



Computer and Fuzzy Theory Application: Review in Home Appliances

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PAPER INFO	ABSTRACT
<p>Chronicle: Received: 07 January 2020 Revised: 14 March 2020 Accepted: 04 June 2020</p>	<p>Clays have a tendency to this article first introduces the basic concepts of fuzzy theory, including comparisons between fuzzy sets and traditional explicit sets, fuzzy sets basic operations such as the membership function of the set and the colloquial variable, the intersection and union of the fuzzy set, and use the above concepts to guide into the four basic reasoning mechanisms of fuzzy mode and introduce several common types of fuzzy application examples such as fuzzy washing machine and fuzzy control of incinerator plant in China illustrate the application of fuzzy theory in real society.</p>
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1. Introduction

In 1965, Zadeh of the University of California at Berkeley in "Information and Control". In this academic journal, published a "fuzzy set" (Fuzzy Sets) Thesis, the fuzzy theory was born. In this paper, professor Zadeh puts "high temperature", "giant man", "big sets that cannot be clearly defined, such as "number", are based on a new set theory. Representation, called fuzzy set. He specifically pointed out: The fuzzy collection pole suitable for abstract things, such as image recognition, information transmission, etc. These basic behaviors of human thinking that are difficult to express mathematically plus to quantify, and in the form of mathematical theory, to develop these situations. When Professor Zadeh published fuzzy set theory, the reaction of the academic community extremely indifferent, with many criticisms. He was once a "modern cybernetic a member of this rigorous theory has changed 180 degrees to advocate vague concepts, and this has aroused fierce criticism from everyone. Fuzzy theory has been despised since the beginning, but since 1974 British Mamdani announced the application of fuzzy logic to control small steam engines. In 1982, Denmark Ostergaard announced the successful operation of fuzzy logic after being built as a cement kiln factory, the practical potential of fuzzy theory was wide attention. In recent years, the blur has been like a whirlwind, in Europe and China. There are huge

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manpower in various parts of Japan and Japan. Research boom. Especially Japan, even more with its strong corporate economic to cooperate with the industrial R&D technology that no one can match, and develop vigorously blur product.

Today, as small as the camera's autofocus device, washing the water flow controller of the clothes machine and the temperature adjustment of the air conditioner are as large as water treatment plant raw water treatment program, subway automatic driving system, the fuzzy trails can be seen everywhere, making the word fuzzy almost synonymous with smart technology. In this article, fuzzy logic develop basic theory, extend its theory to fuzzy control system, and take the fuzzy control system of automatic fuzzy washing machine and incinerator as the example is a simple and clear introduction. There are many applications, for example, see Faber and Stewart [1], Luger et al. [4], Markus et al. [5], and Pandey et al. [6]. Other studies have focused on disaster detection and early warning systems [2, 3, 7].

2. The Basic Concept

The so-called set is composed of some things with common properties. The quality of the organization can be used to summarize a group with the same characteristics tools to sign things. Generally speaking, collection is to express clear things mainly, in order to distinguish, it is customary to use a clear collection (crisp set). Explicit sets have the following common properties: The elements in the set are determined. The elements of the same set have certain identical properties. A whole composed of collective elements, the elements can be distinguished from each other do not. When using a collection to represent a concept, always consider the object restricted to a specific range, this range is called domain (universal of discourse, U_x). Set A in the universe U_x has the following two basic representation methods: Enumeration method. If each element in the set can be listed one by one is enumerated, the set can be represented by enumeration. This method can only be used for a limited set of elements. For example Set A of elements, respectively, A_1, A_2, \dots, A_n , can be expressed as: Descriptive method. If a set defines its elements according to specific properties at that time, this method is called descriptive method.

Common to this method the general formula is as follows: According to this symbol, A is U_x medium-oriented proposition (proposition) $P(x)$ is the set of all elements of truth. For an explicit set A in the universe of U_x , its element x the relationship with the set can use the characteristic function (characteristic function) to illustrate, its definition is as follows: Definition 1. One of the explicit set A in the universe U_x , its characteristic function $[\mu]_A$ to the U_x of the element x is mapped to a set $\{0,1\}$ being. Also which is or the above introduced the affiliation between elements and sets. In the set there is also the same definition of affiliation between combination and set, for example: Subset, equal set, etc. About collection the basic operation of, generally refers to intersection, union set, difference set, complement set. It exhibits many properties, such as commutativity, associativity, distributivity, transitivity, and exclusive neutrality law of excluded-middle, etc.

3. Fuzzy Set and Membership Function

Zadeh formally proposed the fuzzy set theory in 1965. Mold the biggest difference between fuzzy sets and explicit sets is that Zadeh proposed replace explicit sets with membership functions the characteristic function in the union. The membership function changes the original non-zero or 1 characteristic the eigen function value is expanded to a real number between 0 and 1. And the set defined by the membership function is called the fuzzy set. For a fuzzy set A in the universe of U_x , generally as the following definition means: Definition 2. In a fuzzy set A in the universe U_x , its membership

function several $[\mu] A$ to the $U x$ map elements to a range of $[0,1]$ in the real number. That is $\mu A(x): Ux \rightarrow [0, 1]$ or $A(x): Ux \rightarrow [0, 1]$ the above two expressions often appear in the literature, in this article the latter is used as the representation of fuzzy sets. In other words, mod the fuzzy set and its membership function are both represented by the same symbol. But use it is written as $A(x)$ when representing the membership function, and there is a specific x value (x^*) substitute the membership function value into the membership function, then write into $A(x^*)$. In practical applications, the membership function is operated on site personnel, cooperating with experts in the application field, generally the membership function most commonly used in fuzzy logic is segment continuous.

4. The Application of Fuzzy Logic in Home Appliances

Take fuzzy washing machine as an example under the rapidly changing social structure, even the functions of home appliances the orientation has changed a lot. Take washing machines as an example, because small families the emergence of the structure, the proportion of professional women the work is therefore the exclusive work of the housewife. Work shared by the whole family and the flexibility of washing time is improved however, there may be quite extreme differences in the amount of laundry. In this way under the premise, the fuzzy control washing machine set the following development goals and technical issues: When the experienced housewife washes the clothes, computerization of the most appropriate washing method used for total quantity and material. In order to match the operation and use of the whole family, all operations it is best to use a single button, that is, the washer is responsible for pressing the start move the button, the rest are judged by the fuzzy system of the washing machine off.

Fuzzy fully automatic washing machine can be measured by enough sensors the amount of clothing and the quality of the clothing, and can be appropriately blurred control rule base to work out a good washing water volume and washing time, to make the most appropriate control. In order to allow all users to understand the current fuzzy laundry the operating status of the machine, for all expected and completed laundry the process must be clearly displayed to users. The fuzzy washing machine is based on the sophisticated family the housewife considers the problems when washing clothes, such as "do not hurt the cloth material", "strong cleaning power", "shorten washing time", etc. In addition to the theme of cleaning, it also achieves a balance with button operation the effect of control. Fuzzy control provides sensory information and develops sensors for the amount of clothes and fabrics. Based on this principle, developed the most moderate water flow intensity and washing time control technology.

5. Practical Method of Fuzzy Control

In order to make the product practical, the fuzzy control is put into the CPU in the 4 bit CPU, many functions including LCD display. It can realize fuzzy control of saving memory and shortening calculation time. For simplify the sequence and output results from input information to fuzzy control output single, so the possible output combination is fuzzy and real the test results are categorized to divide the range of output combinations and follow 19 practical ways to leave good fuzzy control. It is developed to control the most appropriate water flow, washing time, and dehydration time fuzzy fully automatic washing machine. The application examples of fuzzy automatic washing machines are described above. Needle for problems that are difficult to control by computers until today, fuzzy control can explain the scope of machinery equipment and process control in general industries in the domain, the realization, and home.

6. The Application of Fuzzy Logic in the Manufacturing Industry

Take incinerator control as an example in order to reduce the environmental pollution caused by the landfill method, disposal personnel have racked their brains to design appropriate treatment methods. In addition to the recycling of resources to reduce waste, the incineration method has become the main garbage disposal method adopted by many countries, because this incinerator has also become a very important equipment. But this is equipment that reduces environmental pollution, but it may be exhaust gas exceeds the standard value, which is harmful to the environment. Although discharged gas can use subsequent equipment to reduce pollution, but this is not only time-consuming and also increases the processing cost. So how to control the incinerator can fully burn the contents when burning waste. It has become an important subject of incinerator control. However, because every batch of waste incinerated in the incinerator has different physical and chemical properties, and there is no way before incineration effective screening, so a set of appropriate mathematical models cannot be established. The overall structure of the incinerator. To describe the incineration process. Therefore, the control encountered in the incineration process the control problem is not easy to solve with traditional control methods. And so, when the incinerator burns incompletely, the operator will often the previous combustion situation and the situation of the incinerator contents determine the future control action. In this case, it can simulate the control actions of human experts fuzzy controller may be more capable than traditional mode control strategy give full play to the effectiveness of its control. Collaboration between scholars in Korea and Samsung Heavy industries, we will try to achieve incinerator control with a fuzzy control architecture aims. The overall structure of the incinerator. The goal of its control is to achieve complete combustion while ensuring keep the evaporation rate and processing energy within the target area. This control system the system is based on the fuzzy controller architecture mentioned in the general literature, then make amendments to meet the needs of incinerator control.

As a whole said, this fuzzy control system is divided into three parts in total. First of all, in addition to the use of general meters to measure the incinerator. In addition to the numerical values of the combustion parameters, the more special part is the designer's adapt to the characteristics of the incinerator, and especially use the so-called fuzzy measuring device (fuzzy sensor) to capture what cannot be measured by the meter but is the data required for fuzzy control can be used as input variables of the fuzzy controller, the source of the information. Simply put, the so-called fuzzy sensor to collect some data that can be measured by the instrument through fuzzy collection, the calculation of another group of indicators cannot be measured with equipment. The average operator is judging when cutting off the combustion status of the incinerator, it may be the thickness of the waste, the calorific value of the incineration system, the nature of the waste, and the factors such as burning conditions are used as a reference for control and adjustment. But yes for fuzzy controllers, it is really difficult to describe the "burning condition" like this an abstract concept gives a clear definition. So in this system it is convenient to use the pressure drop of the incinerator, the switch state of the feed inlet, combustion bed length, evaporation rate, dry bed length, oxidation carbon concentration, oxygen concentration, etc. Can be measured by measuring equipment to estimate the size of the above indicators. The output of the entire fuzzy measure the relationship between input and output.

7. Fuzzy Decision Maker

Among the fuzzy control systems of the incinerator, the most special one is the so-called fuzzy decision maker (fuzzy decision maker). Actual mode the fuzzy decision maker is the set point of some parameters in the fuzzy controller decision mechanism. In simple terms, the fuzzy decision maker will the nature

of furnaces, transmissions and other equipment and control target setting values take them into consideration in order to determine the setting value of the controller. For example in other words, the temperature setting of the combustion air is based on the current temperature and the nature of the waste measured by the fuzzy measurer decided. The decision process is based on the experience of operating experts so that the temperature of the incinerator can be maintained at a target area. Such decision rules generally have the following description: "When discarded, when the nature of the material is not good, if the temperature of the combustion air increases, the temperature of the chemical furnace will tend to stabilize." Another parameter determined by the fuzzy decision maker is the evaporation rate. Rate set point. In the past traditional control, in order to maintain evaporation rate in a certain target area, generally used to regulate waste feed the amount to achieve the goal. But because the ingredients of the feed are always there change, so it is difficult to get the desired effect. In this system, in order to obtain the appropriate evaporation rate set point, the waste and the difference between the current evaporation rate and the current set point, to calculate the next set point.

In this fuzzy controller, mainly use the parameter settings calculated by the aforementioned fuzzy decision maker point, compared with the data currently measured by the fuzzy measurer comparison, using fuzzy control rules constructed by expert knowledge reasoning, and finally get the control actions of each operation. In the output part of this fuzzy controller, you can subdivided into steam calorific value, feed port switch, fuel switch, feed rate, fuel rate, throttle angle, etc. And each output variable points have not different input parts. Overall, this multiple-input multiple-output fuzzy control can be regarded as the multiple input single output fuzzy controller combination. For example, for the waste and fuel inlet (feeder and stoker ON/OFF) of the switch control part, the input is the difference between the current evaporation rate and its set point, and the rate of change of the difference. The content of its control rules may be as follows narrative: "If the evaporation rate is high, at the same time the evaporation rate will increase the higher the trend, the waste inlet should be opened," or "if the evaporation rate is low, at the same time the evaporation rate tends to be lower and lower when the situation occurs, the waste inlet should be closed. The content of these rules it is accumulated by the experience of on-site control personnel.

8. Extraction of Control Rules

According to the operation of the aforementioned fuzzy controller components look, we can find that the most difficult part is probably the control rules the establishment. For a complex and variable system like an incinerator that said, the establishment of a rule base is particularly difficult. On-site control personnel are average only know the procedures of its on-site operation, but often cannot the accumulated experience is transformed into effective fuzzy control rules. The other party in the same situation, the on-site operators often there are different control strategies. These factors have increased the fuzzy control the complexity of establishing the rules of the device. In constructing this incinerator model when pasting the control system, the designer and multiple on-site operators staff have had many interviews and summed up their control experience reorganize, get rid of the chaos in addition, designers also use the program reaction of the chemical furnace program under normal feeding operation is used as the reference base point.

In addition, when engaging in computer simulations, they also refer to actual control status of the incinerator. Finally, the designers also incinerate the past traditional control strategy used by the furnace is integrated into the rules of the fuzzy controller in the library, to enrich the performance of the controller. In summary, the fuzzy control system of the incinerator is mainly three parts: Fuzzy measurer, fuzzy decision maker and fuzzy controller composition. This control system will be able to

be measured by the actual measuring device data, through the fuzzy measurer, is converted to the operator to perform the operating state that is inferred but cannot be measured with instruments. Then profit use the fuzzy decision maker to estimate the set value of each variable, so you can let the control gas setting achieve the purpose of automatic adjustment. And these settings the fixed point is compared with the current value obtained by the measuring instrument, and the Paste the controller to infer the control action of each operating variable to complete into the entire control loop. The above control in the computer simulation, the strategy can be adapted to different incinerator conditions. Enough to get satisfactory control results in a short time.

9. Conclusions and Suggestions

This article is based on basic fuzzy logic theory, a series of discussed fuzzy sets, fuzzy patterns and fuzzy reasoning mechanisms, and use examples in the home appliance industry and factories for verification. But, whether applying fuzzy logic to fuzzy model modeling and fuzzy control above, the integration and implementation of expert knowledge in the entire application of fuzzy theory is very important, and the measurement values obtained by various types of sensors accuracy is the key to whether fuzzy theory can implement expert knowledge factor.

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