ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 8, Issue, 9, pp. 19980-19983, September, 2017

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

APPLICATION OF SOFT COMPUTING FOR LOAD FREQUENCY CONTROL OF INTERCONNECTED THERMAL-HYDRO-GAS POWER SYSTEM

Deepesh Sharma and Naresh Kumar Yadav

Department of Electrical Engineering Deenbandhu Chhotu Ram University of Science and Technology, Murthal (Sonepat)-India

DOI: http://dx.doi.org/10.24327/ijrsr.2017.0809.0800

ARTICLE INFO

Article History:

Received 05th June, 2017
Received in revised form 08th July, 2017
Accepted 4th August, 2017
Published online 28st September, 2017

Key Words:

Load Frequency Control (LFC), PI Controller, Bacterial Foraging Optimization, Integral Square Error (ISE).

ABSTRACT

This paper contributes load frequency organization of a consistent three area system. The three areas taken are thermal, gas and hydro plant. For performing LFC of three area scheme traditional and optimized primary regulator with bacterial foraging optimization in conjunction with particle swarm optimization is used while examining change in generation and overall frequency of the method using Integral Square Error (ISE). It is measured with the conventional method, and the implemented technique is compared. The goal of the implemented regulator is to reinstate the regularity to its ostensible rate in the minimum feasible time if any variations in the load command, etc. exists.

INTRODUCTION

The electric power loads are distributed arbitrarily and briefly. It will be unfeasible to preserve the restrictions of both the reactive and active powers devoid of exploiting controllers. Hence, the deviation in frequency, load and power levels will be altering. Therefore, utilization of control structure is necessary for counteracting the possessions of changes in load and for continuing voltage and frequency of the values at base.

Controlling the Frequency of Load

Electric systems are adopted for translating certain energies into electric power. It conveys the power to industrial units, residences, etc., to get together the entire types of electric needs. For achieving the consistent presentation of such apparatus, it is significant to make sure that the superiority of the electric power is fine. It is renowned that three-phase (AC) system is usually employed to pass the power. Throughout the movement, the restrictions such as, reactive and the active should be preserved among utilization and generation of AC power. Those two restrictions represent two points of equilibrium, namely, voltage and frequency. When either of the restrictions is desecrated and a new level is reset, the balanced points will drift. For an excellent eminence of the power system, the voltage, as well as frequency, must lie within the given limits. The eventual assignment includes managing the frequency without affecting the randomly altering power loads that are further said to be the unidentified needs of load. An additional assignment of this system is the adjustment of tie-line swap of power faults. Huge power systems are usually included of control areas demonstrating consistent sets of generators. In an interrelated power system, the production generally encompasses of hydro, thermal, gas and nuclear production. Nevertheless, because of its effectiveness, nuclear plant is normally functioned near to its peak result with supporting in AGC scheme. The gas power plant is most excellent one for reuniting the altering challenges of load. They are utilized for accomplishing ultimate load orders. Therefore the evident option for AGC is moreover hydro or thermal units.

Bacterial Foraging Optimization

The significance of foraging scheme of a group of *E.coli* bacteria in a variety of optimization task is the major suggestion of the innovative algorithm. Bacteria are exploring for nutrients for increased energy attained at an instant. A single bacterium further interacts by transmitting message signals. A bacterium holds foraging decisions subsequent to concerning last two parameters. The occurrence, in which a

Corresponding author:* **Deepesh Sharma
Department of Electrical Engineering Deenbandhu Chhotu Ram University of Science and Technology, Murthal (Sonepat)-India

bacterium shifts by captivating little steps when exploring for nutrients, is said to be chemotaxis and major plan of BFOA is imitating chemo-tactic shifts of effective bacteria in the issue in surveying space.

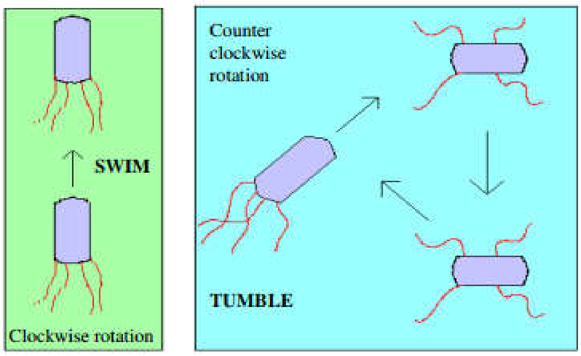

Fig 1 Swim and Tumble of a bacterium

Throughout the foraging of actual bacteria, by locating at ensile flagella locomotion is achieved. Flagellum assists an *E.coli* bacterium to fall or swim, the fundamental functions done by a bacterium at the occasion of foraging. If the flagella turn in clockwise, every flagellum drags the corresponding cell, which guides to autonomously movement of flagella and therefore the bacterium stumbles with smaller number of dropping while it stumbles repeatedly to discover a nutrient gradient in a destructive location. Bacterium swims at a extremely rapid rate when the flagella shift in the contradict clockwise direction. In a pleasant surroundings, the bacteria shift for a far distance. When they obtain enough food, they are enlarged in length, and further, they get smashed in the centre to form a precise imitation of itself in the occurrence of the proper temperature. Passino was stimulated with this incident to commence an occasion of reproduction in BFOA. In case of unexpected ecological attack or alterations, the method of chemotactic could be disappeared, and a set of bacteria may be replaced with certain various bacteria in swarm concern of some other place introduced. This involves the occurrence in which the bacteria are destroyed, or a set is scattered into a novel part of the surroundings which is known as eradication-dispersal in the actual population of bacteria.

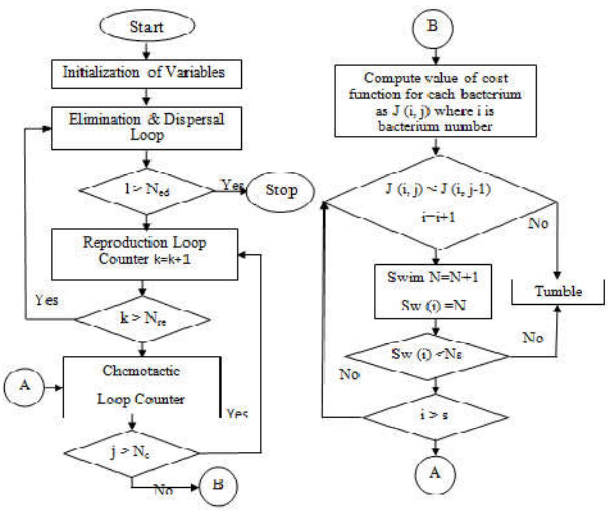

Fig 2 Flow Chart of BFO

Simulation and Results

The objective function, in this case, is Integral Square Error (ISE) for Bacterial Foraging Optimization (BFO) and BPSO (Bacterial Particle Swarm Optimization). When a load interruption of 0.01 is given, i.e., when 1% load interruption is deployed to three plants, subsequently the frequency variation is controlled by the optimized PI Controller and PI Controller. In case of no-load disturbance, the tie line deviation is zero as shown in Fig. 4 for thermal power plant only. Same behavior will be observable on other plants tie line also. If the disturbance in load occurs, conventional PI control will try to mitigate the oscillations and bring back them at zero. But it takes time in functioning, and also overshoot is reduced. So to tune the parameters of integral controller, we first use the BFO, then it is further optimized with the help of PSO and comparison results for different cases are displayed in Figs. 7-9.

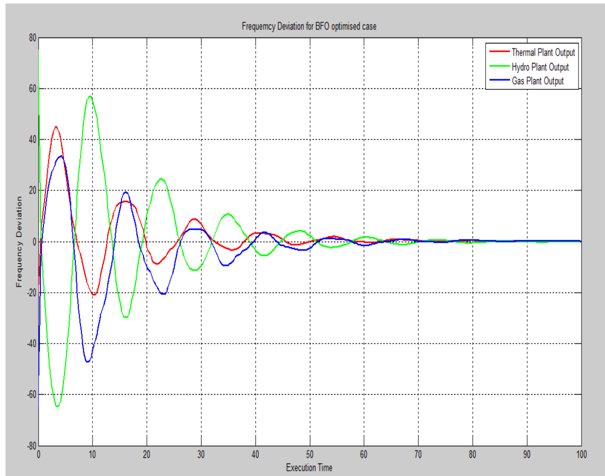

Fig 3 Frequency Deviation for BFO Optimised Case

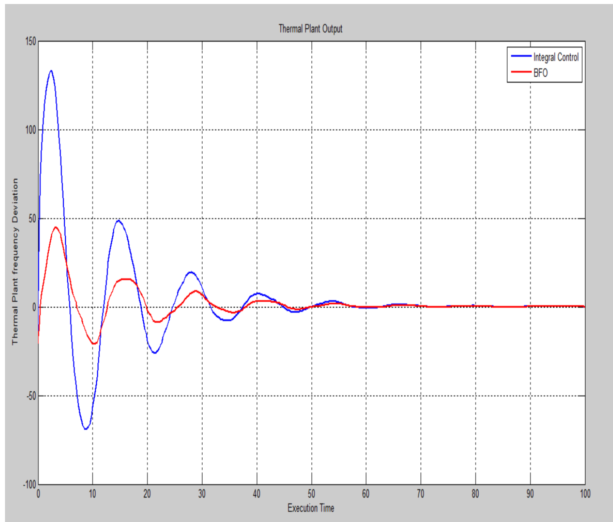

Fig 4 Frequency Deviation for BFO Optimised Case for Thermal Power Plant

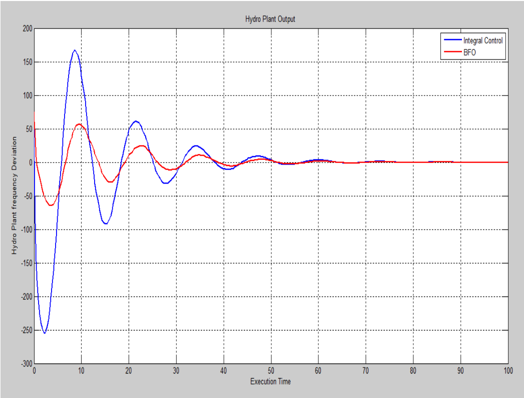

Fig 5 Frequency Deviation for BFO Optimised Case for Hydro Power Plant

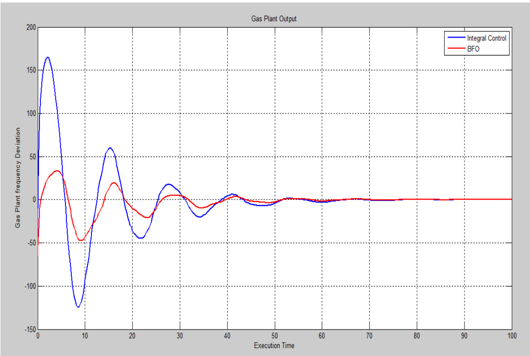

Fig 6 Frequency Deviation for BFO Optimised Case for Gas Power Plant

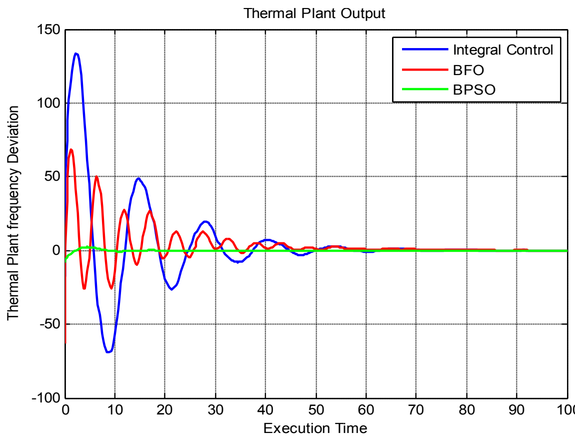

Fig 7 Thermal Plant output for PI, BFO-PI and BPSO-PI Controller

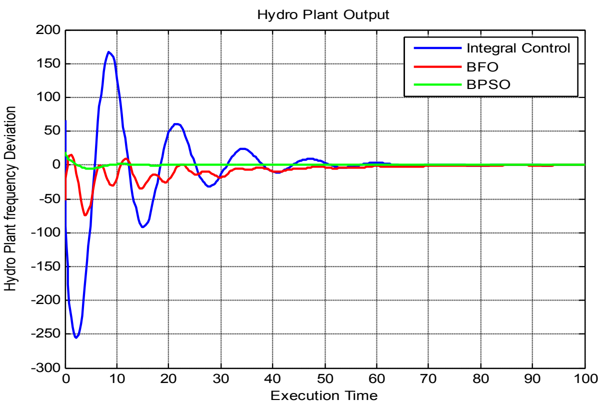

Fig 8 Hydro Plant output for PI, BFO-PI and BPSO-PI Controller

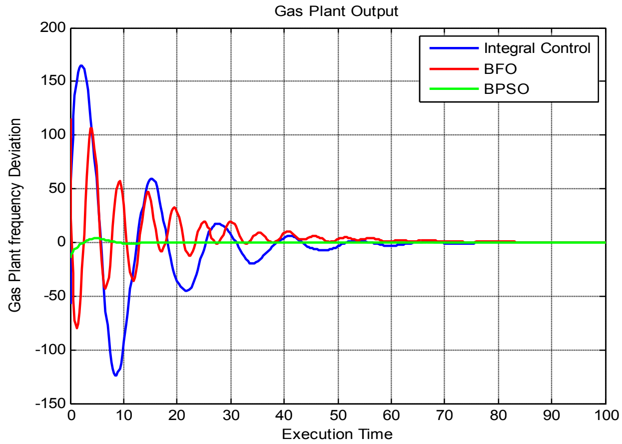

Fig 9 Gas Plant output for PI, BFO-PI and BPSO-PI Controller

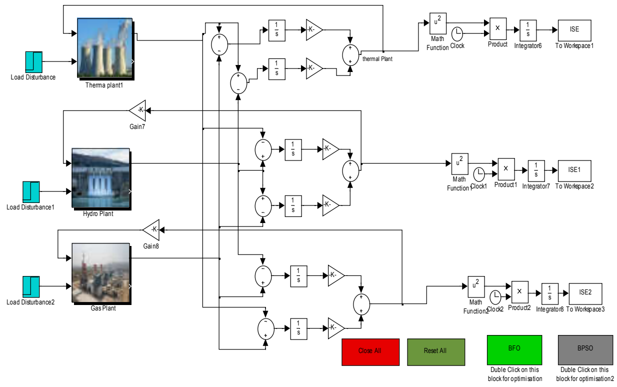

Fig 10 Complete Simulink Model of Proposed Scheme

Table 1 BPSO Initialization Parameters

	Thermal Plant	Hydro plant	Gas Plant
Integral Gain before Optimization	0.1010	0.0510	0.0100
Integral Gain after BFO Optimization	0.1474	0.0001	0.0699
Integral Gain after BPSO Optimization	0.0403	0.2932	0.2095
Maximum Overshoot before Optimization	140	160	160
Maximum Overshoot after BFO Optimization	60	10	100
Maximum Overshoot after BPSO Optimization	10	7	5
Settling Time before Optimization	60	60	60
Settling Time after BFO Optimization	50	48	60
Settling Time after BPSO Optimization	10	9	9

CONCLUSION

The models of interconnected power systems comprising of areas of different characteristics have been developed with integral as well as optimal control strategies. In this work the attempt is made to develop LFC scheme employed with integral controller. Here controlling of LFC with BPSO Optimized Integral Controller is employed. The optimal controllers have been designed and the control equations in continuous time have been obtained for all the power system models under consideration. The results confirms that in all case of load interruption if it is on only hydro plant or in both plants, frequency variations of tie line are remunerated better by optimized integral controller than integral controller. Bacterial foraging optimization proves its point of mature convergence for the objective function of integral square error.

References

Dr. C. Srinivasa Rao, "Implementation of Load Frequency Control of Hydrothermal System under Restructured Scenario Employing Fuzzy Controlled Genetic Algorithm", *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, Vol. 1, Issue 1, July 2012.

J. Syamala, I.E.S. Naidu, "Load Frequency Control of Multi-Area Power Systems Using PI, PID, and Fuzzy Logic Controlling Techniques", *International Journal of Innovative Research in Science, Engineering and Technology*, Vol. 3, Special Issue 1, February 2014.

S. M. Kamali, Dr. Wahida Banu. R. S. D, "A Detailed Analysis of Automatic Generation Control in Power Systems", *International Journal of Emerging Trends in Engineering and Development*, Issue 3, Vol. 6, November 2013.

B. Anand,, *"Load Frequency Control of Hydro-Hydro System with Fuzzy Logic Controller Considering DC Link*", Life Science Journal, 2013.

Ramanand Kashyap, Prof. S. S. Sankeswari, Prof. B. A. Pati, *"Load Frequency Control Using Fuzzy PI Controller Generation PI Controller Generation of Interconnected Hydro Power System*", *International Journal of Emerging Technology and Advanced Engineering*, Vol. 3, Issue 9, September 2013.

Ratnesh Chaturvedi, Dr. Bharti Dwivedi, "Comparative Analysis of PI & Fuzzy Based Cntroller for Load Frequency Control of Thermal-Thermal & Thermal: Hydro System", IJARCST, Vol. 1, Issue 1, Oct-Dec. 2013.

Surya Prakash and Sunil Kumar Sinha, "Performance *Evaluation of Hybrid Intelligent Controllers in Load Frequency Control",* Multi World Academy of Science, Engineering and Technology, Vol. 7, 2013.

Sachin Khajuria, Jaspreet Kaur, "*Load Frequency Control of Interconnected Hydro-Thermal Power System Using Fuzzy and Conventional PI Controller*", *International Journal of Advanced Research in Computer Engineering & Technology* (IJARCET), Vol. 1, Issue 8, October 2012.

Aditi Gupta, "*Frequency Regulation of Deregulated Power System having GRC Integrated With Renewable Source*", IJRET, Vol. 2, Issue 11, Nov. 2013.

H. Golpîra, H. Bevrani, H. Golpîra, "*Application of GA optimization for automatic generation control design in an interconnected power system*", Energy Conversion and Management, Vol. 52, 2011.

Elgerd O.I., *Electric Energy System Theory*, An Introduction, Mc Graw Hill, 1971.

Mukta, Balwinder Singh Surjan, "*Load Frequency Control of Interconnected Power System Deregulated Environment: A Literature Review*", *International Journal of Engineering and Advanced Technology* (IJEAT), Vol. 2, Issue 3, February 2013.

Hossein Shayeghi, Heidar Ali Shayanfar, *"Automatic Generation Control Of Interconnected Power System Using ANN Technique Based On M–Synthesis*", *Journal of Electrical Engineering*, Vol. 55, No. 11-12, pp. 306–313, 2004.

K. S. S. Ramakrishna, Pawan Sharma, T. S. Bhatti, "*Automatic generation control of interconnected power system with diverse sources of power generation*", *International Journal of Engineering, Science and Technology*, Vol. 2, No. 5, pp. 51-65, 2010.

Surya Prakash, S. K. Sinha, "*Load frequency control of three area interconnected hydro thermal reheat power system using artificial intelligence and PI controllers*", *International Journal of Engineering Science and Technology*, Vol. 4, No. 1, pp. 23-37, 2011.

Surya Prakash, S. K. Sinha, *"Application of artificial intelligence in load frequency control of interconnected power system*", *International Journal of Engineering Science and Technology*, Vol. 3, No. 4, pp. 264-275, 2011.

C. Srinivasa Rao, "*Design of Artificial Intelligent Controller for Automatic Generation Control of Two Area Hydrothermal System*", *International Journal of Electrical and Computer Engineering* (IJECE), Vol. 2, No. 2, pp. 183-190, April 2012.

Bipasha Bhatia, *"Automatic Generation Control of Multi Area Power Systems Using Ann Controller*", *International Journal of Engineering Science and Technology* (IJEST), Vol. 4, No. 07, July 2011.

George Gross and Jeong Woo Lee, "*Analysis of Load Frequency Control Performance Assessment Criteria,* IEEE Transactions on Power System, Vol. 16, No. 3, Aug. 2001.

D. P. Kothari, I. J. Nagrath, Modern Power System Analysis, Tata Mc Graw Hill, Third Edition, 2003.

Kundur P., *Power System Stability and Control,* Mc Graw Hill New York, 1994.

C L Wadhawa, *Electric Power System*, New Age International Publication, Edition 2007.

Jawad Talaq and Fadel Al Basri, *"Adaptive Fuzzy Gain Scheduling for Load Frequency Control*, IEEE Transactions on Power System, Vol. 14, No. 1, Feb. 1999.

How to cite this article:

Deepesh Sharma and Naresh Kumar Yadav.2017, Application of Soft Computing For Load Frequency Control of Interconnected Thermal-Hydro-Gas Power System. *Int J Recent Sci Res.* 8(9), pp. 19980-19983.
DOI: http://dx.doi.org/10.24327/ijrsr.2017.0809.0800

****