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Controller Design For Boiler

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Abstract*: This involves a mathematical modelling of a boiler. First, data is acquired from the boiler set-up. The model is designed to control the different parameters related to the boiler set-up automatically. Simulation is done in the Simulink toolbox in MATLAB. Through simulation, temperature curve are obtained. Simulation is done by different controllers like PID, Fuzzy and Anfis. The temperature curves are obtained and are compared. The curve with the best settling time is applied to the hardware.*
Keywords*: Boiler, Simulink, PID, Fuzzy, Anfis****.***

I. Introduction

Boiler is an energy converter in which input can be either chemical or electrical energy and the output can be thermal energy. Boiler is actually a closed vessel in which water or any other fluid is heated. The heated fluid flows out of the boiler which can be used for various purposes such as central heating, power generation and many more. Electric boilers uses immersion type or resistance type of heating elements. Boilers have been very common in power plants. The control system for boiler is a multivariable process that shows great interactions and the input constraints are subjected to a wide range of operating conditions.

Construct the models from input and output data obtained from the set-up.. The model should be such that it should describe the behavior of the process around an operating point. Controller designing is done for this model. A conventional PID controller is designed, along with that Fuzzy and Anfis controllers are designed. Experimentation is done on Boiler set-up.

II. Boiler And Controller Specifications

The boiler used for the hardware demo is around 10cm height, 30cm in length and 10m wide. It can hold upto 3 litres of water. The maximum heat it can withstand is around 120°C.

The transfer function of the boiler used in the simulation is given as -

T.F.= (0.2304s + 0.01265)/(s2 + 0.06689s + 0.005244)

The above transfer function is obtained from [1].

The input to the system is heat in the form of temperature in degree Celsius and the output is pressure of the steam in terms of psi.

A. PID Controller

PID controller is a Proportional-Integral-Derivative controller which follows control loop feedback mechanism which is most commonly used in industrial control system. A PID controller regularly calculates the error value as the difference between a set point and measured process variable and then applies correction based on Proportional, Integral and derivative terms. The equation governing the PID controller is:-

$u(t) = K_p\, e(t) + K_i\, e(t)dt + K_d\, de(t)/dt$

where , K_p, K_i and K_d are non-negative and coefficients of proportional, integral and derivative.

After calculations, the values of controller parameters are obtained

$K_p = 2.8272$

$K_i = 1$

$K_d = 0.25$

B. FUZZY Controller

A Fuzzy controller is a control system based on fuzzy logic. A fuzzy logic is basically a mathematical system that analyses analog input values in terms of logical variables that are 0 and 1 .

The membership functions for the input and output od Fuzzy controller are shown in Fig:-B(i) and B(ii) respectively.

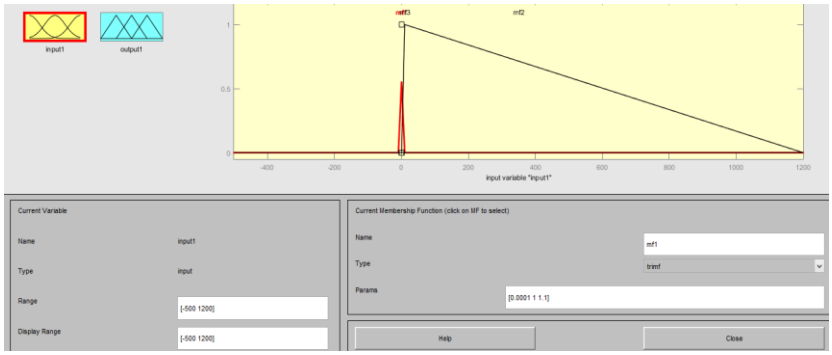

Fig:- B(i)

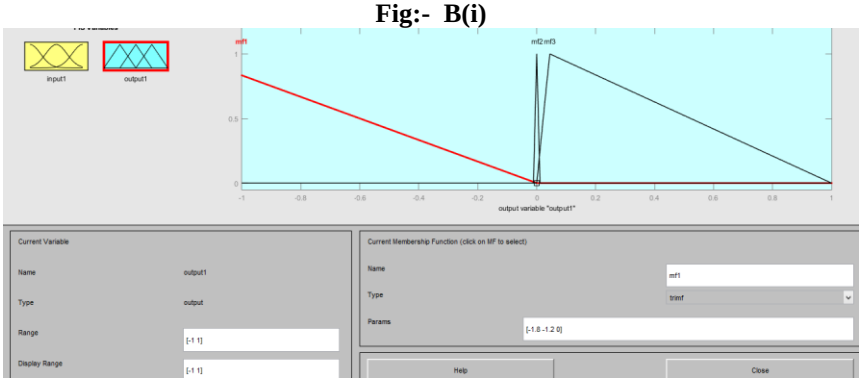

Fig:- B(ii)

C. ANFIS Controller

An adaptive neuro-fuzzy inference system or adaptive network based fuzzy inference system(ANFIS) is a kind of artificial neural network that is based on Takagi-Sugeno fuzzy interference system. Since it integrates both neural networks and fuzzy logic principles, it has potential to capture benefits of both in single framework.

The membership functions for the input and output of the Anfis controller are shown in Fig:- C(i) and fig:-C(ii) respectively.

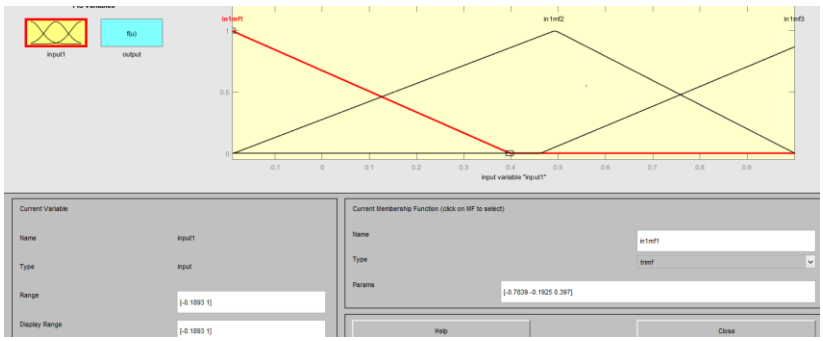

Fig:- C(i)

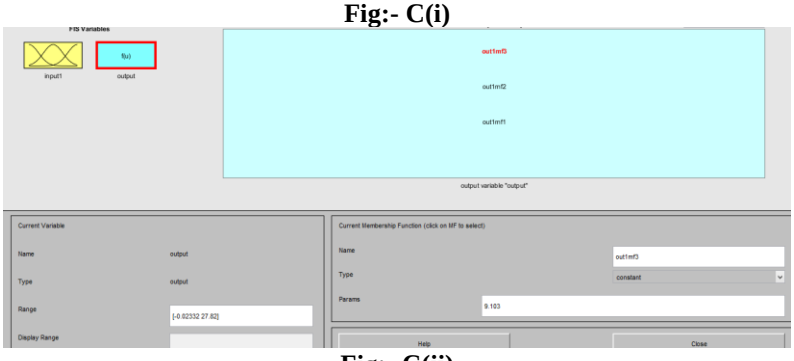

Fig:- C(ii)

III. Block Diagram

The heated steam temperature is an important parameter in the production process of boiler. To adjust the temperature of heated steam, the amount of water going inside should be controlled.

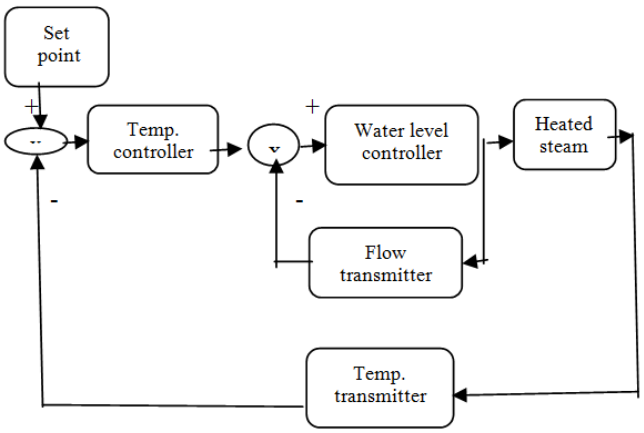

Fig:-III(i)

IV. Simulation Results

From the simulation, three temperature responses were obtained from the given transfer functions.

- The simulation result for PID controller is shown in the fig:-IV(i)
  The settling time is near to 37seconds.
- The simulation result for fuzzy controller is shown in the fig.:- IV(ii)
  The settling time is 23 seconds.
- The simulation result for PID controller is shown in the fig:IV(iii)
  The settling time is near to 37seconds.

The temperature response graph for the three different controllers PID, Fuzzy and Anfis are –

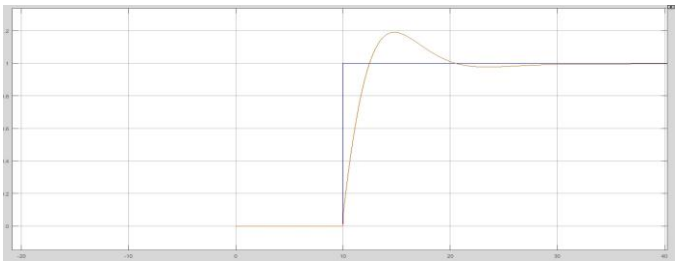

Fig:-IV(i)

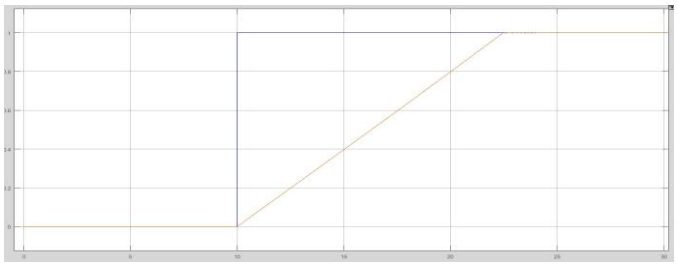

Fig.-IV(ii)

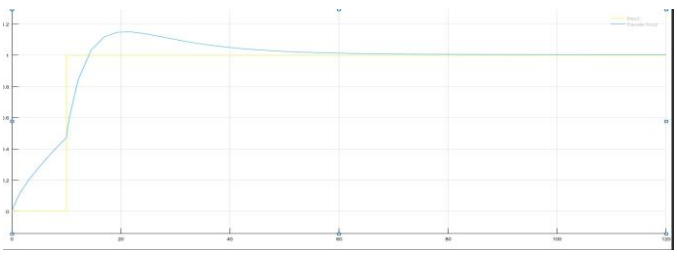

Fig.-IV(iii)

V. Conclusion And Result

The different controllers are studied and compared on the basis of their temperature response, it can be concluded that fuzzy controller is the most steady among the three.
A real time working model for the boiler set up is made which will easily show the actual working of the industrial boiler.

Acknowledgement

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References

[1] Jaya S. Lahane, Meera A. Khandekar System Identification and Controller Design for Boiler and Heat Long Exchanger Set-Up –: IJAREEIE, Vol 3, Issue 7, 2014
[2] Zhe Dong, Xi, Qian Zhang Design of Boiler Control system -:7th International Conference on Intelligent Human System 2015
[3] Jerin Jose, Nafissa K., Md. Ismail Yasar- Fuzzy logic based control of Marine boiler system -:2015 IEEE International Conference on PICC.
[4] C.Maican, M.Vinatoru, G.Canureci, E.Iancu- Control system simulator for Steam Boiler Parameters.