ALGORITHMS FOR SYNTHESIS OF FUZZY REGULATORS

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Annotations: The influence of the dimension of an a priori set of possible values of the used linguistic variables, as well as the form of the corresponding membership functions on the nature of nonlinear transformations in simply connected fuzzy control models, is studied. The formation of logical-linguistic models of dynamic objects is the most important problem in the methodology of analytical design of fuzzy control systems.

The use of fuzzy logic technology, focused on the processing of logical-linguistic models of knowledge representation, opens up broad prospects for creating intelligent control systems for complex dynamic objects operating in conditions of incomplete information. Fuzzy logic, built on the theory of fuzzy sets, was originally created as a specialized mathematical apparatus for formalizing models of objects and systems, the description of which by traditional methods is complex or irrational from the point of view of developing appropriate software-algorithmic and hardware controls. The corresponding logical-linguistic descriptions make it possible to formalize inaccurate, semantically vague judgments and are built using generalized categories that specify the classification of initial concepts at the level of fuzzy sets.

The models obtained as a result of the interpretation of these descriptions can serve as a constructive basis for the development of algorithms and systems for intelligent control of complex dynamic objects for various purposes. The accepted methods of processing models built on the basis of fuzzy logic technology allow for the possibility of their implementation both at the software level using standard computing tools, and at the hardware level with the help of specialized controllers that allow for high performance due to parallelization of operations.

A set of priority studies aimed at developing fuzzy logic technology for building intelligent control systems should include an analysis of the features of fuzzy logic inference in tasks of intelligent control of complex dynamic objects, the development of principles for organizing self-learning processes, the development of models and algorithms for intelligent control, the creation of software and hardware for intelligent control based on specialized fuzzy processors. The principal feature of the organization of control of complex dynamic objects is the need to take into account various factors of uncertainty. These include, in particular, the unreliability of the mathematical model of the controlled object, the change in parameters over a wide range, the effect of external disturbances, etc. To solve control problems under conditions of uncertainty, a

large number of adaptation, identification, self-adjustment, and self-organization algorithms have been proposed.

An analysis of the possibilities of known technical solutions shows that the problem of adaptation in control systems has not been completely resolved. In recent years, the idea of applying the theory of fuzzy sets for the mathematical description of dynamic systems in terms of linguistic variables and the synthesis of fuzzy control algorithms has been developed [1-3]. The paper [1] outlines the principles for constructing logical-linguistic control models and develops methodological foundations for constructing fuzzy controllers. It analyzes the issues of organization and specific features of fuzzy inference in the problems of intelligent control. It is shown that the effectiveness of logical-linguistic models of control systems is determined by the choice of 151 categories to describe the relationship of their parameters using the appropriate membership functions.

The influence of the dimension of an a priori set of possible values of the used linguistic variables, as well as the form of the corresponding membership functions on the nature of nonlinear transformations in simply connected fuzzy control models, is studied. The formation of logical-linguistic models of dynamic objects is the most important problem in the methodology of analytical design of fuzzy control systems. In the materials of the report, the issues of formation of logical-linguistic models of control objects and the derivation of rules that form the basis of fuzzy control algorithms are considered. These fuzzy controllers are based on a probabilistic description of the states of control systems and provide the possibility of automated synthesis of logical-linguistic control models and the corresponding membership functions. The issues of using controllers based on fuzzy logic in automatic control systems of various configurations are considered. Analytical expressions for control actions at the output of a fuzzy controller with identical bell-shaped membership functions are obtained, questions of designing a fuzzy controller are presented, and a practical scheme of a fuzzy controller is proposed. The use of fuzzy logic makes it possible, regardless of the nature of the disturbing effect and the values of the parameters of the ACS links, to stabilize the output value in the supported control range.

The approach being developed in the automatic determination of membership functions and the derivation of production rules makes it possible to create a wide range of adaptive control systems based on fuzzy logic methods and technologies. The results obtained can be used in solving problems of intelligent control of technological processes.

Literature

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