Available online at www.sciencedirect.com
ScienceDirect
Journal of the Franklin Institute 348 (2011) 1927–1946
Journal of The Franklin Institute
www.elsevier.com/locate/jfranklin

Comparative performance analysis of artificial bee colony algorithm for automatic voltage regulator (AVR) system

Haluk Gozde*, M.Cengiz Taplamacioglu

Gazi University, Faculty of Engineering, Electric & Electronics Engineering Department, Ankara, Turkey

Received 22 October 2010; received in revised form 14 November 2010; accepted 12 May 2011
Available online 19 May 2011

Abstract

In this study, Artificial Bee Colony (ABC) algorithm is applied to the Automatic Voltage Regulator (AVR) system for obtaining optimal control. The tuning performance of this algorithm and its contribution to the robustness of the control system are also extensively and comparatively investigated. In the performance analysis, Particle Swarm Optimization (PSO) algorithm and Differential Evolution (DE) algorithm are used for the purpose of comparison. These analyses are realized by benefiting from different analysis methods such as transient response analysis, root locus analysis, bode analysis and statistically Receiver Operating Characteristic (ROC) analysis. Afterwards, the robustness analysis is applied to the AVR system, which is tuned by ABC algorithm in order to determine its response to changes in the system parameters. At the end of the study, it is shown that the ABC algorithm is successfully applied to the AVR system for improving the performance of the controller and shows a better tuning capability than the other similar population based optimization algorithms for this control application.
© 2011 The Franklin Institute. Published by Elsevier Ltd. All rights reserved.

1. Introduction

Providing constancy and stability of the nominal voltage level in an electric power network is also one of the main control problems for an electric power system, because all equipments that are connected with this power network have been designed for a certain

*Corresponding author. Gazi University, Faculty of Engineering, Department of Electrical & Electronics Engineering, 06750 Maltepe, Turkey. Tel.:+903122311340; fax:+903122308434.
E-mail addresses: halukgozde@gmail.com (H. Gozde), taplam@gazi.edu.tr (M.C. Taplamacioglu).

0016-0032/$32.00 © 2011 The Franklin Institute. Published by Elsevier Ltd. All rights reserved.
doi:10.1016/j.jfranklin.2011.05.012

voltage level called rated or nameplate voltage. If the nominal voltage level deviates from that value, the performance of these equipments decreases and their life expectancy drops. In addition to this, the other important reason for this control is that the real line losses depend on real and reactive power flow. In fact, the reactive power flow depends greatly on terminal voltages in the power system. However it is possible to minimize the real line losses by controlling the nominal voltage level. To solve these control problems, which are explained above, an Automatic Voltage Regulator (AVR) system is applied to power generation units [1]. The AVR system is a closed loop control system that provides terminal voltage at the desired value. The configuration of this control system will be investigated in the next section. In the related literature, to realize the AVR system with better dynamic response, a number of different control strategies such as optimal, adaptive, robust control, etc. have been reported by researchers so far. But the self-tuning adaptive control technique is distinguished from the other control techniques because it makes the process, which is under control, less sensitive to changes in process parameters, and in particular it is also simpler to implement than the other modern control techniques. For this purpose, this type of control is applied to the AVR system in this study. Previous works related to the AVR system, which uses the self-tuning methods, initiated in the years of the 1990s. For example, Swidenbank et al. [2] applied the classical self-tuning control techniques to the AVR system in 1999. After this study, Fitch et al. [3] used a generalized predictive control technique as a self-tuning control algorithm in the same year.

Since the conventional self-tuning control techniques containing more mathematical computing may also be unsuitable in some operating conditions due to the complexity of the power system such as nonlinear load characteristics and variable operating points, the usage of artificial intelligence based self-tuning control and optimization techniques was preferred by researchers from the beginning of 2000. For example, Panda and Padhy [4] proposed PSO based optimal design method for STATCOM-based controller with multiple PSS, and they tested the stability of their design in two area power system. After three years, they used the improved genetic algorithm method in order to solve the optimal design problem of flexible AC transmission system (FACTS)-based controller for the power systems [5]. However, self-tuning PID controllers tuned by these optimization methods have also been initiated to be applied to the AVR system frequently in these years. Gaing [6] suggested a PSO based self-tuning PID controller for the AVR system, and he compared the result of his method with that of the genetic algorithm based method in 2004. Two years after, Kim and Cho [7] developed the hybrid method, which contained genetic algorithm and bacterial foraging optimization technique, in order to improve the performance of the self-tuning PID controller in the AVR system. In 2007, Mukherjee and Ghoshal [8] reported the Sugeno fuzzy logic self-tuning algorithm based on crazy-PSO for PID controller, and proposed a novel cost function in this optimization method. They also compared their results with the genetic algorithm based controller. Later on, Zhu et al. [9] suggested a chaotic ant swarm algorithm in order to optimize the gains of PID controller in the AVR system in the year of 2009. In the same year, Zamani et al. [10] designed the particle swarm optimization based fractional order PID controller for the AVR system. They investigated the basic performance and robustness of their controller and compared with that of the classical PID controller. Coelho [11] proposed the chaotic optimization approach for tuning of the PID gains in 2009. Chatterjee et al. [12] also made a comparison

دریافت فوری ← متن کامل مقاله

ISIArticles
مرجع مقالات تخصصی ایران

✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
✓ امکان دانلود نسخه ترجمه شده مقالات
✓ پذیرش سفارش ترجمه تخصصی
✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
✓ دانلود فوری مقاله پس از پرداخت آنلاین
✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات