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Load Frequency Control Optimization Depending on Genetic Algorithm

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Abstract: New contribution is recommended in this paper through artificial intelligent by genetic algorithm GA to counteracted the weakness points of load frequency control LFC. The main problem of load frequency control LFC is the drop frequency at the transient heavy load in power system station which causes distorted of sinusoidal wave, increase the harmonics as results minimizing the system efficiency with instability of station. Therefore, the genetic algorithm with load frequency control GA-LFC is used to optimize the frequency and to control the frequency deviation. The two inputs signal of GA are desired frequency and actual frequency and the output will be optimized via objective function of GA and supply to power system. Simulink Matlab program with toolbox is used in this system. From the results, it is obvious that GA is specialist of optimization the LFC.

Keywords: Load Frequency Control LFC, Genetic Algorithm GA, Turbine, Governor

1. Introduction

The electrical power system consists of generation, transmission and distribution which makes the system is more complex [1] and causes mismatch between load demand and generation [2]. Therefore, the load frequency control LFC is one of an important part in power system station to control frequency and to decrease frequency deviation [3]. However, the response of classical load frequency control LFC is not adequate to overcome the problem at load. In addition, the comparison between the active power frequency and reactive power is very compulsory because of mechanical inertia constant [4] [5]. Fuzzy logic control is proposed to control automatic power system with load frequency control [6] [7] [8].

Many researchers proposed a lot of research to enhance the frequency by PID controller but the overshoot and undershoot of PID controller caused disturbance of system. The artificial intelligent AI is very important in industries to identify, control, and optimize the system. Many researchers focused on GA [9] [10] to systematize test generation. Another improved the software system as compared with arbitrary testing [11] [12] [13]. A lot of research is proposed by difference methods to improve the LFC such as: perturb and observe method, Fuzzy logic method, power station method and intelligent algorithms [14-33].

2. Materials and Methods

The main reasons of using the GA in this system that GA is an evolutionary algorithm, it can find optimal solution in a reduced computational time and faster computation of objective function. GA is used instead of PID controller of traditional LFC to eliminate the problems which causes by PID controller. The inputs of GA are two frequency signals that are called desired and actual frequency. These two inputs are optimized by GA based on objective function to generate output signal. Also, the output signal is an input to LFC. The block diagram of proposed GA-LFC is shown in figure 1.

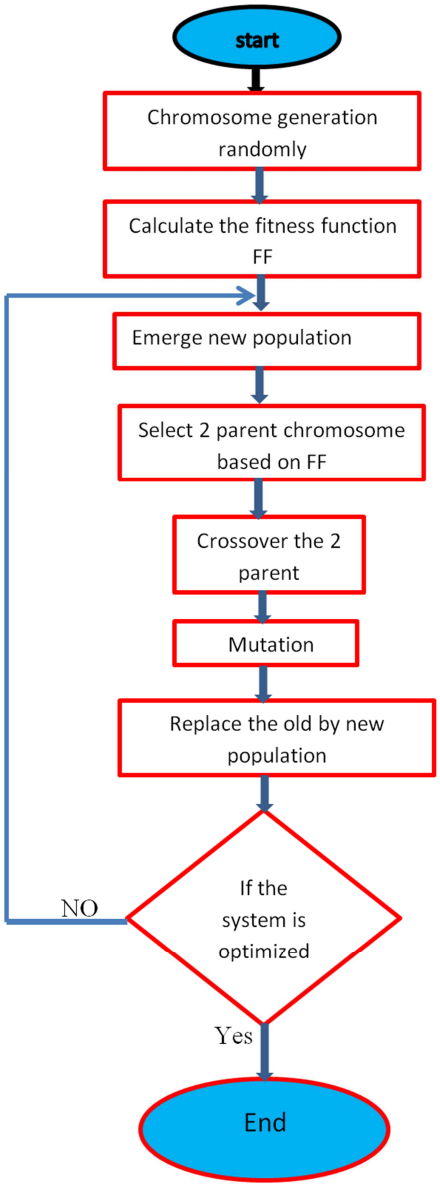

Figure 1. *Block diagram of proposed GA-LFC.*

3. Simulation Results

The Simulink of the suggested method by GA-LFC is shown in figure 2. The output signal from GA will supply to steam turbine. these signals generated by turbine are the inputs to governor.

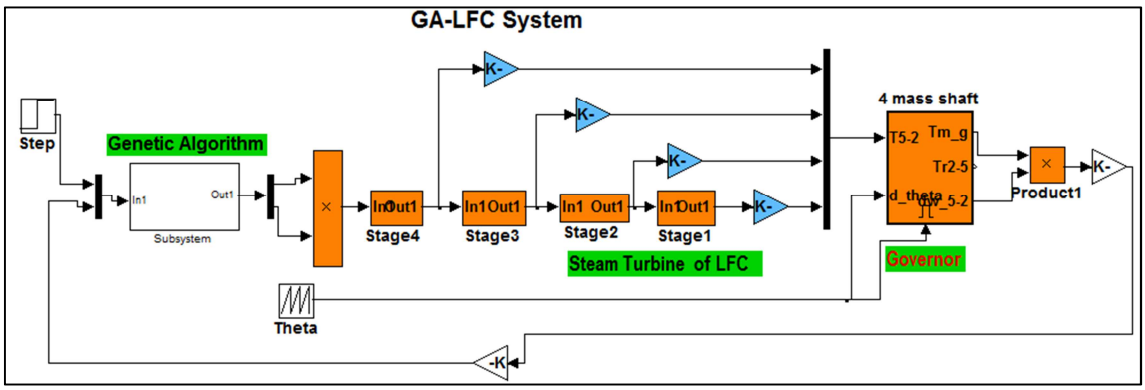

Figure 2. *Simulink of GA-LFC system.*

The frequency deviation of GA-LFC is approximately equal to zero. In contrast, the classical LFC has oscillation to reach the zero as shown in figure 3.

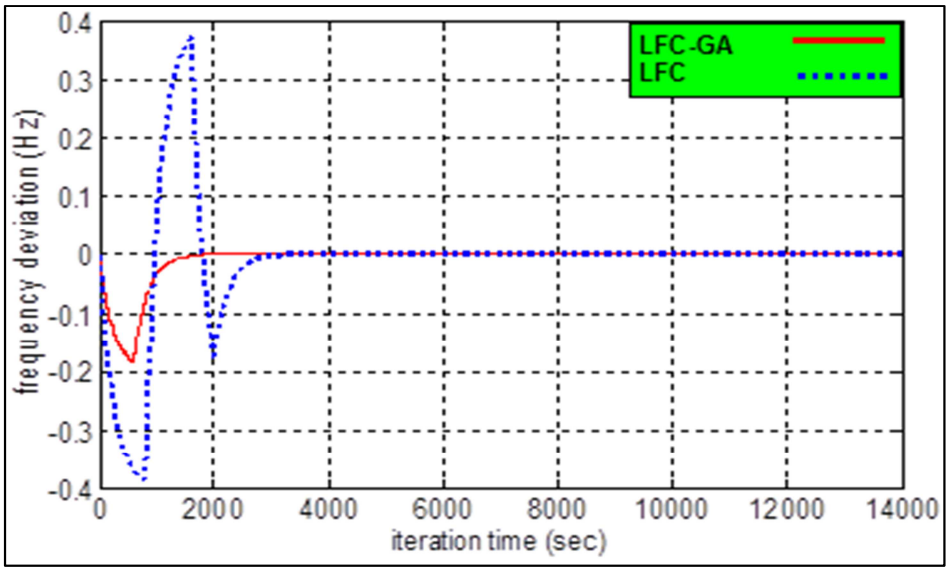

Figure 3. *Comparison results of frequency deviation.*

Figure 4 shows the error signal between the desired and actual frequency is nearly zero with proposed GA-LFC while the error in classical LFC is fluctuating between 3-4Hz.

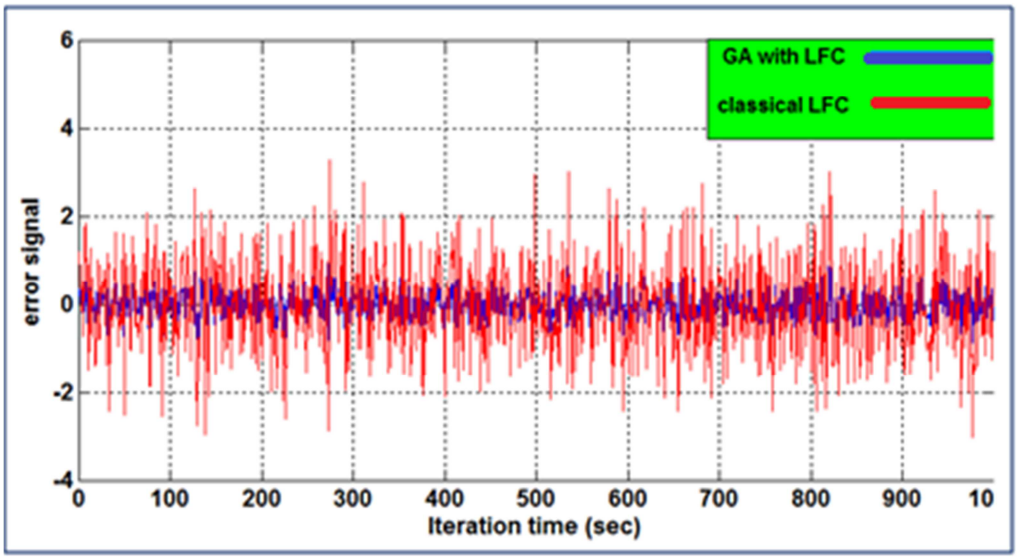

Figure 4. *Comparison Error signal of frequency.*

4. Conclusion

The simulation results mentioned above demonstrates that the system with GA-LFC is better than the LFC system. Therefore, the enhancement of system performance via GA-LFC is obvious but the improvement of system by LFC system is trivial. The artificial intelligent depending on GA for power system generation leads to optimize the system and improved the response of LFC. The GA is chosen in this suggested method because it is simple, need low computation time, and fast response as compared with another intelligent techniques.

References

[1] Mohamed Menaa, Mourad Hasni, Nour EL Yakine Kouba, and Mohamed Boudour, "Optimal load frequency control based on artificial bee colony optimization applied to single, two and multi-area interconnected power systems", IEEE confrernce Tlemcen 25-27 May 2015.

[2] Shalini Pal, Sathans, and Rishabh Verma, "Fuzzy gain scheduled automatic generation control of two area multi unit power system", IEEE conference Allahabad 12-14 April 2013.

[3] Sanjiv Kumar Jain, Ashish Bhargava, R. K. Pal, “Three area power system load frequency control using fuzzy logic controller”, IEEE conference Indore 10-12 Sept. 2015.

[4] Ismail H. Atlas, Jelle Neyens, “A fuzzy logic load frequency controller for power system”, International Symposium on Mathematical methods in Engineering, MME-06, Cankaya University –Trkey April 27-29, 2016.

[5] S. Sivanagaraju and G. Sreenivasan, Power systen operation and control. Pearson publication in South Asia.

[6] 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.

[7] Eisa Bashier M. Tayeb, “Automation of interconnected power system using fuzzy controller”, IEEE conference Pattaya City 28-30 Sept. 2011.

[8] Hassan Farhan Rashag, S. P. Koh, Ahmed N. Abdalla, “Modified Direct Torque Control Using Algorithm Control of Stator Flux Estimation and Space Vector Modulation Based on Fuzzy Logic Control for Achieving High Performance from Induction Motors” Journal of Power Electronics (JPE), vol. 13, no. 3, 2013, pp. 369-380.

[9] R. Kumar, S. Singh, and G. Gopal, "Automatic Test Case Generation Using Genetic Algorithm," International Journal of Scientific & Engineering Research (IJSER), vol. 4, pp. 1135-1141, 2013.

[10] K. Singh and R. Kumar, "Optimization of functional testing using Genetic algorithms," International Journal of Innovation, Management and Technology, vol. 1, p. 43, 2010.

[11] F. S. Babamir, A. Hatamizadeh, S. M. Babamir, M. Dabbaghian, and A. Norouzi, "Application of genetic algorithm in automatic software testing," in International Conference on Networked Digital Technologies, 2010, pp. 545-552.

[12] S. P. Tripathy and D. Kanhar, "Optimization of Software Testing for Discrete Testsuite using Genetic Algorithm and Sampling Technique," International Journal of Computer Applications, vol. 63, 2013.

[13] Hassan Farhan Rashag, S. P. Koh, Nadia M. L. Tan, K. H. Chong, S. K. Tiong “High Performance of Space Vector Modulation Direct Torque Control SVM-DTC Based on Amplitude Voltage and Stator Flux Angle” Research Journal of Applied Sciences, Engineering and Technology, vol. 5, no. 15, 2013, pp. 3934-3940.

[14] G. Shahgholian, S. H. Seyed-Hadi Mozafarpoor-Khoshrodi, "Improvement of perturb and observe method for maximum power point tracking in wind energy conversion system using fuzzy controller", Energy Equipment and Systems, Vol. 4, No. 2, pp. 111-122, Autumn 2016.

[15] G. Shahgholian, K. Khani, M. Moazzami, "Frequency control in autanamous microgrid in the presence of DFIG based wind turbine", Journal of Intelligent Procedures in Electrical Technology, Vol. 6, No. 23, pp. 3-12, Autumn 2015.

[16] G. Shahgholian, N. Izadpanahi, "Improving the performance of wind turbine equipped with DFIG using STATCOM based on input-output feedback linearization controller", Energy Equipment and Systems, Vol. 4, No. 1, pp. 63-77, March 2016.

[17] M. Ghasemi, A. R. Roosta, B. Fani, "Coordinated control of FACTS devices by using ADALINE neural network to enhance the transient stability of power system", Journal of Intelligent Procedures in Electrical Technology, Vol. 3, No. 9, pp. 27-40, Spring 2012.

[18] G. Shahgholian, J. Faiz, "An analytical approach to synthesis and modeling of torque control strategy for two-mass resonant systems", International Review of Automatic Control, Vol. 2, No. 4, pp. 459-468, July 2009.

[19] G. Shahgholian, E. Haghjoo, A. Seifi, I. Hassanzadeh, "The improvement DSTATCOM to enhance the quality of power using fuzzy-neural controller", Journal of Intelligent Procedures in Electrical Technology, Vol. 2, No. 6, pp. 3-16, Summer 2011.

[20] M. Fooladgar, E. Rok-Rok, B. Fani, G. Shahgholian, "Evaluation of the trajectory sensitivity analysis of the DFIG control parameters in response to changes in wind speed and the line impedance connection to the grid DFIG", Journal of Intelligent Procedures in Electrical Technology, Vol. 5, No. 20, pp. 37-54, winter 2015.

[21] G. Shahgholian, A. Movahedi, "Power system stabiliser and flexible alternating current transmission systems controller coordinated design using adaptive velocity update relaxation particle swarm optimisation algorithm in multi-machine power system", IET Gener. Transm. Distrib., Vol. 10, No. 8, pp. 1860-1868, May 2016.

[22] G. Shahgholian, Kh. Khani, M. Moazzami, "The Impact of DFIG based wind turbines in power system load frequency control with hydro turbine", Dam and Hedroelectric Powerplant, Vol. 1, No. 3, pp. 38-51, Winter 2015.

[23] S. Padhan, R. K. Sahu, S. Panda, "Automatic generation control with thyristor controlled series compensator including superconducting magnetic energy storage units", Ain Shams Engineering Journal, Vol. 5, pp. 759-774, 2014.

[24] P. Chauhan, V. Pandya, J. Chauhan, R. Karangia, "Simulation and analysis of ALFC with higher order prime-mover models for single control area", Proceeding of the IEEE/ICEETS, pp. 1084-1089, Nagercoil, April 2013.

[25] S. Pothiya, I. Ngamroo, S. Runggeratigul, P. Tantaswadi, "Design of optimal fuzzy logic based PI controller using multiple tabu search algorithm for load frequency control", International Journal of Control, Automation, and Systems, Vol. 4, No. 2, pp. 155-164, April 2006.

[26] M. Mahdavian, G. Shahgholian, M. Janghorbani, S. Farazpey, M. Azadeh, "Modelling and analysis of a PSS application for LFC in hydro-electric power plant", Proceeding of the IEEE/ECTICON, pp. 1-6, Chiang Mai, Thailand, June/July 2016.

[27] R. K. Khadanga, J. K. Satapathy, “Time delay approach for PSS and SSSC based coordinated controller design using hybrid PSO–GSA algorithm”, International Journal of Electrical Power and Energy Systems, Vol. 71, pp. 262-273, 2015.

[28] K. Zare, M. Tarafdar-Hagh, J. Morsali, “Effective oscillation damping of an interconnected multi-source power system with automatic generation control and TCSC”, International Journal of Electrical Power and Energy Systems, Vol. 65, pp. 220-230, 2015.

[29] G. Shahgholian, A. Movahedi, J. Faiz, "Coordinated design of TCSC and PSS controllers using VURPSO and genetic algorithms for multi-machine power system stability", International Journal of Control, Automation, and Systems, Vol. 13, No. 2, pp. 398-409, April 2015.

[30] G. Shahgholian, A. Movahedi, "Coordinated design of thyristor controlled series capacitor and power system stabilizer controllers using velocity update relaxation particle swarm optimization for two-machine power system stability", Revue Roumaine Des Sciences Techniques, Vol. 59, No. 3, pp. 291-301, 2014.

[31] IEEE Working Group Report, "Hydraulic turbine and turbine control models for system dynamic studies", IEEE Trans. on Power Systems, Vol. 7, No. 1, pp. 167-179, Feb. 1992.

[32] M. Mahdavian, G. Shahgholian, M. Janghorbani, B. Soltani, N. Wattanapongsakorn, "Load frequency control in power system with hydro turbine under various conditions", Proceeding of the IEEE/ECTICON, pp. 1-5, Hua Hin, Thailand, June 2015.

[33] A. H. Elbatran, O. B. Yaakob, Y. M. Ahmed, H. M. Shabara, "Operation, performance and economic analysis of low head micro-hydropower turbines for rural and remote areas: A review", Renewable and Sustainable Energy Reviews, Vol. 43, pp. 1624-1635, Nov. 2015.