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Improved Performance of Stability and Turbine Response of Hydro Power Plant System by Fuzzy Logic

Amit Kumar Shukla [1], Mukesh Kumar Gupta[2]
[1]M.Tech Scholar, JaganNath University, Jaipur, Rajasthan, India
[2]Professor, JNIT, Jaipur, Rajasthan, India

Abstract: **-** In this Research work, simulation model of typical canal kind small hydro-electric power plant developed through model inter-connection of assorted equipments of plant into consideration during MATLAB/SIMULINK based mostly package surroundings. Varied elements of tiny electricity plant, governor, semi-Kaplan turbine and open channel. Synchronous exciter, generators are being thought about below modeling and simulation. Aim is to check its behavior throughout transient condition. Victimization simulated model sweetening through Fuzzy logic controller are done to scale back oscillations, peak overshoot and peak undershoot throughout transient amount and additionally to enhance steady state response this invalidator prices and safety conditions, in choosing simplest alternatives within early phase of design and to see devices.

Using fuzzy logic, the turbine response max overshoot is 0.25 and stabilizes at 0.36. Whereas using PID the turbine response max overshoot is 0.38 and stabilizes at 0.8. Without any controllers the max overshoot is 0.39 and stabilizes at 0.9.

Keywords: - *hydraulic transients, integral and proportional controller, mathematical models, Matlab/Simulink, small hydro-electric power plant.*

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I. INTRODUCTION

In irrigation channel based for the most part little hydro plants, using heads out there gives extra or less consistent force era. Be that as it may it's seen that zenith out there is kind of consistent while there are enormous varieties inside release out there. Capacity era is absolutely subordinate upon watering system discharges season astute through channel that relies on yield design inside of area. Power era is for nine months as months of April, May and August don't appear to be considered since release is littler sum than one cumecs. Displaying and simulation of little hydro force plant is effective apparatus for outlining station operations and judgment worth of physical cdroope by picking right system parameters. Prior this was done gigantic or little hydro force plants. With the exception of channel sort little hydro force plants this study helps in valedictory costs and wellbeing conditions. It moreover aides in valedictory parameters of administration types of gear like senator, water level controller, exciter and so on and in choosing element powers performing on system that ought to be contemplated in auxiliary examination of penstock and their backing.

II. PROBLEM STATEMENT

Synchronous generator is joined with stack through link as indicated. Burden is 1.2mw on generator. Since motions are all through transient sum is unbelievably huge for mechanical data and in entryway operation of generator. To scale back their motions into confined shift, PID controller was utilized. Estimations of representative, exciter, synchronous generator and water driven turbine are same as given some time recently. Comparing results are demonstrated between figures nine and ten.

At the point when plant was joined with its load, there has been a lot of motions inside mechanical force (info to generator) and inside gate operation all through starting transient sum as advantageous from waveforms. By exploitation PID controller, a wavering inside mechanical force and in gate hole all through transient sum was definitely diminished. Though most overshoot and most undershoot was furthermore controlled. For mechanical force relentless state came to in however 0.5 seconds as analyzed while not provocative ailment controller wherever unfaltering state was come to when 3.7 seconds. We have the capacity to say that there have been no motions all through transient sum. Same case happened with entryway operation, there was outrageously low swaying in its operation all through transient sum, once PID was in operation. In irrigation channel based for the most part little hydro plants, using heads out there gives extra or less consistent force era. Be that as it may it's seen that zenith out there is kind of consistent while there are enormous varieties inside release out there. Capacity era is absolutely subordinate upon watering system discharges season astute through channel that relies on yield design inside of area. Power era is for nine months as months of April, May and August don't appear to be considered since release is littler sum than one cumecs. Displaying and simulation of little hydro force plant is effective apparatus for outlining station operations and judgment worth of physical cdroope by picking right system parameters. Prior this was done gigantic or little hydro force plants. With the exception of channel sort little hydro force plants this study helps in valedictory costs and wellbeing conditions. It moreover aides in valedictory parameters of administration types of gear like senator, water level controller, exciter and so on and in choosing element powers performing on system that ought to be contemplated in auxiliary examination of penstock and their backing.

III. MATHEMATICAL MODELING

For the most part differential comparisons are usual to depict fluctuated establishment components. Investigation of element conduct of system relies on character of differential mathematical statements.

IV. SMALL-SYSTEMS

If system comparisons are straight, procedures of direct system examination are usual to study dynamic conduct. Each part is mimicked by excdroope work and these excdroope capacities squares are joined with speak to system underneath study.

V. LARGE-SYSTEM

State space model are utilized for system studies depicted by direct differential comparisons. In any case, for transient soundness study nonlinear differential mathematical statements are utilized.

VI. PROCEDURES UTILIZED FOR DISPLAYING FOR CANAL SORT LITTLE HYDRO STATION.

Generator models come running from central circuit comparisons and along these lines utilization of park's cdroope. Hydraulic turbine model incorporates each straight and nonlinear administration ways. Nonlinear models are required wherever speed and force cdroopes are monstrous.For representative, scientific mathematical statements of typical differential comparisons speaking to dynamic conduct is utilized. Here controller comprises of two components electrical (PID controller) and electro water powered components.For exciters an ordinary differential mathematical statement is utilized.

VII. MATHEMATICAL/ SCIENTIFIC MODELING OF SYNCHRONOUS MACHINE

Synchronous machine into thought is expected to have three stator curl windings, one field loop and two damper windings.

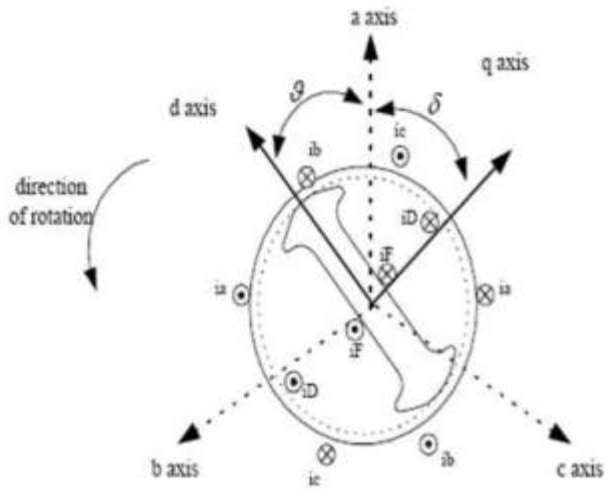

Figure 1:- Representation Of synchronous Machine

VIII. PROPOSED DESIGN

We are proposing the Fuzzy logic for improve the performance of the system . For improve the performance we use fuzzy logic by different rules .Performance is improving in terms of turbine response and stability of the turbines. Using fuzzy logic we can reduce the set up time and thus the performance of the turbine as well as servo motor increases.

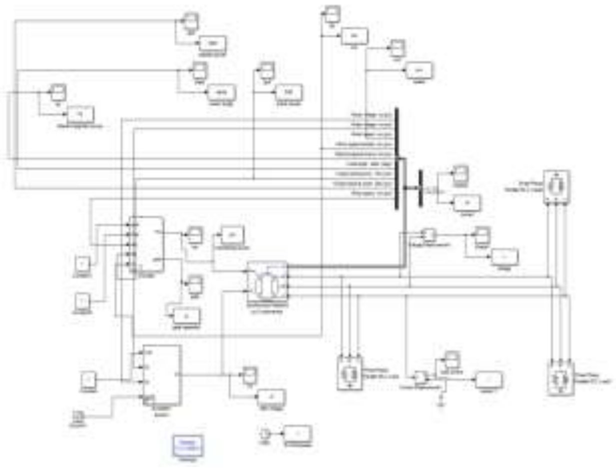

Figure 1:- Design Model

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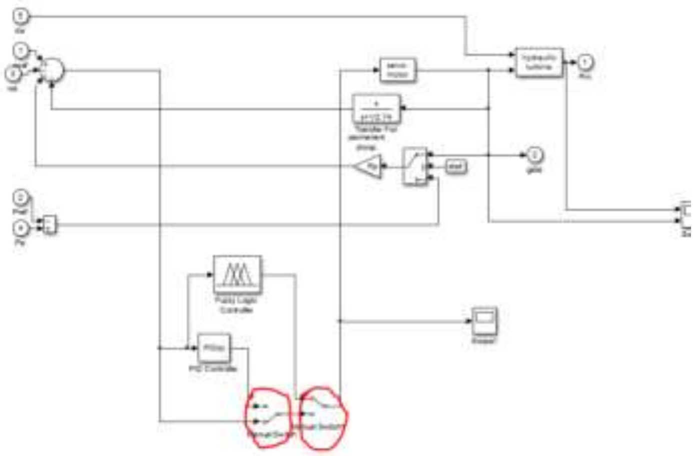

Figure 2:- Controller Change By Switch

According to model, use two switches one switch is for PID controller and second switch is for Fuzzy logic. The first graphs are showing the stability of the system.

The range of the input system is 0 to 1. We have 7 rules for input of fuzzy logic.

Input of Fuzzy rule	Output of fuzzy rule
MF1	MF1
MF2	MF2
MF3	MF3
MF4	MF4
MF5	MF5
MF6	MF6
MF7	MF7
MF1	MF2
MF1	MF3
MF1	MF4
MF1	MF5
MF1	MF6
MF1	MF7

Table 1: - Fuzzy Logic Rule

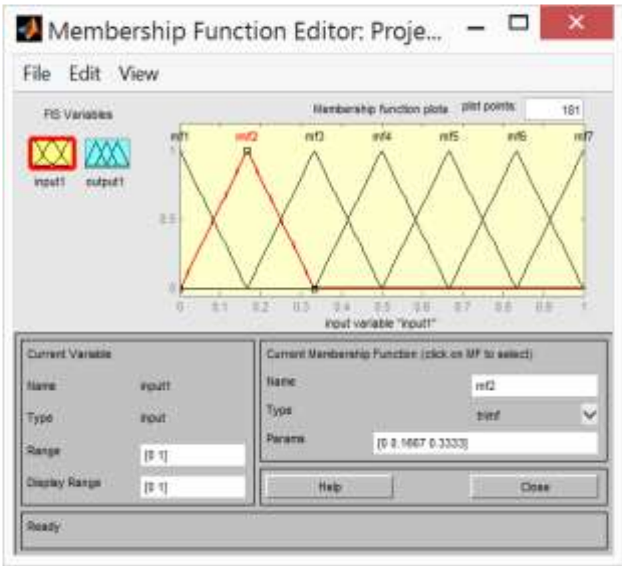

Figure 3:-Input Fuzzy Logic File

Take 7 parameters for design the rules. The range of the input is [0 to 1]. It is changing according to rule.Inout waves are in form of triangular mfs.

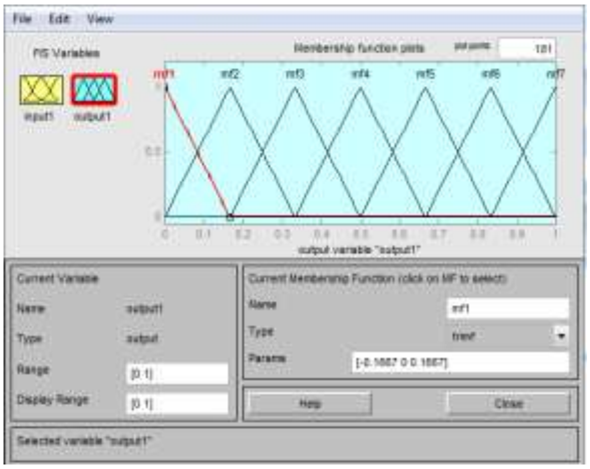

Figure 4:- Output Fuzzy Logic Rule File

The range of the output fuzzy logic file is [0 to 1].

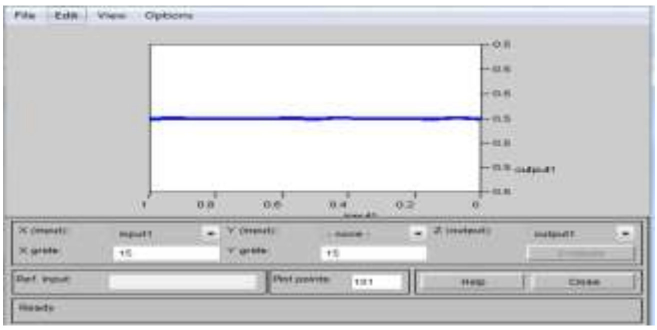

Figure 5:- Surface View

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Surface view of the fuzzy logic rules are showing in image. As the input get change, output is changing. So the graph is coming as a straight line.

IX. RESULTS

9.1 WITH NO CONTROLLERS

Hydro power plant system output is depending on the controller. As the controller change the characteristics of the output will change. Without any controller the stability graph is going up to 0.05 and the turbine response overshoot is going up to 0.4.

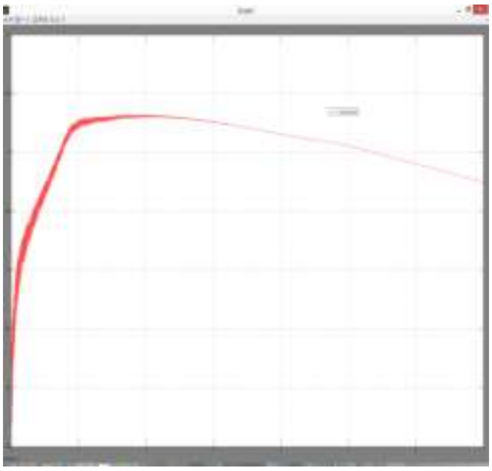

Figure 6:- Stability Graph For With Out Any Controller

Figure 7: - Turbine Response Graphs For Without Controller

9.2. WITH PID

After apply PID controller the step response something get improve. But it is not stable according to desire output.

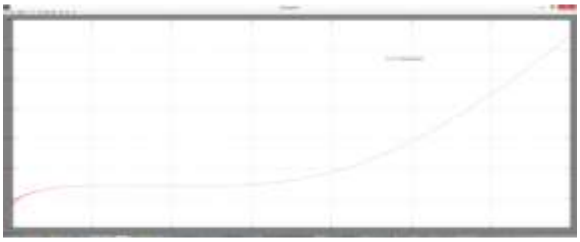

Figure 8: - Stability Graph For PID Controller

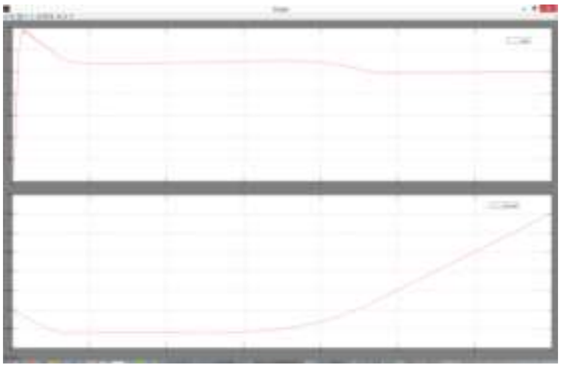

Figure 9:- Turbine Response For PID Controller

Turbine response is touching to the value of 0.4. Stability graphs increase randomly then not stable. It is getting stable after so much fluctuation.

9.3 WITH FUZZY LOGIC

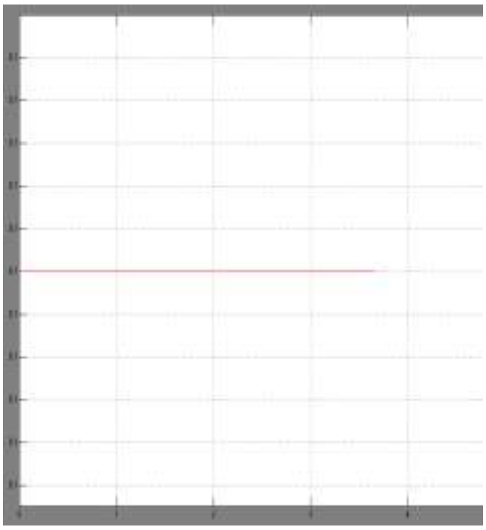

Figure 10:- Stability Of Turbine For Fuzzy Logic

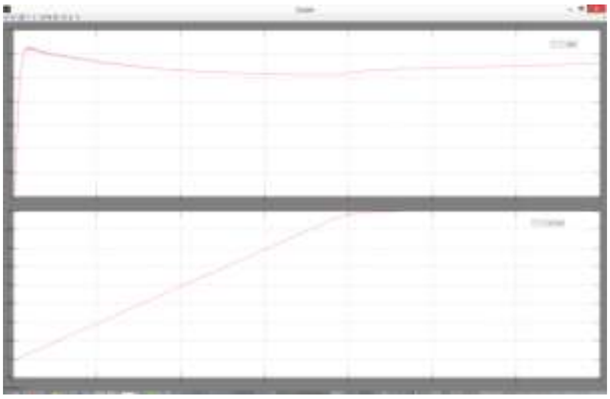

Figure 11:- Turbine Response For Fuzzy; Logic

Turbine response graphs is better from the PID and without fuzzy . The graphs is starting and goes up to peak point and then after stability it gets reverse back and at a pix point it get stable .

X. CONCLUSION

Using fuzzy logic, the turbine response max overshoot is 0.25 and stabilizes at 0.36. Whereas using PID the turbine response max overshoot is 0.38 and stabilizes at 0.8. Without any controllers the max overshoot is 0.39 and stabilizes at 0.9.

References

[1] Carmen L.T. Borges, Senior Member, IEEE, and Roberto J. Pinto. *Small Hydro Power Plants Energy Availability Modeling for Generation Reliability Evaluation.* IEEE TRANSACTIONS ON POWER SYSTEMS, VOL. 23, NO. 3, AUGUST 2008.

[2] *National Association of State Energy Officials (NASEO).* Web site: www.naseo.org

[3] *Micro-hydro.* Web site: www.geocities.com/wim_klunne/hydro/index.html

[4] *U.S. Department of Energy Hydropower Program*. Web site: hydropower.inel.gov

[5] *Volunteers in Technical Assistance (VITA).* Web site: www.vita.org

[6] *Energy Efficiency and Renewable Energy Clearinghouse (EREC).* Web site: www.eren.doe.gov/consumerinfo/.

[7] Prabha Kundur, *Power System Stability and Control* by Tata McGraw-Hill, New York. A Power System Engineering Series.

[8] Paul M. Anderson and A.A. Fouad *Power System Control and Stability* IEEE PRESS. The Institute of Electrical and Electronics Engineer, Inc., New York.

[9] K.R.Padiyar, *Power System Dynamics-Control and Stability*, Interline Publishing Pvt. Ltd., Banglore.

[10] Hongqing Fang, Long Chen, Nkosinathi Dlakavu, and Zuyi Shen *Basic Modeling and Simulation Tool for Analysis of Hydraulic Transients in Hydroelectric Power Plants.* IEEE Transactions on Energy Conversion, Vol. 23, No. 3, September 2008.

[11] FANG Hong-qing, *Student Member, IEEE, and SHEN Zu-yi* . **Modeling** *and Simulation of Hydraulic Transients for Hydropower Plants.* 2005 IEEE/PES Transmission and Distribution Conference & Exhibition: Asia and Pacific Dalian, China.

[12] GE Baojun, XIN Peng and LV Yanling. *The Excitation System Simulation of Huge Hydro-generator*. Harbin University of Science and Technology Harbin, China, E-mail: Gebj@hrbust.edu.cn, xinpeng4321@sina.com, 978-1-4244-4813-5/10/$25.00 ©2010 IEEE.

[13] Fang Yang Hao Lei Yuanzhang Sun Wei Lin and Tielong Shen. *Control of Hydraulic Turbine Generators Using Exact Feedback Linearization*. 8th IEEE International Conference on Control and Automation Xiamen, China, June 9-11, 2010.

[14] Tin Win Mon, and Myo Myint Aung. *Simulation of Synchronous Machine in Stability Study for Power System* World Academy of Science, Engineering and Technology 39 2008).

[15] Innocent Kamwa, Daniel Lefebvre and Lester Loud, *Member, IEEE, Small Signal Analysis of Hydro-Turbine Governors in Large Interconnected Power Plants,* 0-7803-7322-7/02/$17.00 © 2002 IEEE.

[16] Li Wang, *Senior Member, IEEE*, Dong-Jing Lee, Jian-Hong Liu, Zan-Zia Chen, Zone-Yuan Kuo, Huei-Yuan Jang, Jiunn-Ji You, Jin-Tsang, Tsai, Ming-Hua Tsai, Wey-Tau Lin, and Yeun-Jong Lee. *Installation and Practical Operation of the First Micro Hydro Power System in Taiwan Using Irrigation Water in an Agriculture Canal*. ©2008 IEEE.

[17] Fang Yang Hao Lei Yuanzhang Sun Wei Lin and Tielong Shen, *Control of Hydraulic Turbine Generators Using Exact Feedback Linearization.* 2010 8th IEEE International Conference on Control and Automation Xiamen, China, June 9-11, 2010.

[18] Shahram Jadid and Abolfazl Salami *Accurate Model of Hydroelectric Power Plant for load pickup during Power System restoration*. 0-7803-8560-8/04/$20.00©2004 IEEE.