



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 12, December 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.569

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com



Temperature Control Using Optimized Techniques

Sabbarapu J Surya Prakash¹, R Madhu²

P.G. Student, Department of Electronics and Communication Engineering, UCEK, JNTUK, Kakinada, India 1

Associate Professor, Department of Electronics and Communication Engineering, JNTUK, Kakinada, India 2

ABSTRACT: Temperature is most commonly used process parameter in the industries. The Continuous development of industries temperature control Technology is more . Temperature control have been fast response.so, our aim is to control the temperature with optimal techniques. As my reference paper said that conventional controllers are not optimally and does not exhibit better performance it's rise time and setting time is too large. So, genetic algorithm based PID controller is used to overcome this above limitations. Here genetic algorithm shows better result then the conventional controllers.

Here my proposed method is harmony search algorithm it's shows better results than genetic algorithm and fast response. Here harmony search method is get sharp control over temperature and harmony search algorithm is music inspired algorithm used to solve various optimization problems. Harmony search has simplicity of implementation, precious, and speed of response then genetic algorithm.

KEYWORDS: PID, genetic algorithm and harmony search algorithm.

I. INTRODUCTION

Here the paper deals with PID, mathematical model, genetic algorithm and harmony search algorithm and results.

Importantly knows about PID control is that there are manifold controlling methods in industries are hasproportional integral and derivative(PID) controller, predictive controller, internal mode controller (IMC), and sliding mode controller (SMC) and mostly used in industries are PID controller due to its simplicity and clear functionality of operation[3].

A PID controller generates an error value based on proportional, integral, and derivative terms (denoted P, I, andD) and applies a correction depending on the difference between a desired set point (SP) and a measured process variable (PV).Cohen Coons, Direct Synthesis and Ziegler Nicholes methods are conventional PID methods[4].

The soft computing techniques such as fuzzy logic, genetic algorithm and artificial neural networks are used to solve complex problems[5]. As conventional controllers are not optimally tuned and the controller used for controlling the temperature of electric furnacehasn't shown any improvement It has an excessively long rising and set time.. So, genetic algorithm based PID controller is used to overcome this above limitations. Here genetic algorithm shows better result then the conventional controllers. Here my proposed method is harmony search algorithm it's shows better results than genetic algorithm and fast response. The harmony search algorithm is good alternative because it is easier to optimize and good results than genetic algorithm.In Harmony search setting time is less and speed of response is more than genetic algorithm.

Here taken reference equation has temperature models as[8]:

$$G(S) = \frac{-0.1125S+0.15}{0.75SS^3+1.825S^2+1.25S+0.2} \quad (1)$$

II. PID CONTROLLER

Proportional, Integral, and Derivative control are the three forms of PID control. The schematic diagram of a PID controller is shown in Figure.

In the case of a constant error signal, however, it does not display variation. The reason for this is that if the error signal's value remains constant over time, its rate of change will be zero. As a result, derivative controllers are used in



conjunction with proportional controllers to consider even continuous error signals PID controller employs a fundamental control method with strong control property. PID controllers are most commonly (around 90% of the controllers) adopted controller in the industries. PID controller consists of three (03) basic gain parameters (K_p, K_i, K_d). The rising time and steady-state error both decrease as the proportional gain increases. If the K_i increases, the rise time (t_{rt}) decreases but the settling time (t_{st}) and the overshoot increase which can be overcome by the increase of the derivative gain. Here the input to the PID controller is $e(t)$ and output is $u(t)$. As the control characteristics (overshoot, rise time, and settling time) change with the variation of the gain parameters i.e., K_p, K_i, K_d .

III. GENETIC ALGORITHM (GA)

Genetic algorithm (GA) is an optimization process. It is inspired by the process of selection and mechanics of genetics. The important part of genetic algorithm is selection of proper objective functions. The genetic algorithm search for the optimum solution and start blindly in search of best solution from the collection of potential solutions. The collection of solutions is known as populations and each solution of population is called chromosome. These are compared with themselves based on fitness value[1]

.GA algorithm composed of 3 basic operations, they are

1. Selection,
2. crossover, and
3. mutation

A flowchart depicts the Genetic Algorithm process. Initialize the population first, then select the population to create a new one. The fitness values are ranked and used to make the selection. Selection, crossover, and mutation are all used in the genetic operation..

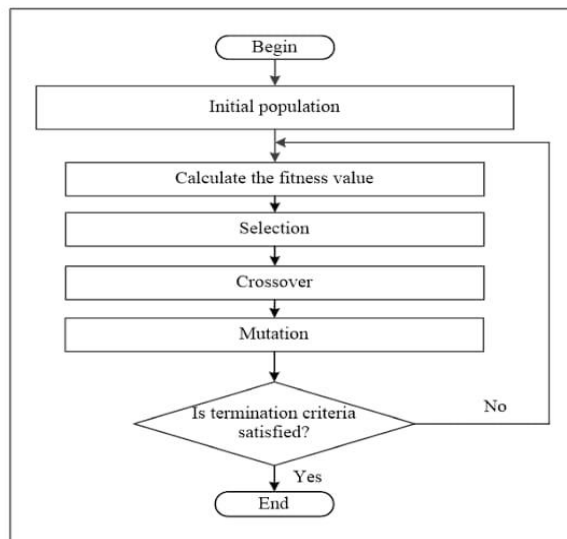


Fig : Genetic algorithm (GA)

IV. HARMONY SEARCH ALGORITHM (HSA)

The basic version of the harmony search algorithm for optimization problems has three parameters, the harmony memory size HMS, the harmony memory consideration rate HMCR and the pitch adjustment rate PAR.

Finding optimality in an optimization process is analogous to finding harmony in music. Each musician in music performance plays a musical note at a time, and those musical notes together make a harmony. As similar, each variable in optimization has a value at a time, and those values together make a solution vector. As the music group improves their harmonies practice by practice, the algorithm improves its solution vectors iteration by iteration. In the



harmony, the new solution is replaced by the worst solution. The HS metaheuristic algorithm was inspired by natural musical performance processes that take place when a performer seeks a more harmonious condition. The HSA based PID controller is shown in figure.

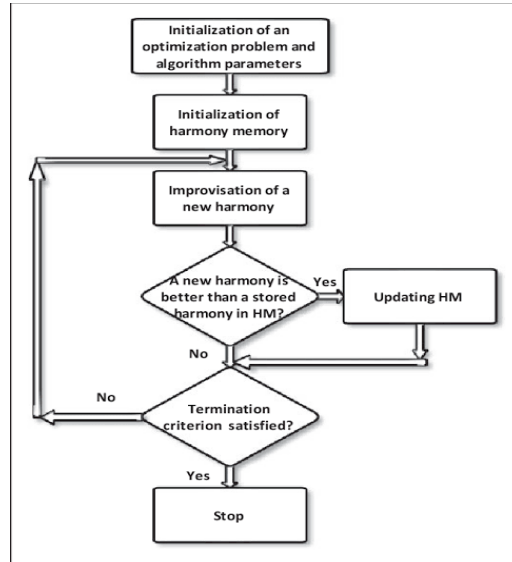


Fig : Harmony search algorithm

The above figures are Harmony search algorithm flowchart and HS based PID controller.

The steps in harmony search flowchart gives:

1. Initialize the problem and algorithm parameters.
2. Initialize the harmony memory.
3. Improvise a new harmony.
4. Update harmony memory.
5. Check stopping criterion.

The process of proposed is described as

Selection of the gain parameters: The PID controller is used in cascade with the temperature system. Here the three basic gain parameters of the PID type controller are K_p , K_i , and K_d . If K_p rises, the rise time and the steady-state error decrease. Again, if K_i increases, the rise time decreases but the overshoot and the settling time increase, which could be overcome by increasing the K_d .

As the control characteristics (overshoot, rise time, and settling time) change with the variation of the gain parameters, one needs to choose the optimum value of the gain parameters (K_p , K_i , K_d). So, algorithms are applied to find the suitable (optimum) values of these gain parameters.

Choosing the object function: The optimum (minimum) value of this object function. These algorithm uses the error signal $e(t)$, which is the difference between the set input and output to form the object function. It is the function which is optimized algorithm is considered as the object function for optimization.

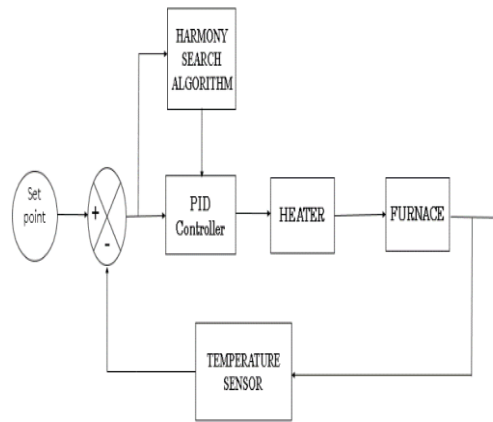


Fig:Harmony Search based PID

Finding the optimum value :This steps procedure is used to adjust the PID controller, i.e. to find the best K_d , K_i , and K_p values. There is no set rule for determining the size of the population. It is chosen at random. The population size and ranges of gain parameters are found through trial and error, with the method outperforming the others.

The comparison of the above shown method are genetic algorithm, ZN method, Cohen-coon method and Direct synthesis are GA method shows better result than the other methods. ZN method is highest overshoot than other methods, GA and nelder mead has least amount of overshoot. The proposed method of Harmony search better result than this methods. The harmony search as leads amount overshoot than other and has fast response than other methods.the propose harmony search shows better performance than other methods.

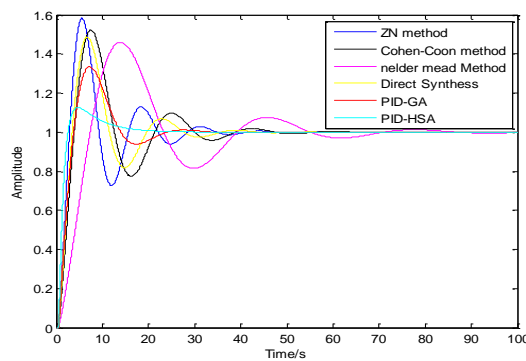


Fig:Step Response of HSA with other methods

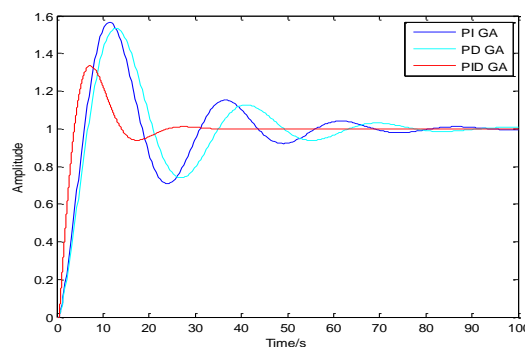


Fig:Step Response of GA with PI,PD and PID Controller

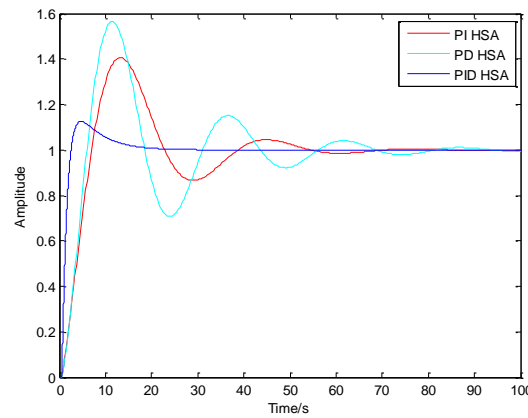


Fig:Step Response of HSA with PI,PD and PID Controller

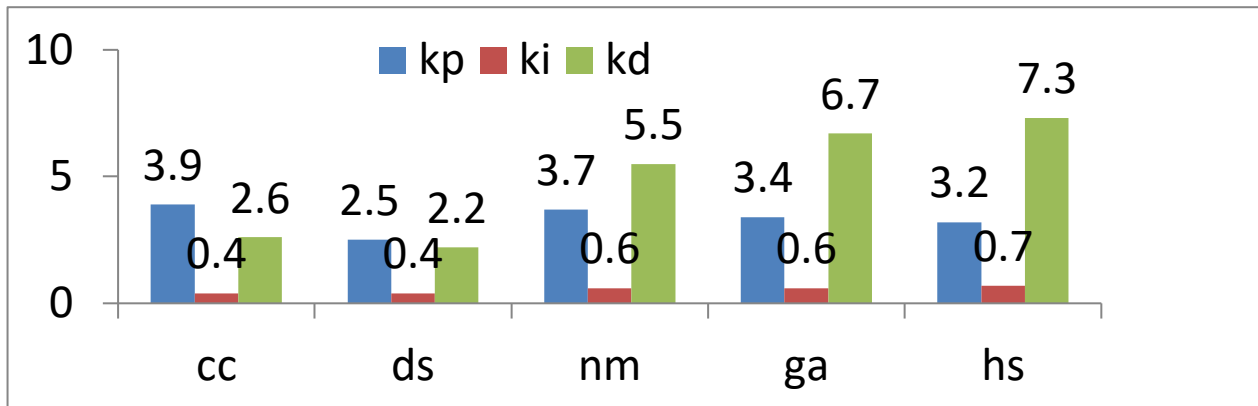


Fig:Response of system with HSA controller

V. CONCLUSION

The optimized PID controller to control the temperature of the electric furnace. From this optimization we obtained the optimum value of $K_p = 3.2010$, $K_i = 0.7520$, and $K_d = 7.320$. For these values of the gain parameters, the step response of the system exhibits better result than other methods. And have fast response than other. This sharp and prompt control over the temperature has great response industries. Here I have designed simulink for a pi, pd for genetic algorithm and harmony search algorithm as we showed the results and simulated their analysis. Here shows that harmony search algorithm gives better responses than genetic algorithm and other methods.

Temperature has a fast response and takes more time to decrease. Searching path in harmony search is random and GA is in other so its takes more time than HS.

REFERENCES

1. Md. Manjurul Gani, Md. Saiful Islam, Muhammad Ahsan Ullah (2019) Chittagong university of engineering and technology, Chittagong, Bangladesh. Optimal PID tuning for controlling the temperature of electric furnace by genetic algorithm. In 2019 Springer Nature
2. Li J, Yan C, Liu J (2012) Design of temperature control system based on fuzzy PID, advanced materials research, vol 418 - 420. Trans Tech Publications, Switzerland, pp 1756–1759
3. Jayachitra A, Vinodha R (2014) Genetic algorithm based PID controller tuning approach for continuous stirred tank reactor, Hindawi Publishing Corporation. Adv Artif Intell 2014, 791230
4. Sabura Banu U, Uma G (2007) ANFIS gain scheduled CSTR with genetic algorithm based PID minimizing integral square error, In: IET-UK international conference on information and communication technology in electrical sciences (ICTES 2007), Dr. M.G.R. University,



5. Chennai, Tamil Nadu, India. Dec. 20–22, pp 57–62
6. Rahmat MF, Yazdani AM, Movahed MA, Mahmoudzadeh S (2011) Temperature control of a continuous stirred tank reactor by means of two different intelligent strategies. *Int J Smart Sens Intell Syst* 4(2):244–267
7. Chunchen W, Feng C, Guang Z, Ming Y, Liangzhe L, Taihu W (2017) Design of genetic algorithm optimized PID controller for gas mixture system. In: 2017 IEEE 13th international conference on electronic measurement & instruments, 13th IEEE international conference on electronic measurement & instruments (ICEMI), 20–22 Oct. 2017, pp 6–9
8. Ayam M, Liqaa SM, Raof TH (2016) Speed control for separately excited DC motor with PID controller, GA, And PSO. *Int J Recent Sci Res* 7(7):12673–12678
9. Sinlapakun V, Assawinchaichote W (2015) Optimized PID controller design for electric furnace temperature systems with Nelder Mead Algorithm. In: 12th international conference on electrical engineering/electronics, computer, telecommunications and information technology (ECTI-CON), 24–27 June 2015, pp 1–4
10. Jiang W, Jiang X (2012) Design of an intelligent temperature control system based on the fuzzy self-tuning PID. In: International symposium on safety science and engineering in China, 2012 (ISSSE-2012), *Procedia Engineering* 43, pp 307–311
11. Flores-Morán E, Yáñez-Pazmiño W, Barzola-Monteses J (2018) Genetic algorithm and fuzzy self-tuning PID for DC motor position controllers. In: 2018 19th international carpathian control conference (ICCC), Szilvasvarad, pp 162–16



**Impact Factor:
7.569**



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details