Ain Shams University
Faculty of Engineering
Electrical Power and Machines Department

Optimal Design of Controller for AVR Performance Enhancement

By

Ahmed Magdy Mosaad Hussien

B.Sc. Electrical Engineering, Ain Shams University, 2014

A Thesis Submitted in Partial Fulfillment of the Requirement for the Degree of Master of Science in Electrical Engineering

Cairo 2017

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List of Abbreviations

- ABC: Artificial Bee Colony
- ACO: Ant Colony Optimization
- APSO: Adaptive Particle Swarm Optimization
- AVR: Automatic Voltage Regulator
- BAT: Bat Search
- CS: Current Search
- CRPSO : Craziness based Particle Swarm Optimization
- DE: Differential Evolutionary
- GA:Genetic Algorithm
- GSA: Gravitational Search Algorithm
- HSA:Harmony Search Algorithm
- LUS: Local Unimodal Sampling
- MOL: Many Optimizing Liaisons
- PID: Proportional-Integral-Derivative
- PIDA: Proportional-Integral-Derivative-Acceleration
- PSO:Particle Swarm Optimization
- RLA: Reinforcement Learning Automata
- TS: Tabu Search
- TCGA:Taguchi Combined Genetic Algorithm
- TLBO: Teaching Learned Based Optimization
- VRPSO: Velocity Relaxed Particle Swarm Optimization
- WOA: Whale Optimization Algorithm

Abstract

Power system stability and power quality are improved by excitation control of synchronous generator. Automatic Voltage Regulator (AVR) system is an important device to regulate synchronous generator terminal voltageby control of excitation.A controller is recommended to improve stability and get fast response so Proportional-Integral-Derivative (PID) and Proportional-Integral-Derivative-Acceleration (PIDA) controllers are used.Harmony Search Algorithm (HSA), Local Unimodal Sampling (LUS), Teaching Learned Based Optimization (TLBO) and Whale Optimization Algorithm (WOA) are the optimization techniques used to tune each controller parameters.Integrated Square Error (ISE) is used as an objective function to minimize error voltage for better stability and response. Transient response, Root locus and Bode diagram are calculated for each controller using the four optimization techniques. The results are compared with other optimization techniques to find out the best response and stability for an AVR system. The results show also which controller is better. Robustness analysis is made on the best system to check terminal voltage response with respect to load variation to ensure that this system can be applied for the AVR of synchronous generator in Power system.

Keywords: Automatic Voltage regulator, Controller,Optimization techniques, Objective function

Statement

This thesis is submitted to AinShamsUniversity for the degree of Master of Science in Electrical Engineering.

The work included in this thesis was carried out by the author. No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

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