INVESTIGATION OF THE DEFUZZIFICATION METHOD INFLUENCE ON CHARACTERISTICS OF THE SYSTEM WITH TAKAGI-SUGENO FUZZY CONTROLLER

One of the possible approaches to the synthesis of electromechanical system's controller is application of the fuzzy set theory. This approach makes it possible to take into account nonlinearities and synthesize control influences for different points of the state space.

Traditionally, the most common defuzzification methods are center of average (COA) and mean of maximum (MOM) one of the possible modifications of which is method of average minimums. In the case of Mamdani type controller, there are several classical defuzzification methods - the first maximum, average maximum, the last maximum, center of gravity etc. And in case of Takagi-Sugeno type controller one usually uses a COA defuzzification method. Other approaches are not sufficiently investigated.

In this paper, a comparison between the classical approach and defuzzification which is usually applied in the case of Mamdani controller is help. Research is conducted on the example of two-mass system. The use of fuzzy set theory allows to synthesize control influences to ensure the formation of the system's trajectory as a combination of it's subsystems's trajectories with desirable characteristics. At controller synthesis only output error is fuzzified, and the other coordinates of the system state space are not.

One should note that the choice of a particular defuzzification method does not affect the behavior of the system under the influence of external disturbances and it is primarily determined by the switching sequence between the subsystems. Application of COA method, unlike max-defuzzification provides smooth switching between subsystems.

For some input-output models, particularly in the case of Takagi-Sugeno, choice of defuzzification is not essential because it can not significantly improve the dynamic characteristics of the system. Another situation one can observe when using Mamdani model where switchings can be quite large.

Obviously, the major disadvantage of MOM and min defuzzifications is abrupt switching between subsystems. Besides, the use of such defuzzification, as well as conventional variable structure systems may result in chattering effect that significantly affects the quality of the synthesized system. Most smooth switching is obtained by means of COA and BADD defuzzification with small parameter value. In all investigated defuzzification methods values of all coordinates varied according to the change of the control influence.