International Journal of Innovative Computing, Information and Control
Volume **7**, Number **9**, September **2011**
 ISSN 1349-4198
pp. 5299–5312

ADAPTIVE BACKSTEPPING AND PID OPTIMIZED BY GENETIC ALGORITHM IN CONTROL OF CHAOTIC

Laarem Guessas[1,2] and Khier Benmahammed[3]

[1]Department of Electronic
Faculty of Technology
[2]Intelligent Systems Laboratory
Faculty of Sciences of Engineer
Ferhat Abbes University
Setif, Algeria
guessaslar@yahoo.fr

[3]Electrical Department
Oum El-Kora University
Mecca, Saudi Arabia
khierben@ieee.org

Received January 2010; revised August 2010

Abstract. *In this paper, the robust adaptive control scheme based on adaptive backstepping design is used to control the autonomous second order strict feedback form such as the Lorenz Chaotic system. The design procedure is recursive; at the i^{th} step, the i^{th} subsystem is stabilized with respect to a Lyapunov function V_i by the design of a stabilizing function α_i, tuning function τ_i, and the update law $\dot{\hat{\theta}}_i$ for the unknowns' adaptive parameters estimates $\hat{\theta}_i$, the feedback control u is designed at the final step. This procedure possesses strong properties of global stability and tracking which are built into the nonlinear system in a number of steps, which is never higher than the system order, without any growth restrictions on nonlinearities. The results show the guarantee of all the parameter estimates to converge to their true values. Some simulation results for the chaotic system cited above are shown to illustrate the parameter convergence with adaptive backstepping design.*
Keywords: Adaptive backstepping design, Adaptive parameters estimates, Lyapunov, Stabilizing and tuning functions, Up date and control laws

1. Introduction.

In the first years after the penetration of the concept of deterministic chaos into the scientific literature [1,2], chaotic behavior was regarded as an exotic phenomenon which might be of interest only as a mathematical speculation and would never be encountered in practice, yet further development highlighted a number of applications where chaotic modes may appear sometimes as harmful, sometimes as useful. Moreover, entire classes of problems that are of practical importance arose where one has to control a nonlinear system by reducing or, on the contrary, increasing the degree of its chaoticity [3].

Yet in the last few years, adaptive control of nonlinear systems has emerged as an exciting research area. Early efforts focused on the state-feedback problem and resulted in a systematic design procedure called adaptive backstepping. Backstepping is a systematic method for nonlinear control design, which can be applied to a broad class of nonlinear systems in the so-called non or autonomous "strict-feedback" form; the name backstepping refers to the recursive nature of the design procedure. First, only a small subsystem is considered, for which a virtual control law is constructed. Then, the design