TECHNOLOGICAL DEVELOPMENTS IN NETWORKING, EDUCATION AND AUTOMATION
2010, 291-296, DOI: 10.1007/978-90-481-9151-2_51

Generalized Minimum Variance Controller with Dynamic Pole Assignment to Improve Performance in Industrial Applications

M.A. Paz Ramos, S.C. Garibo Esquivel, O.J. Santos Sánchez, R. Fernández del Busto, J.F. Briones de la Torre, J.L. Gallegos Ramirez and J. I. Rodríguez Martínez

Abstract

A comparison is made between the Generalized Minimum Variance Controller (GMVC) and a new version of it, the Generalized Minimum Variance Controller with a Dynamic Pole Assignment (GMVCDPA) regarding stability and performance under process parameter variations. Simulation examples show that the proposed structure has better characteristics than the original GMVC. To further illustrate the advances of the GMVCDPA, three laboratory experiments are carried out: for DC motor, speed and position control and for chamber prototype, temperature control. Results obtained in temperature control experiment are compared with those obtained with an industrial PID controller.

Fulltext Preview

Generalized Minimum Variance Controller with Dynamic Pole Assignment to Improve Performance in Industrial Applications

M.A. Paz Ramos[1], S.C. Garibo Esquivel[2], O.J. Santos Sánchez[3], R. Fernández del Busto[4], J.F. Briones de la Torre[1], J.L. Gallegos Ramirez[1], J. I. Rodríguez Martínez[3]

[1] Universidad Politécnica de Aguascalientes, Aguascalientes, Aguascalientes, México.
[2]Instituto Tecnológico de Aguascalientes, Aguascalientes, Aguascalientes, México.
[3]Universidad Autónoma del Estado de Hidalgo, Pachuca Hidalgo, México.
[4]Tecnológico de Monterrey Campus Ciudad de México, México Distrito Federal, México.

Abstract **– A comparison is made between the Generalized Minimum Variance Controller (GMVC) and a new version of it, the Generalized Minimum Variance Controller with a Dynamic Pole Assignment (GMVCDPA) regarding stability and performance under process parameter variations. Simulation examples show that the proposed structure has better characteristics than the original GMVC. To further illustrate the advances of the GMVCDPA, three laboratory experiments are carried out: for DC motor, speed and position control and for chamber prototype, temperature control. Results obtained in temperature control experiment are compared with those obtained with an industrial PID controller.**

I. INTRODUCTION

A good deal of control problems found in industry, are properly solved with conventional control strategies; however, there are some areas in which these techniques are not adequate, and where adaptive controllers have showed better results. Particularly, self-tuning regulators (STR) are being used and have become the most popular adaptive applications in the industry.

A particular STR structure is studied in this work: the Generalized Minimum Variance Controller (GMVC), which is described in section II. The design of the cost polynomials for GMVC, according to a pole assignment is discussed in section III. In order to achieve better results in practice, we propose an algorithmic modification of the original GMVC in section III. In section IV, we discuss stability issues and in section V performance issues are revisited. Finally in section VI physical implementations are presented.

II. GENERALIZED MINIMUM VARIANCE CONTROLLER

Clarke and Gawthrop proposed the generalized minimum variance controller (GMVC) [1], defining a pseudo-output of the system $\phi(t)$ which includes not only the system output, but the reference and control signals as well. Among other properties, this algorithm allows the user to tailor the performance of the controller through a specific choice of the optimality criterion, and also deal with non-minimum phase systems. In the GMVC a generalized output, or pseudo output is defined, by the following equation:

$$\phi(t+k)=Py(t+k)+Qu(t)-Rr(t) \quad (1)$$

where P, Q, R (called cost polynomials) are used to modify the control performance [2] while y is the process output, u is the control input, r is the reference signal and k is the system delay. The cost function to be minimized is the mathematical expectation of $\phi(t+k)$,

$$J=E[\phi^2(t+k)] \quad (2)$$

The control law proposed for the GMV controller is

$$Hu(t)+Gy(t)+Er(t)=0 \quad (3)$$

where the control polynomials H, G and E are directly estimated from (1), because in an implicit way, the following relationship prevails:

$$PC=FA+z^{-k}G \quad (4)$$

where:

$$H=BF-QC \quad \text{y} \quad E=-CR \quad (5)$$

In Figure 1, we can see a synthesis of the structure of the GMVC where A, B and C are the process polynomials. The control algorithm is clearly explained in [2].

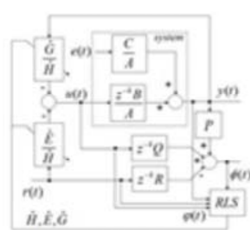

Figure 1. Functional diagram of a GMVC

K. Elleithy et al. (eds.), *Technological Developments in Networking, Education and Automation*, DOI 10.1007/978-90-481-9151-2_51, © Springer Science+Business Media B.V. 2010

Share this Item

email citeulike Connotea Delicious