords: Generalized minimum variance control, Coprime factorization, State space, Genetic algorithm, Strongly stable

1. **Introduction.** Generalized Minimum Variance Control (GMVC) has been first proposed by Clarke and others [1], and widely applied in industry to control plant with uncertainty. GMVC can also be applied for a wider class of plants, such as unstable or non-minimum phase plants. In the design procedure, generalized output is selected so that the closed-loop system is stable. And the controller is given by minimizing its variance. Because the characteristics of controller and closed-loop system are determined simultaneously, there is a problem that the designed controller may be unstable in spite of desirable closed-loop characteristic.

To design the closed-loop system and the controller independently, the authors have proposed extended GMVC design scheme for single-input, single-output systems [2, 3]. Their methods have new design parameter introduced by using coprime factorization approach [4]. Although the controller poles are designed to be stable by selecting the new design parameter without changing the closed-loop poles [5, 6, 7], a problem of how to select them has not been solved. That is, its parameter must be selected by trial and error. Therefore, this paper explores a selection method of design parameter introduced in the extended GMVC by using a genetic algorithm [8, 9, 10].

The proposed method can be obtained by the following steps. In the first step, a stable closed-loop system and its controller are designed by the conventional GMVC control law [1] in the state space approach. Designed in the state space approach, it becomes easier to apply this method to multi-input, multi-output systems. In the second step, a coprime factorization of the conventional controller is given by state observer. Then, all the stabilizing controller is expressed in Youla-Kucera parameterization [4] and the new design parameter is introduced. In the third step, the new parameter of previous step is selected by a genetic algorithm. Then, the stable controller can be given.

This paper is organized as follows: Section 2 describes a problem statement and a design procedure of GMVC in state space approach; Section 3 shows the extended GMVC by