Study On Sunlight Greenhouse Temperature And Humidity Fuzzy Control System

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Abstract: Through establishing fuzzy control system model, designing on fuzzy controller, controlling sunlight greenhouse temperature and humidity, we designed temperature and humidity fuzzy control system, and then studied on input and output parameter in fuzzy controller, analyzed membership function of inputting and outputting parameter, then designed fuzzy control operation. The greenhouse has the best entironment for crop growing. [Nature and Science. 2005;3(1):45-48].

Key words: greenhouse; fuzzy control; temperature; humidity

Introduction

The sunlight greenhouse is a kind of new-type, highly-efficient, controllable agricultural production facility. For years, people regard sunlight greenhouse as research object, making further investigation on various kinds of produce factor, which can influence produce control in the hope of obtaining the best benefit (Yu, 2002). Because the sunlight greenhouse is a non-linear system with big inertia, in addition influence factor are numerous, it is very difficult to describe the production process with the mathematics model. The crop-grow fuzzy control system designed in this paper is a kind of automatic control system, which based on the knowledge of fuzzy mathematics and fuzzy language knowledge expression. It also regards fuzzy logic regular reasoning as the theoretical foundation, and it is a numerical control system adopting the computer numerical control technology of the closes-ring structure form one of feedbacks passageway.

1 Systematic Design Thought

The sunlight greenhouse production process is very complicated, especially the extreme fuzzy in the requisition for environmental parameter. So this paper researches on it with the fuzzy control theory (Zhong, 2001). The basic principle of fuzzy controls is: to compare ideal value of controlling quantity with the measuring value t transient, receive input parameter (deviation E), and calculate declination variation rate ΔE, turn E and ΔE into fuzzy quantity e and Δe, and then make a decision by fuzzy control regular R and e、Δe, get fuzzy control parameter u, finally turn the fuzzy control one into accurate quantity, act on the target under controlled, circulate like this, and realize the fuzzy control of the target. The fuzzier the fuzzy target that controls is, the more superiority this kind of control method reflects than the other methods they are. So that it is very suitable for the control of the environmental system of the greenhouse.

2 Temperature and Humidity Fuzzy Control ystem

The frame diagram of fuzzy control system is as Figure 1 shows.

2.1 Study on input and output parameter in fuzzy controller

Input parameter is an external variable of the fuzzy controller, and its numeric equals difference between measurement T(t)、H(t) and ideal T0、H0 of moment t. That is

$$E_{\mathrm{T}} = T(t) - T_0 \quad \text{（Temperature deviation）（1）}$$

$$C_H = E_{\mathrm{H}} = H(t) - H_0 \quad \text{（Humidity deviation）（2）}$$

Quantitative temperature deviation set X_1 11 grade, then X_1={-5，-4，-3，-2，-1，0，1，2，3，4，5}.

Quantization factor of the temperature deviation $K_{eT}=\frac{C_T}{1}=5$。

E_H fuzzy control area establishes less than ±5%, C_i value as {*NB*，*NM*，*NS*，*ZO*，*PS*，*PM*，*PB*}, Quantization is grade 11, X_3={-5，-4，-3，-2，-1，0，1，2，3，4，5}. Quantization factor of the t humidity deviation $K_{eT}=\frac{C_T}{1}=5$.

In the temperature and humidity control, it does not merely make temperature rise to the heating of the greenhouse, but also can increase the greenhouse moisture evaporation. It makes the humidity rise too. When arranged wetly at the same time, it will make temperature change too. The coupling phenomenon is named cross between the temperature and humidity. To introduce solving coupling parameter α_1， α_2，it receives the equation of outputting.

$$U_T=(1-\alpha_1)\times C_T+\alpha_2\times C_H$$

$$U_H=(1-\alpha_2)\times C_H+\alpha_1\times C_T \qquad (\alpha_1、\alpha_2 \in [0\sim 1]) \quad (3)$$

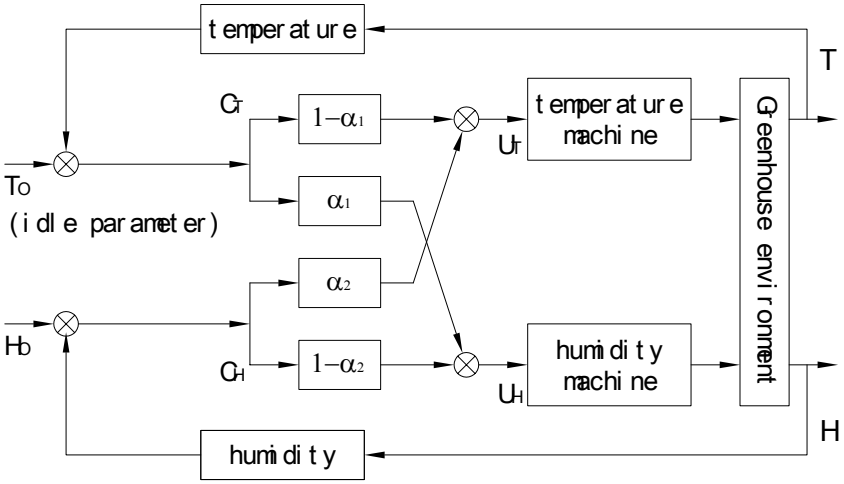

Figure1. The frame diagram of fuzzy control system

2.2 Outputs quantity described

Output variable is endogenous variable of fuzzy controller for adjust temperature and wet machine it is input variable. Because it is coupling output of the input information, its variable classification corresponds to variable of inputting grade.

U_T is temperature control exporting parameter. Its fuzzy subset E_i value is {*NB*，*NM*，*NS*，*ZO*，*PS*，*PM*，*PB*}. Among them *PB* (heat completely): The proportion valve is opened maximum. *PM* (mild heat): proportion 1/2 valve turn on degree, *PS* (little to heat). 1/3 of proportion valve is opened degree. *ZO* (not rise or low the temperature): The proportion valve closes and the skylight does not open. *NS* (the little drop in the temperature): The skylight opened 1/3 degree. *NM* (mild lowers the temperature): The skylight opened 1/2 degree. *NB* (lower the temperature completely): The skylight is opened maximum.

U_H is humidity control exporting parameter. Its fuzzy subset F_i value is {*NB*，*NM*，*NS*，*ZO*，*PS*，*PM*，*PB*}，among them *PB* (the whole humidification): All hydrant open. *PM* (mild humidification): hydrant open of half, *PS* (little humidification): hydrant turn on 1/3. *ZO* (no increase or lower humidification): hydrant close and skylight close. *NS* (little lower temperature): 1/3 of skylight is opened. *NM* (mild lowers the temperature): 1/2 of skylight is opened. *NB* (lower the temperature completely): The skylight is opened biggest. Quantification output amount 11 grade, so X_6={-5，-4，-3，-2，-1，0，1，2，3，4，5}.

Obviously, when α_1 and α_2 are all 0, $U_T=C_T$，$U_H=C_H$，equal to two single circuits control at this moment. When they are all 1, $U_T=C_H$，$U_H=C_T$，then it is limit coupling at this moment （Zhang 2002）. The real α_1 and α_2 are among 0~1. The concrete

methods are to hypothesize α_1 and α_2 to be equal to 0 and carry on the experiment to the greenhouse. Whenever heat or eliminate damp, it will make the temperature and humidity in the greenhouse have greater fluctuations. Then gradually increase α_1 and α_2, it makes the fluctuation reduce, achieve the goal of solving coupling, thus get the optimum value.

2.3 Membership function of inputting and outputting parameter

Membership function is always gotten by experience, so it has greater random. The choice of the fuzzy variable Membership function has certain influence on the functions of the fuzzy controller（Liu, 2001）. Generally speaking, the steeper the form of Membership function is, the higher the resolution ratio is and the higher sensitivity of the control is. On the contrary, the slower the form of Membership function is, the characteristic control is gentle, and systematic stability is fine. The form of Membership function adopts the triangle or bell has small influence on control function, we choose the triangle form of Membership function for the purpose to achieve simplified calculation.

Temperature and humidity deviation Membership function, the Membership functions of temperature and humidity controlled output are shown in Figure 2 and Figure 3. Stability is fine. The form of Membership function adopts the triangle or bell has small influence on control function. We choose the triangle form of Membership function for the purpose to achieve simplified calculation (Ren, 2001). Temperature and humidity deviation membership function, the Membership functions of temperature and humidity controlled output are showed in Figure 2 and Figure 3.

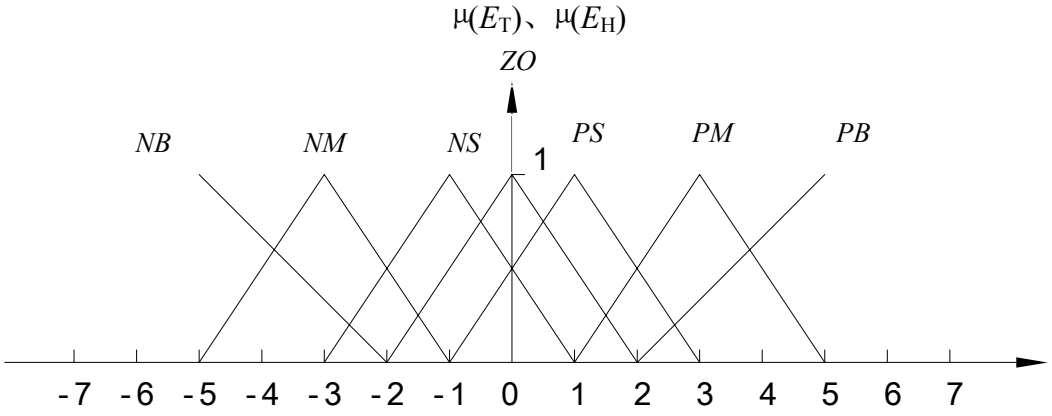

Figure 2. The temperature and humidity deviation Membership functions

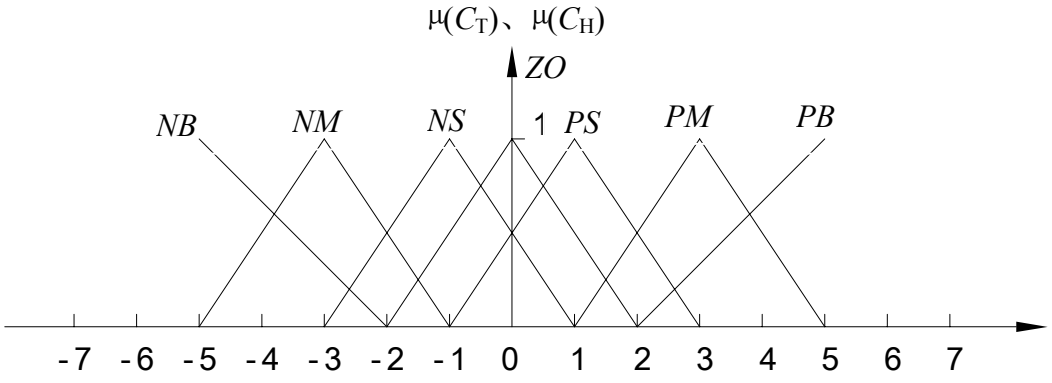

Figure 3. The Membership functions of temperature and humidity controlled output

3 Design of Fuzzy Control Operation

In the fuzzy control operation design, control operation of the execution according to outputting variable information. When the error is less, besides wanting the error of dispelling, should consider systematic stability, prevent system produce unnecessary exceeding adjusting even shock. When E_T is *NS or ZO*, the groundwork is turned into the stability problem. In order to prevent exceeding adjusting, making the system steady as soon as possible, it will confirm the controlling amount according to the concrete conditions that temperature will be changed soon at this moment, and it will choose the corresponding control rule. If ΔE_T is plus then indicating the temperature change has the tendency to reduce, so the fuzzy control system should fetch the smaller control amount. The same principle when deviation is plus or minus, the corresponding symbol carries on the change（Xu, 1987）. The humidity fuzzy control rule in line with when the error is greater the controlling amount does the best to make the error reduce rapidly. When the error is less, besides wanting the error of dispelling, should consider systematic stability.

4 Conclusion

This paper has put forward a train of thought and method in connection with the sunlight greenhouse on temperature and humidity fuzzy control. Through fuzzily controlling and regulating the crop growth environment of the sunlight greenhouse, it will play a enormous role to improve the output and quality of the crops.

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