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INTRODUCING SAFE AND EFFICIENT MANAGEMENT METHODS FOR SMALL HYDROPOWER PLANTS USING ODD LOGIC

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Abstract

Many factors associated with river flow are vague, subjective and difficult to quantify. The fuzzy logic method is very useful for a problem solving approach such as small hydropower. The rule base and membership functions have a great impact on the performance and efficiency of the power plant, as well as on the optimization of the production of small hydro power plants in the high mountain region, especially in Uzbekistan. The performance of a fuzzy linguistic variable can be easily characterized in general terms. The paper initially presents a new Fuzzy Logic Controller (FCL) method for the safe control of dam reservoirs through weir gates.

Key words: fuzzy logic, spillway gate control, turbine valve control.

1. INTRODUCTION

From a small hydropower project, consumers require power at rated frequency and voltage. To maintain these parameters within the specified limits, various controls are required. The voltage is maintained by controlling the excitation of the generator, and the frequency is maintained by eliminating the mismatch between generation and load demand due to river flow and head through the turbine. Power can be controlled by controlling the flow through the turbine, and dams are kept safe by control of spillway gates [1-7].

2. STUDY METHODS

The main components of small HPPs are a river, a reservoir, a dam with spillway gates, a conduit, hydraulic distributors, a hydraulic turbine, a generator and a suction pipe. A dam with spillway gate and reservoir [8-17] is also needed for flood control, irrigation system, tourism and public water supply, in addition to electricity generation.

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To release or block water through a conduit, a turbine flow control valve is used to generate electricity in a hydro turbine. When the water is released from the tank, it enters the blades of the hydraulic turbine all the way through the pressure pipeline. The turbine generates electricity through a generator connected to it by a hydroelectric power station at the top, and then the water is discharged to the bottom side, where the drainage system is driven as required. Similarly, in order to release or block water in a reservoir operation system in dams, sluices or weir gates are used to control overflow. Here, the research approach is to create a fuzzy rule base for controlling the turbine gate and valve, and then to simulate their operation synchronously.

Safe spillway gate control: Application of a KNL system to ensure the safety of a dam or reservoir [18-27], consisting of two input variables: "Dam level in the lake" and "Water inflow rate". "Weir gate open" is the only output variable and is controlled by the KNL rule base. The main goal of this control task is to discharge excess water (hazard level or higher) as soon as possible for the overall safety [28-33] of the system and thus return it to a safe or desired level (below the hazard level) through the KNL.

3. DISCUSSION

The main purpose of a hydropower generation and dam or reservoir management system is to keep the system within limits by regulating the flow through the dam outlet and the inflow through the turbine valves under all conditions to ensure safety as well as efficient hydropower generation. Due to uncertain changes during floods or floods, quick and efficient manual management of the reservoir is very difficult. Just as with undefined load changes, effective control of the regulator is very difficult. When generating all hydroelectric power, it is desirable to have a constant frequency value when the load value changes. But the main problem with hydroelectric power generation is to maintain a constant frequency, because these stations respond quickly to a small change in the regime of the river. The frequency of the system changes depending on the difference between the consumed and generated power. In addition, people are emotional and forgetful. Thus, people can make wrong decisions in extreme conditions. Therefore, this shortcoming should be completely solved by automation.

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Triangular fuzzy membership functions are used because of their simplicity and also because of their simplicity compared to PID control. The rule base is built intuitively by running the optimal number. rules using KNL [35-48]. The predictive accuracy of the fuzzy model is very reasonable, as shown either in manual calculation or in the MATLAB FIS editor. It was well understood that the lack of data in the simulation of reservoir operation affected the assessment of an appropriate release policy. But still, from very approximate data, the model is able to generate fairly accurate results. These results demonstrate that fuzzy logic is a very useful evaluation technique and does not require hard numbers to evaluate.

4. CONCLUSION

The present study aims to improve the application of fuzzy logic through the use of the MATLAB FIS editor or manual calculations for hydroelectric power generation. Hydroelectric power generation is one of the earliest known renewable energy sources and therefore plays an important role in the socio-economic development of countries, and they have gained special importance due to their relatively clean and environmentally friendly characteristics. The model here is fundamental to understanding the physical system. This paper proposes an efficient and accurate fuzzy control based method for hydropower generation system and dam reservoir operation for safe and efficient operation. There are no disadvantages of a human-based control system in this method. In addition, with the help of ASP, the parameters of membership functions are optimized and the degree of automation of the fuzzy control system can be increased. We have also seen that the KNL rule base is built intuitively using the optimal number of no. rules using the Delphi Method. Initially, the variables, membership functions, and rule base were randomly defined. Then, using the "Taboo Search Algorithm" (TAB), the most appropriate values of the parameters characterizing the fuzzy membership functions are selected. The predictive accuracy of the fuzzy model is very reasonable. This work can be extended to develop a method for relating fuzzy logical-linguistic variables to various efficient management of other renewable energy sources in the future.

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