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A design for an adjustable fuzzy pulse pump controller in a frequency-locked servo system

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Abstract

In this paper, an Adjustable Fuzzy Pulse Pump Controller (AFPPC) is proposed for use in a Frequency-Locked Servo system (FLS). The defuzzification used in the AFPPC is the α-cut based Adjustable Defuzzification Method (a-ADM). By use of the α-ADM, the behavior of the AFPPC can be easily and effectively modified and therefore a proper motion profile of the AFPPC can be easily obtained without tuning the membership functions and fuzzy control rules. Besides these points, the proposed AFPPC is able to overcome drawbacks inherent in the traditional FLS (e.g., slow locking process and overshoot) such that a fast and stable response without overshoot and containing zero steady-state error is obtained. In this paper, the mathematical model for the AFPPC-based FLS (AF-FLS) is derived as well. Based on this model, computer simulation is conducted to determine the a value of the AFPPC, and the system stability is discussed to determine the sampling period T. To justify the proposed approach, a position servomechanism based on AF-FLS is designed and built. The experimental result is very close to the theoretical result. In comparison with a conventional pump controller and a normal fuzzy pulse pump controller, the acquisition time of the AF-FLS is reduced by 43% and 32%, respectively. The results of simulation and experiment show that AFPPC has a suitable pump voltage to achieve fast locking response without overshoot as described.

Key words：Adjustable fuzzy pulse pump controller;Frequency-locked

servo system; α-cut based adjustable defuzzisication method