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APPLICATION OF FUZZY LOGIC IN THE ELECTRIC POWER INDUSTRY

U.I. Ashurova, candidate of technical sciences, associate professor
Mingachevir State University, Azerbaijan

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One of the control schemes for improving the dynamic characteristics of generators is based on the method of fuzzy logic theory. Fuzzy control is the most suitable tool for the given purposes due to its reliability and simplicity of calculations. The research results show that the fuzzy controller is not affected by operating conditions and reacts quickly enough to changes in input values.

One of the prospective directions of the intellectualization of the energy field is the research and application of power transmission with flexible controlled alternating current or FACTS technology. FACTS (Flexible Alternating Current Transmission Systems) is a flexible alternating current transmission system. The main task of FACTS technology is to increase the capacity of the network, voltage regulation, static or dynamic stability. In general, FACTS is a system based on power electronics.

The installation of several FACTS devices in the network (for example, thyristor-controlled reactive power sources) implies the presence of a control system in order to exclude negative effects from the individual control signals of these devices. The linear approach to the synthesis of regulators, which is often used on the basis of FACTS devices, usually considers a single operating point. When changing the mode of the energy system, it is necessary to control the settings of the regulator. In addition, the power system parameters are also affected by the operation of the FACTS device. Non-linear models of the energy system, their parametric uncertainty and unexpected change of operating modes in the event of an accident greatly complicate the problem of synthesis of coordinated management. Application of fuzzy logic methods along with traditional numerical methods allows to solve the indicated problems. Fuzzy logic-based controllers do not require information about the complete mathematical model of the studied system, are robust against the influence of parametric and structural disturbances, and can work in a wide range of system operation mode [1].

In recent years, the increased interest in non-conventional and renewable energy has opened up new opportunities to apply the methods of fuzzy set theory. One of the promising areas of modernization of old generation systems is wind energy. However, due to the occurrence of stochastic nature in the autonomous wind generator system, it is almost impossible to fulfill the requirements of consumers' reliability and uninterrupted power supply. The hybrid wind-diesel system has no such drawback. However, the random nature of wind and the large unevenness of the load can cause significant variations in power on the grid. In the worst case, instability may occur if the frequency in the system is not kept within an acceptable range. ER (engineer - remote control) controllers are widely used for diesel-turbine speed controllers. However, since constant power factor ER-controllers are designed to operate at nominal operating conditions, these controllers exhibit negative dynamic characteristics

over a wide range of operating conditions. Research shows that the application of a fuzzy controller improves the quality indicators of the regulation system when the intensity of load and wind flows changes [2].

The application of fuzzy logic methods is also effective in the classic type of dynamic stability enhancement, such as electric braking. Electrical braking of the generator occurs by placing load resistors in the power output circuit of the generator. Based on the principles of fuzzy logic, a signal is sent to the controller about the change in the rotation speed of the generator rotor. At the output of the fuzzy controller, a signal is generated to control the firing angle of the thyristor, which controls the load resistors (figure 1).

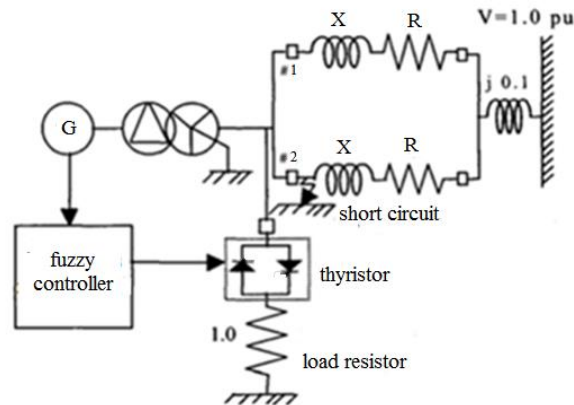


Figure 1 - Load resistor connection diagram

The indicated scheme allows to control the acceleration of the rotor rotation in a simple and effective way, thereby improving the dynamic stability. An innovation in the system of regulation of the influence of the generator is a stabilizer based on fuzzy logic. Stabilizers are widely used to increase the reliability of synchronous generators in power systems. Conventional stabilizers have fixed parameters for a single operating point and can be operated with optimum efficiency under nominal conditions. Since the properties of the feed system elements are non-linear, conventional stabilizers cannot provide optimal performance for all operating conditions.

Currently, many control schemes have been developed to improve the dynamic characteristics of generators. One of them is based on the method of fuzzy logic theory. Fuzzy control is the most suitable tool for the given purposes due to its reliability and simplicity of calculations. The research results show that the fuzzy controller is not affected by operating conditions and reacts quickly enough to changes in input values.

Thus, the application of fuzzy logic methods is a promising direction for research in various fields of the energy field.

References

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