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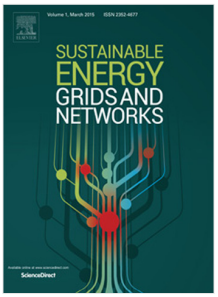

Improved grey wolf optimization technique for fuzzy aided PID controller design for power system frequency control

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Improved grey wolf optimization technique for fuzzy aided PID controller design for power system frequency control

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Abstract

Frequency regulation of power systems by fuzzy aided PID controller is proposed in this study. The controller gains are optimized by an Improved Grey Wolf Optimization (IGWO) method. The improvement in GWO method is done by an approach which does not consider less important delta wolves for updating the position vector in the hunting stages of the algorithm thus making the algorithm simpler with less implementation time. Proposed IGWO is initially evaluated using some standard test functions. The outcomes are equated with GWO, modified GWO (MGWO), Differential Evolution (DE), Gravitational Search Algorithm (GSA) and Particle Swarm Optimization (PSO) techniques to illustrate its supremacy. The IGWO algorithm is then employed to optimize PID, hybridized structure of Fuzzy PD and cascade PI-PD(FPD/PI-PD) and fuzzy based PID parameters for frequency regulation of two-area power system. The superiority of fuzzy PID is established over recently proposed Automatic Generation Control (AGC) approaches. In the second stage, the methodology is applied to a two-area six-unit test system with diverse sources and supremacy of the proposed approach is established over optimal feedback controller, DE tuned PID and TLBO tuned 2DOF PID for the same test system. Finally, the suggested technique is used in a three area nonlinear test system and the supremacy of suggested approach over IGWO tuned FPD/PI-PD and hybrid Firefly Algorithm-Pattern Search (hFA–PS) tuned fuzzy PID is shown. Sensitivity study is conducted to show the ability of the suggested approach to perform satisfactorily with varied conditions.

Keywords: Automatic Generation Control (AGC); Grey Wolf Optimization; Nonlinearities; Reheat Turbine; PID controller; Fuzzy logic.

1. Introduction

Automatic Generation Control (AGC) is necessary for steady operation of power systems. AGC minimizes the demand and generation mismatch and thus lessens the errors in line power and frequency deviations [1, 2]. Numerous schemes have been advised in literature to answer AGC problems. In [3], a nonlinear optimal model-free control, using sliding mode technique, was suggested for frequency regulation in the isolated MG with Electric Vehicle (EV). A modified Black Hole Optimization Algorithm (MBHA) was employed for tuning of model-free sliding mode control (SMC) controller coefficients in [3]. In [4], a SMC with adaptive rotating reference was recommended to control