Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **15 (2008)** 859-872
 http://www.watam.org

STATISTIC TRACKING STRATEGY FOR NON-GAUSSIAN SYSTEMS BASED ON PID CONTROLLER STRUCTURE AND LMI APPROACH

Yang Yi[1] Tao Li[1] Lei Guo[1,2*] Hong Wang[3]

[1]Research Institute of Automation
Southeast University, Nanjing, P. R. China
[2]Institute of Instrument Science and Opto-Electronics Engineering
Beihang University, Beijing, P. R. China
[3]Control Systems Center
Manchester University, Manchester, UK

Abstract. In this paper, the robust PID tracking control problem is considered for stochastic systems with non-Gaussian variable. The tracked objective is the statistic information of a given target probability density function (PDF), rather than a deterministic signal. Following B-spline expansion approximation for the measurable integrated performance function, the statistic tracking control problem can be reduced to a tracking problem for the nonlinear weighting dynamics. A robust control strategy with PID structure is proposed for the nonlinear weighting system in the presence of exogenous disturbances, and the improved convex LMI algorithms are provided to compute the controller gains. Furthermore, in order to enhance the robust performance, the peak-to-peak measure is applied to optimize the tracking performance. Rigorous stability and performance analysis are developed via the use of Lyapunov stability criterion.

Keywords. Non-Gaussian systems, probability density function, B-spline expansion, convex optimization, PID tracking control, linear matrix inequality.
AMS (MOS) subject classification: 93E03, 93E20, 37N35

1 Introduction

Recently, tracking control for Gaussian systems has received much attention. The objective is to ensure that the mean or the variance of the difference between the output and a given reference signal is convergent and minimized [1-3]. However, non-Gaussian variables exist in many stochastic systems due to the nature of the random input sources and system nonlinearity, which may posses asymmetric and multiple peak stochastic distributions [4-5]. For non-Gaussian systems, mean and variance are insufficient to characterize the stochastic properties. On the other hand, along with the development of advanced instruments and data processing techniques, the measurement for feedback can be in a form of stochastic distributions of the system output [4-11]. Consequently, the controlled objective can be represented as a target PDF corresponding to system output (see [9-11]). This kind of control problem has been called the stochastic distribution control (SDC).