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Hydro-Electric Power Dam Control System Using Fuzzy Logic

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Abstract

This research presents the construction design of Hydro-Electric Power Dam Control System using Fuzzy Logic. In this design two input parameters: water level and flow rate and three output parameters: release valve control, drain valve control and Penstock switching are used. This proposed system uses a simplified algorithmic design approach with wide range of input and output membership functions. The hardware of control system for fuzzifiers and defuzzifiers is designed according to the need of system. The proposed simplified algorithmic design is verified using MATLAB simulation and results are found in agreement to the calculated values according to the Mamdani Model of the Fuzzy Logic Control System. The construction of a dam is necessary for the electric power generation, flood control, irrigation system, metropolitan and industrial water supply. Different kind of methods have been introduced and implemented to control the hydroelectric power dam due to non-deterministic behavior of water parameters such as flow rate and release etc. The result of this dissertation work will definitely be very efficient for power dam control system by fuzzy logic.

Keywords: *Hydro-Electric Power, Dam Control System, Fuzzy Logic.*

Introduction

The modern-day technologies in the areas of information storage and retrieval, web search, image processing, control, pattern recognition, bio information and computational biology, e-markets, autonomous navigation, and guidance are benefited using fuzzy sets. An integrated framework sustaining a variety of facets of human-centric computing is developed by means of fuzzy sets. The current trends of information technology have proved that the increasing level of intelligence, autonomy and required flexibility comes true with the increased human centricity of resulting results. The holistic view covers concepts, design methodologies, and algorithms with interpretation, analysis, and engineering knowledge. The computing systems are based on predefined models of two-valued logic and human information processing, concerned with two distinct words. In order to communicate between these two words we need to develop an interface. This is the key motivation behind the emergence of human-centric systems and human centric computing.

To control the water release, the controller reads the water level and flow rate after every sampling period. This proposed design work of Hydro-Electric Power Dam System is the application of fuzzy logic control system consisting of two input variables: water level and flow rate, and three output variables: Drain valve and (Releasing) Valve control used in a reservoir plant of Hydro-Electric Power Dam to monitor the system of Dam plus the switching of penstock depending upon the level of water in the dam.

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communicate between these two words we need to develop an interface. This is the key motivation behind the emergence of human-centric systems and humancentric computing. The fuzzy logic is an important technology and a successful branch of automation and control theory, which provides good results in control of power systems. This paper aims to use fuzzy control to insure good control of isolated MHPP. The proposed control scheme is suitable for turbine systems with both guide vane governors and synchronous generators, especially permanent magnet machines which have no automatic voltage regulator.

Results and Discussion

MATLAB simulation was adapted according to the arrangement of membership functions for four rules as given in Table 6.1.Results are compared in Table and found correct according to the design model.

Various values of input and output variables match the dependency scheme of the system design. The simulated values were checked using MATLAB-Rule viewer as shown in Figure.The correctness of results shows the validity of the simplified design work for processing system using control system.

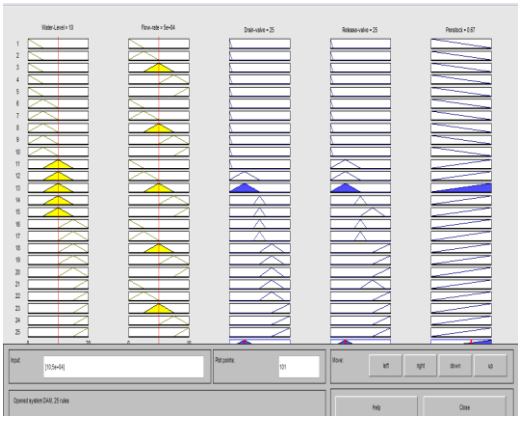

Figure 1: MATLAB Rule Viewer

Table 1: Comparison of Simulated and Calculated Result

Result	Release (Control Valve)	Drain Valve
Design Values	64.2	85.7
Matlab Simulation	65.2	83.8
% error	1.55	2.21

Simulation Graphs Discussion

This system was simulated for the given range of input variables. The given value of: Water Level = 13 lies in region 3 of the range 10-15 and Flow Rate = 95000 lies in region 4 of the range 75000-100000. The four rules were applied for MATLAB simulation according to this range scheme. In this design model, the release and drain control valves depends upon the selected values of water level and flow rate. The simulated and calculated results are according to the dependence scheme. Figure shows the control valve is directly proportional to water level and it does not depend upon the flow rate. Fig. 6.2 also shows that the drain valve system is directly proportional to flow rate.

Table 2: The Water Level, Flow Rate, Drain/Release Valve Opened/Closed and Penstock

Rule No.	Inputs		Outputs		
	Water Level	Flow Rate	Release (Valve)	Drain Valve	Penstock
1	Below Danger	Fast	50% opened	50% opened	ON
2	Below Danger	Very Fast	50% opened	75% opened	ON
3	Danger	Fast	75% opened	Fully Opened	OFF
4	Danger	Very Fast	75% opened	Fully Opened	OFF

Conclusion

Both the design model and simulation results are same. The designed system can be extended for any number of inputs and outputs. The drain valve control output can be utilized further for land irrigation according to the need and water release control valve for electric generation to fulfill the dire need of this system in automation. The design work is being carried out to design state of the art fuzzy logic Hydro- Electric control system in future using FPGAs.

Future Scope

The artificial neural network (ANN) can also be used for the hyro power dam control system. Also some other parameters can also be changed in represented fuzzy model for the utilization and efficient use of hydro power plants.

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