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MFO for Automatic Gain Controlling of FO-PID having Multiple Sources

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Abstract: PID controllers are used for the application in industries at higher rate as compared to others. An improved model of the PID controller is proposed that covert the order of the integer of the integration as well as the derivative into the fractional order. This improved controller is named as the FOPID controller. The FOPID is applicable to various AGC based applications. In a micro grid the FOPID controller is utilized for steadiness investigation and compensation of reactive power. The FOPID controller has two extra parameters more than PID controller that makes two degree of freedom in controller design and application.

This study proposed a novel approach for FOPID system. The innovation is done in proposed work by implementing the Moth Flame Optimization with Fuzzy based PID controller to optimize the results. The proposed work is implemented in MATLAB and for the purpose of evaluation the analysis is done by considering Cuckoo search and proposed work. On the basis of the analysis, it is derived that the accuracy of MFO algorithm is higher than Cuckoo search algorithm. MFO algorithm has good robustness, fast convergence speed and global optimization in comparison to other optimization algorithms that makes it more effective and reliable than other optimization techniques.

Keywords: FOPID, Hydrothermal, Electric governor, Gas power system, MFO.

I. INTRODUCTION

Keeping the frequency and voltage in the nominal value or in predetermined restriction are the key significant problems in the power mechanism operation and protection. The reliability and quality of generation power depend on balance between the power generated and power demand plus power losses in all over the power system. In the frequency and tie-line power deviation is occurred as this balance is disrupted. Hence using a proper control method it is necessary to prevent the power system to go to an unstable state. So far, different control method has been used to control the power system frequency in various type of power system.

Until now, some review articles in the LFC issue have been published. For load frequency control of two-area power mechanism the fuzzy PID type controller has been examined. At the power creation in the occurrence of the GRC a two-degree-offreedom PID load frequency controller is presented. On the basis of the maximum peak of response particularization for Automatic Generation Control (AGC) in multi-machine power mechanism the vigorous PID controller is tuned. By applying Neuro Fuzzy Inference System (ANFIS) and Artificial Neural Network (ANN) on the basis of Genetic Algorithm (GA) for LFC issue an adaptive PID has been tuned. Presently, an enhanced edition of PID controller named as FOPID controller have been utilized by several researchers at the several research studies. For Automatic Generation Regulator by applying CNC-ABC paradigm the FOPID controller parameters has been optimized.

In a micro grid the FOPID controller is utilized for steadiness investigation and compensation of reactive power. The FOPID controller has two extra parameters more than PID controller that makes two degree of freedom in controller design and application. Thus, to load frequency control of a couple of domain multi-source interconnected power system by taking into an account the GRC and the Flexible Alternating Current Transmission System (FACTS) appliances like SMES the FOPID controller has been utilized.

On the basis of the established balanced within the power produced and required among the power losses the generation power quality and flexibility was predictable in the whole power system [1]. There is some deviation caused in power and frequency because of disruption in balance. Some random change in the loads can also be seen due to this disruption. This is the reason, it is recommended to use the proper control method so that overall constancy of power unit can be obtained. Till the time numerous control method exist and used to control the frequency parameter in different power systems [2].

II. FOPID CONTROLLER

PID controllers are used for the application in industries at higher rate as compared to others [11]. An improved model [12] of the PID controller is proposed that covert the order of the integer of the integration as well as the derivative into the fractional order. This improved proposed controller is named as the FOPID controller. The order of the calculus operators is the only way to differentiate the PID and FOPID controller. It helps the operator to make it more advance in the flexibility in the design as well as the degree of freedom of the actual practices. The formulation of the FOPID can be mathematically demonstrated as follows:

$$C(s) = K_p + K_t \frac{1}{s^{\gamma}} + K_D S^{\mu} \qquad (1)$$

In the above equation λ depicts the integration order whereas μ depicts the order of derivative. The structure of the FOPID can be demonstrated as shown in the Figure 1.3.

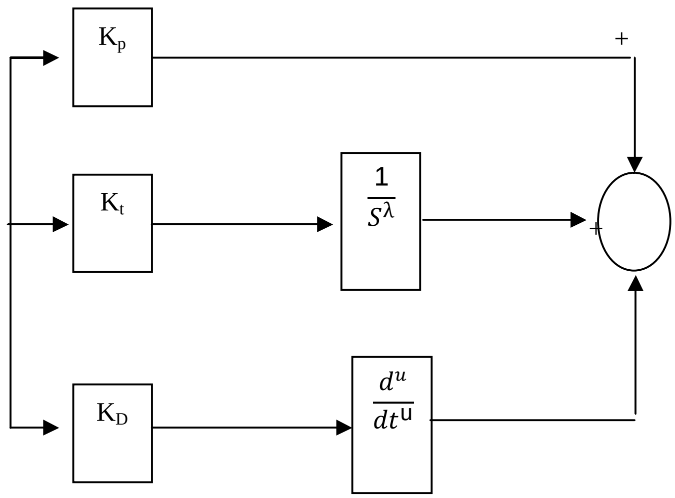

Figure1. FOPID controller structure

III. PROBLEM FORMULATION

In traditional systems for FOPID based power grid systems many researches had been conducted in order to reduce the overshoot in the output. Most of research was done by applying the cuckoo search optimization algorithm in order to obtain reduced overshoot in PID based power systems. By applying the cuckoo search the overshoot was reduced but not to a satisfactory level. Because cuckoo search is considered as the oldest method used for optimization. It suffers from lot of problems such as in cuckoo search algorithm a cuckoo can laid down only one egg in the nest then each egg in the nest considered as a candidate for the solution. Similarly each nest can have multiple eggs and hence it can leads to the multiple candidates for the solution. The aim of the cuckoo search algorithm is to generate a more appropriate solution as compare to the worse solution in order to replace the inappropriate solution with it. Hence it requires enhancing the values but in some real time based applications, there is a requirement of minimum value which cannot be obtained by using the cuckoo search algorithm hence there is a need to develop a system by using such a technique which can overcomes the problems of cuckoo search algorithm.

IV. PROPOSED WORK

As the power electronics is utilized broadly and becoming necessary in the energy alteration mechanism, the errors of these backbone dc–ac converters may conclude in critical issues and expense. In several applications it is turned into a requirement that the power converters must be flexible to survive some errors to assure specific accessibility of the energy supply.

Conventional resolutions to overcome these issues are exactly choosing and managing the positive- and negative-sequence currents. A novel series of control strategies that use the zero sequence components was applied to improve the power control capacity under this difficult situation. As the biggest demerit of this zero sequence current control simulink model was that it generates Total harmonic distortion (THD). So, in this paper the author had modify the existing mechanism that is a zero sequence current control simulink model in order to remove the Total Harmonic Distortion by using multi-level inverters and introduce the filter in the control circuit. The Pulse Width Modulation is also utilized in the present work for the power conversion and also to control the power.

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V. METHODOLOGY

The Figure 2 illustrates the block diagram of the projected mechanism. Here the methodology of the projected mechanism is discussed below as:

A. Power System

The three power methods that are hydrothermal power method, Electric Power method and Gas thermal power method has been taken for the projected mechanism. The major aim of these mechanisms is to decrease the issue of overshoot in the mechanism. The method produces unwanted outcome among the high utilization of cost because of the issue of the overshoot. Therefore, in the next section three mechanisms are taken on which tuning has done.

B. Pid Controller

A PID controller has characteristics of each controller such as it has the characteristics of proportional controller along with the characteristics of Integral controller and finally contains the characteristics of Derivative controller. The rise time of the system can be minimized by Proportional Controller and also it helps in reduction in error in steady state but it is not able to achieve it completely. Now in integral controller the steady state error can be removed completely and also resulted in bad transient response. On the other hand, the derivative controller makes the system stable along with reduction in overshoot. Thus, every power system has tuned using the PID controller as it reduces the problem of overshoot in the system and produces the desired output.
Applied Proportional Integral Derivative controller’s transfer function is given below:

$$K_p\left(1 + \tau_d s + \frac{1}{\tau_i s}\right) \ldots\ldots\ldots\ldots \quad (1)$$

C. Optimization Using MFO

After tuning individual power system using PID controller, the hybrid values from each power system has acquired. Once the tuning has done optimization by MFO algorithm is performed.

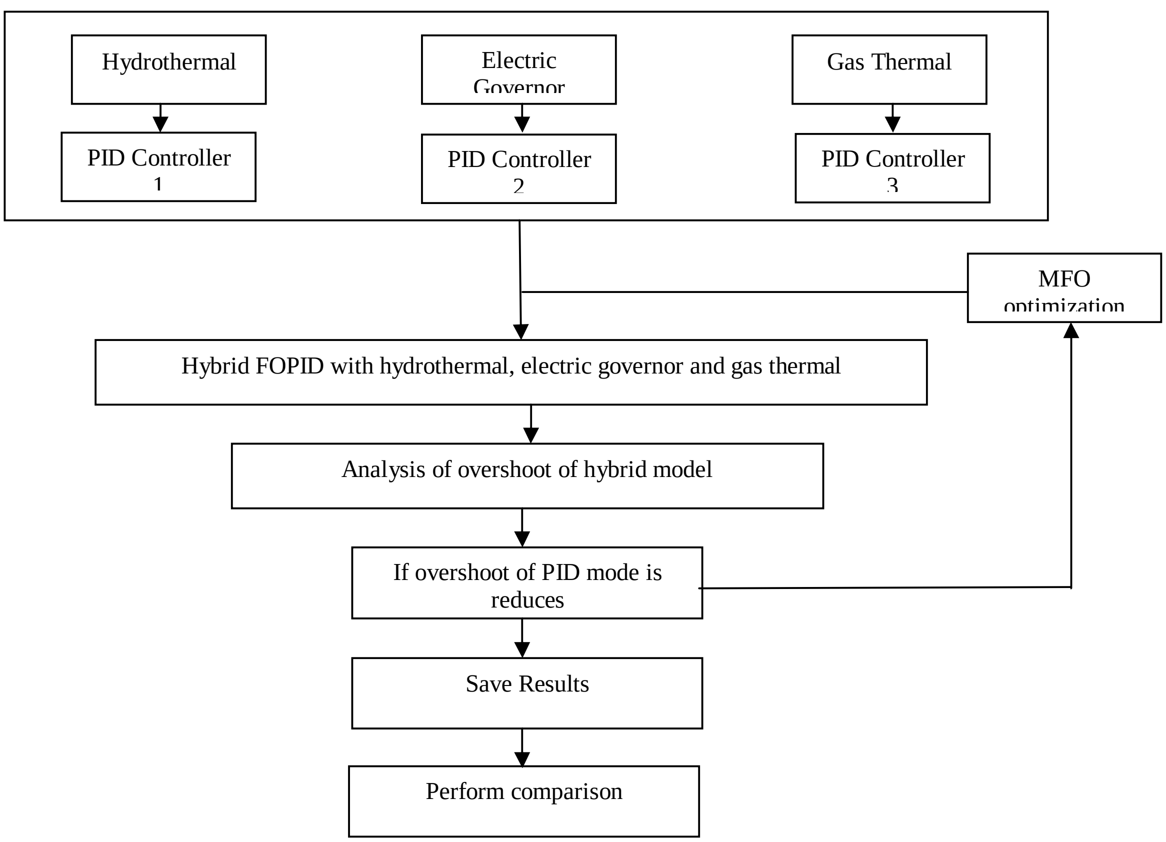

Figure 2 Block Diagram of proposed work

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D. Hybridization

Once the optimization has done to select the optimum parameters, next the acquired output will be the hybrid FOPID which have three different power systems such as hydrothermal power system, Electric Power system and Gas thermal power system. The idea behind their hybridization is the analysis of problem of overshoot in the hybrid system.

E. Analysis of Overshoot

The combined model is then analyzed to detect the effect of overshoot in the system. The hybrid model is then examined in terms of how far it is stable and efficient. Now checks if the problem of overshoot has reduced, in that case, saves the results but if the effect of Overshoot has not reduced yet then again perform optimization algorithm over the acquired output to reduce the effect of overshoot in the hybrid system. The process will be continued until the desired output is not produced or the number of variations (overshoot) is not accordingly.

F. Perform Comparison

Lastly, the output acquired from each power system with MFO optimization has showed. Thus, each power system output is compared with the individual optimization algorithm to confirm the stability of the system. From the results, it has observed the MFO optimization paradigm is efficient than CSA when the tuning of PID controller has been analyzed.

Once the optimization has done to select the optimum parameters, next the acquired output will be the hybrid FOPID which have three different power systems such as hydrothermal power system, Electric Power system and Gas thermal power system. The idea behind their hybridization is the analysis of problem of overshoot in the hybrid system

VI. RESULTS

The proposed system aims to control the output of the electric governor, hydrothermal and gas turbine. In this study the analysis of traditional technique to control the output of the system has been analyzed for the purpose of comparison. The proposed work tunes the MFO approach with PID controller. This section of the study depicts the results that are obtained after implementing the proposed work to control or manage the output of the electric governor, hydrothermal and gas turbine systems by using MFO approach.

Figure 3 illustrates the transfer function model of three area multi-source mechanism. The nominal parameters values for hydrothermal and hydro-thermal-gas mechanism are also illustrated here. To choose the various parameters accessible in the supplementary controller the CSA based optimization is utilized and on the basis of the integral of time multiplied absolute error (ITAE) criteria the deliberation of control mechanism occurs.

$$J_2 = ITAE = \int_0^T \{|\Delta f_1| + |\Delta P_{tiei-j}|\} t.dt \qquad (2)$$

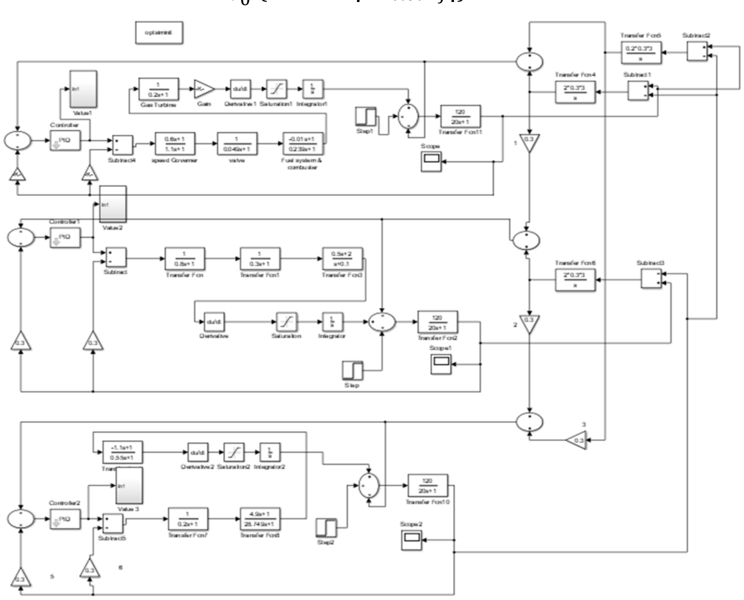

Figure 3 Transfer function model of three-area thermal system

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In addition, this study has been expanded to the multi-source mechanism that contained thermal, gas and hydro units. The dynamic presentation of the projected mechanism is measured among the traditional PID controller. The graph of Figure 4 illustrates the Gas turbine PID in which the Peak overshoot that is achieved is very less near about 3.9 and also its settling time is attained at 300.

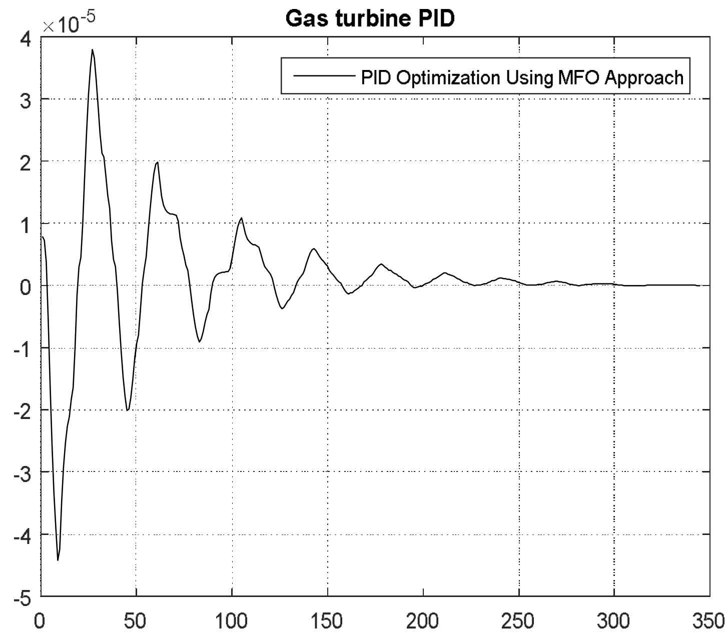


Figure 4 Gas turbine PID

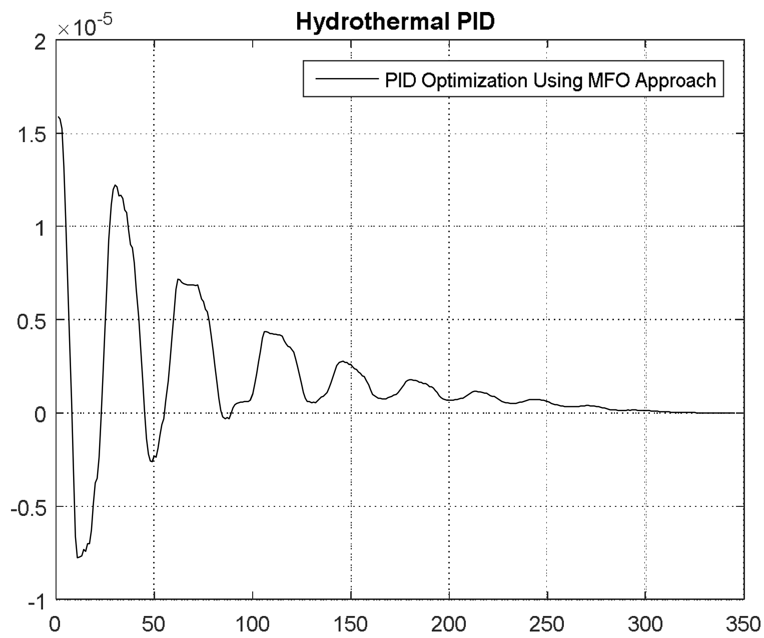


Figure 5 Hydrothermal PID

The graph of Figure 5 illustrates the Hydrothermal PID. In this graph the peak overshoot of the projected mechanism is less that is approximately 1.6 less than the gas turbine PID and its settling time is attained near about 275 that is also very less than the gas turbine PID. The results are obtained in the projected mechanism by applying the MFO approach.

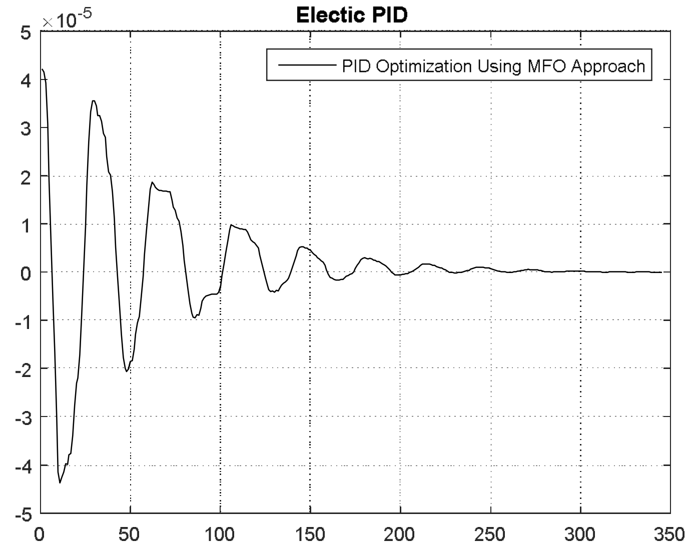


Figure 6Electric PID

The Electric PID is depicted in the graph of the Figure 6 that illustrates the peak overshoot of the electric PID is near about 4.2 that is very low and the settling time is also near about 275 same as hydrothermal PID by applying MFO approach in the projected mechanism.

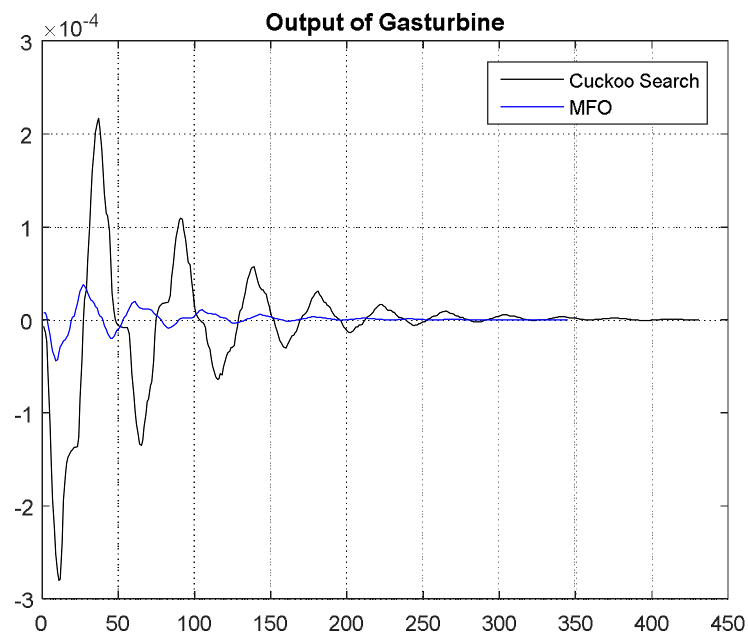


Figure 7 Output of Gas Turbine

The graph of figure 7 illustrates the output of gas turbine of the projected mechanism by applying MFO approach and compared with the conventional mechanism by applying cuckoo search algorithm. It is experimented that the deviation in the power creation and scheduled tie power is effectively low comparative to the PID controller. Here in this graph it is demonstrated that the output of the projected mechanism is much better than the conventional mechanism as the peak overshoot of the projected mechanism is near about 0.4 that is very less than the conventional mechanism and it also has attain the settling time earlier than the conventional mechanism that is around 150.

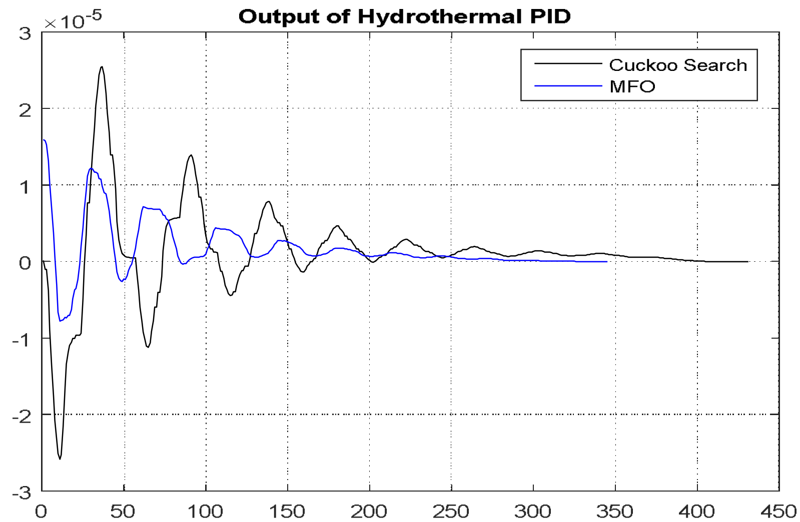


Figure 8 Output of Hydrothermal PID

The graph of figure 8 illustrates the output of the Hydrothermal PID in which the comparison results of the conventional mechanism having cuckoo search algorithm and the projected mechanism having MFO approach has demonstrated. In this graph the peak overshoot of the projected mechanism is very less comparative to the traditional mechanism that is approximately 1.6 and the settling time is nearly 280 whereas the traditional mechanism has 2.6 peak overshoot and 380 settling time.

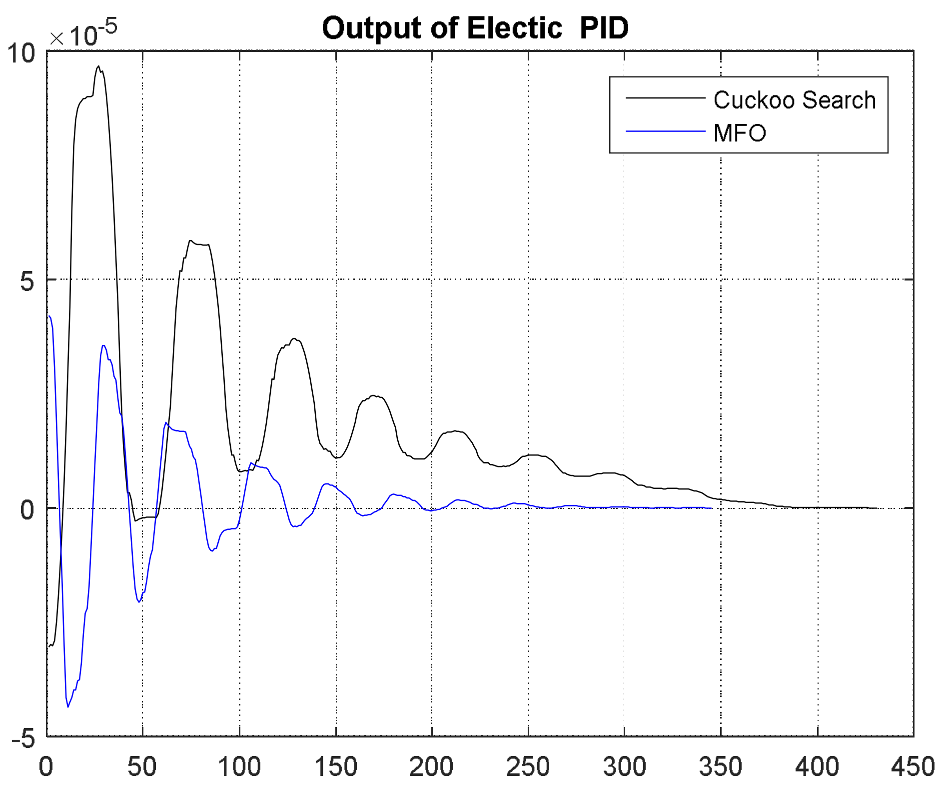


Figure 9 Output of Electric PID

The graph of figure 9 illustrates the output of the Electric PID of the conventional and the projected mechanism. Here, the peak overshoot of the projected mechanism is nearly 4 where as the peak overshoot of the conventional mechanism is nearly 9.5.

Similarly the settling time of the projected mechanism is approximately whereas the settling time of the conventional mechanism is near about 390. Therefore, the projected mechanism has better peak overshoot and the settling time comparative to the conventional mechanism. Hence it is proved that the results of the projected mechanism in any case are better than the conventional mechanism as the projected mechanism is more efficient than the traditional mechanism.

VII. CONCLUSION

On the basis of the established balanced within the power produced and required among the power losses the generation power quality and flexibility was predictable in the whole power system. There are some deviation caused in power and frequency because of disruption in balance. Some random change in the loads can also be seen due to this disruption. This is the reason, it is recommended to use the proper control method so that overall constancy of power unit can be obtained. Till the time numerous control method exist and used to control the frequency parameter in different power systems.

This study develops a MFO Optimization based PID controller for the output of three power grid systems. The simulation is done by considering the output of three power systems such as hydrothermal power system, gas turbine and electric governor power system. The proposed system presents a tuning of PID controller with MFO algorithm. The analysis of cuckoo search algorithm is also done for the comparative purpose. The result section shows that the tuning of PID controller with MFO is better than the tuning of PID with cuckoo search algorithm.

As to reduce the problem of overshoot in the power system, MFO optimization algorithm has reduced with the cuckoo search optimization algorithm. However, in future, chaos based firefly algorithm can be collaborate with the firefly optimization algorithm to enhance the output of the system in an effective and efficient manner.

REFERENCES

[1] Abdul-ghaffar I.H.,Ebrahim. A. E. and Azzam A., "Design of PID Controller for Power System Stabilization Using Hybrid Particle Swarm-Bacteria Foraging Optimization" WSEAS transactions on power systems, Issue 1, Volume 8, Pp 12-23, ,January 2013.

[2] Arzani Ali, Arunagirinathan Paranietharan, Jayawardene, Iroshani and Venayagamoorthy, K.Ganesh,"Dynamic Performance Enhancement of a Utility-Scale Solar PV Plant", IEEE, pp. 26 – 30, 2016.

[3] Bevrani Hassan,Daneshfar Fatemeh and HiyamaTakashi, "A New Intelligent Agent-Based AGC Design With Real-Time Application", IEEE, vol. 42, pp. 994 – 1002, 2012.

[4] DebbarmaSanjoySaikia ChandraLalit, SinhaNidul, Kar Biswajit andDattaAsim, "Fractional order two degree of freedom control for AGC of an interconnected multi-source power system", **IEEE, pp.**505–510, 2016.

[5] Debnath Kumar Manoj,Singh Bahadur Manjit and Mallick KumarRanjan, "Design of Optimal 2-DOF PID controller using GWO Technique for Automatic Generation control of a multisource Power System", IEEE, pp. 531 – 536, 2016.

[6] El-Metwall A.Khaled, "Power system stabilization using swarm tuned fuzzy controller**"** Proceedings of the 17th World Congress The International Federation of Automatic Control Seoul, Korea, July 6-11,Pp 11106-11111, 2008.

[7] Guolian HOU,ZhengXiaobin, Jiang Pengcheng and Zhang Jianhua, "Study of Modeling and Intelligent Control on AGC System with Wind Power", IEEE, pp. 4775 – 4780, 2014.

[8] Hiyama Takashi, Zuo Dunding and Funabashi T., "Multi-Agent Based Automatic Generation Control of Isolated Stand Alone Power System", IEEE, vol. 1, pp. 139 – 143, 2002.

[9] Karray F.,Gueaieb W. and Sharhan Al-S., "The Hierarchical Expert Tuning of PID Controllers Using Tools of Soft Computing" IEEE , Vol. 32, no.Pp 77 -87., February 2002 .

[10] Kawanishi Tetsuya,Inagaki Keizo, Kanno Atsushi and YamamotoNaokatsu, "Precise Measurement Techniques for Optical-to-electric Conversion", IEEE, pp. 3906 – 3906, 2016.

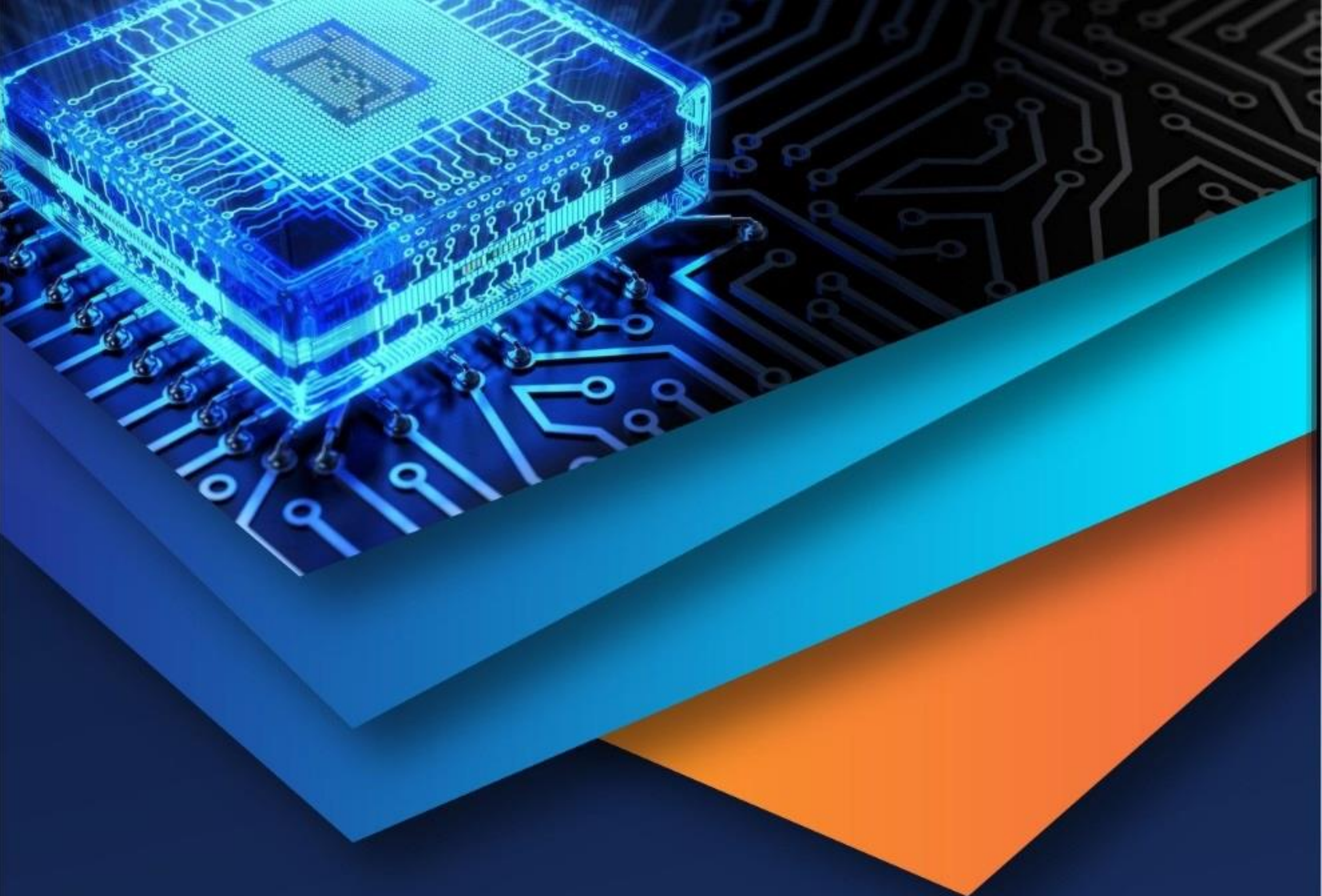
[11] Li Yuxiang, Zhao Yinliang and Shi Jiaqiang, "A Hybrid Samples Generation Approach in Speculative Multithreading", IEEE, pp. 35 – 41, 2016.

[12] Li Zhongwen, Zang Chuanzhi, Zeng Peng, Yu Haibin and Jing Bian, "Fully Distributed Optimal Automatic Generation Control for an Islanded Microgrids", IEEE, pp. 13 – 17, 2016.

[13] Mallick Kumar Ranjan, DebnathKumar Manoj, MallickKumarRanjan, SatapathyPriyambada, "Load frequency controller Design Using Hybrid Differential Evolution Particle swarm optimization (DEPSO) of an interconnected multi-source power system", IEEE, pp. 2629 – 2633, 2016.

[14] Mathur D.H.,Siguerdidjane H. and Bhateshvar K. Y., "Power Frequency Balance in Multi-Generation Smart Grid System with V2G option", IEEE, pp. 1 – 6, 2015.

[15] Mehta M.Ankur, and Rus Daniela, "An End-to-End System for Designing Mechanical Structures for Print-and-fold Robots", IEEE, pp. 1460 – 1465, 2014.



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