Research on an Indeterminacy Causal Induction Auto-Reasoning Mechanism in Expert System

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***Abstract*—Based on fuzzy language field and fuzzy language value structure, a new knowledge representation frame is presented. A generalized cell automation and the corresponding generalized induction logic causal model are also proposed, which can synthetically process random and fuzzy indeterminacy. Thus, a new indeterminacy causal induction auto-reasoning mechanism is presented on the basis of fuzzy state description. Moreover, application of the mechanism on intelligent controller is discussed.**

***Index Terms*—language field; language value structure; generalized cell automation; generalized induction logic causal model; auto-reasoning; intelligent controller**

I. INTRODUCTION

In 1992, Stephen Muggleton divided the existing induction acquirement of expert knowledge into two kinds: static induction and order induction. But there are some problems in both of them. In static induction, a1though induction is generalized and correct rules can be generated when expressing with abundant swatches, however, the rules are so abundant and complicated that human experts cannot understand. In order induction, fuzzy and complex parameters in general algorithm are demanded. Additionally the reasoning demands a large amount of samples, and this makes the efficiency very low. At present, for multi-variab1e control cooperating process based on expert system, the control model and method, which can synthetically and parallelly process indeterminacy, nonlinear and time-variant dynamic characters are absent[1].

To the construction of reasoning rules in expert systems and research on complex system control and complicated reasoning, reasoning mechanism and computing model are very important. Especially, the indeterminacy induction reasoning mechanism is extremely important. Generally, most rules are experiential ones which originates from limited evidence. They are the assumptions on the basis of limited evidence so they are probable. On account of the characteristic of random indeterminacy and causal inevitability determined by prior probability, A. W. Burks constructs a theory for this kind of induction reasoning rules, namely Cell Automation Theory [2], which unifies the ones of probability, causality and induction. However, there is another kind of indeterminate information, namely fuzzy information, during the research on induction reasoning and causality. In order for synthetically dealing with random and fuzzy indeterminate induction reasoning rules, a generalized cell automation is presented and a generalized induction logic causal model is also constructed in the paper. Thus, self-contained causal automation and induction logic causal model are constructed. Taking it as the background, a indeterminate automation induction mechanism is built. The work is very important for the research on inevitable relationship between objects, inherent developing mechanism and the essence of objects. The mechanism is proved scientific, effective and applicable by applying it to the design of intelligent controller in built-up air-conditioners.

II. INTRODUCTION OF LANGUAGE FIELD AND LANGUAGE VALUE STRUCTURE

Human language is not only easily understood and accepted but also easily used to representing indeterminate knowledge. The intelligent reasoning is the one that intelligent language quantifies, combines, operates and transforms in language field[3, 4, 8].

Definition 2.1 Given an arrangement of n intervals in real number domain, if any two adjacent intervals' intersection is not empty and they do not contain each other, the arrangement is called as a secant interval sequence.

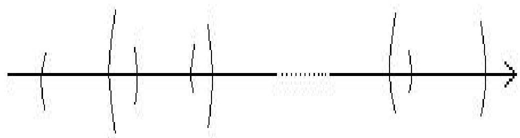

Figure 1. Secant interval sequence

Definition 2.2 For the set D of n real number intervals constructing overlapping interval sequence, the binary relation a $\prec$ is defined as: for any two intervals $[x_1, y_1]$ and $[x_2, y_2]$ of D,

$$[x_1, y_1] \prec [x_2, y_2] \ \ iff \ \ (x_1 \le x_2) \wedge (y_1 \le y_2).$$

Apparently, the binary relation defined on D is a complete ordering one.

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Definition 2.3 $C = \langle D, I, N, \leq_N \rangle$ is called language field, if

1) D is the set of all overlapping intervals of basic variable on R;

2) $N \neq \varphi$ is a finite set of language value ;

3) $\leq_N$ is a complete ordering on N ;

4) $I : N \to D$ is a standard value mapping, and satisfies isotonicity.

Definition 2.4 For the language field $C = \langle D, I, N, \leq_N \rangle$, $F = \langle C, W, K \rangle$ is a language value structure of C, if

1) C satisfies definition 3.3;

2) K is a natural number;

3) $W : N \to R^K$, it satisfies the following:

$$\forall n_1, n_2 \in N(n_1 \leq_N n_2 \to W(n_1) \leq_{dic} W(n_1))$$

$$\forall n_1, n_2 \in N(n_1 \neq n_2 \to W(n_1) \neq W(n_1))$$

in which, $\leq_{dic}$ is a lexicographic order on R^K .

It is evident that if R is defined as [0, 1], definition 3.3 and definition 3.4 are fuzzy language field and fuzzy language value structure.

Definition 2.5 Given two language fields $C_1 =< D_1, I_1, N_1, \leq_{N_1} >$ and $C_2 =< D_2 , I_2, N_2, \leq_{N_2} >$, we say that C_1 is an expansion of C_2, if there is a 1-1 mapping $f : D_1 \to D_2$, $g : N_1 \to N_2$, satisfying:

1) f is monotonous ;

2) $(\forall n_1 \in N_1) f(I_1(n_1)) = I_2(g(n_1))$;

Theorem 2.1 (Expansion theorem) Given two language fields $C_1 =< D_1 , I_1 , N_1 , \leq_{N_1} >$ and $C_2 =< D_2 , I_2, N_2, \leq_{N_2} >$; C_1 is an expansion of C_2, if and only if C_1 and C_2 are the same type language field (it means $|N1|=|N2|$).

Proof: First, according to the definition of language field, both N1 and N2 are limited sets; If C1 is the expansion of C2, there is one-one mapping between N1 and N2, then it is certain that | N1 | is equal to | N2|, namely | N1 | = | N2 | .

Second, if | N1 | = | N2 | , we will prove that C1 is the expansion of C2.

Since | N1 | = | N2 | , so assume that

$$N_1=\{ n_1^1, n_2^1, n_3^1, \cdots, n_h^1 \};$$

$$N_2=\{ n_1^2, n_2^2, n_3^2, \cdots, n_h^2 \}$$

Where $n_1^1 \leq_{N_1} n_2^1 \leq_{N_1} n_3^1 \leq_{N_1} \cdots \leq_{N_1} n_h^1$; $n_1^2 \leq_{N_2} n_2^2 \leq_{N_2} n_3^2 \leq_{N_2} \cdots \leq_{N_2} n_h^2$.

make

$$I_1(n_i^1)=d_i^1;\ I_2(n_i^2)=d_i^2$$

According to the isotonicity of I_1 and I_2,

$$d_1^1 \prec d_2^1 \prec d_3^1 \prec \cdots \prec d_h^1 ;$$

$$d_1^2 \prec d_2^2 \prec d_3^2 \prec \cdots \prec d_h^2$$

make

$$f(d_i^1)=d_i^2 ;\ g(n_i^1)=n_i^2$$

f is apparently monotonous, and

$$f(I_1(n_i^1))=f(d_i^1) = d_i^2 =I_2(n_i^2)=I_2(g(n_i^1)).$$

So, C1 is the expansion of C2.

Proof completes.

From the above, we can know that since the same type language fields are not distinguished from each other in terms of the expansion. Especially, a simple basic description framework can be provided for describing other type language field and its language value structure if the language value structure of the language field comprised of the language values of natural numbers in natural number set such as “very large”, “large”, “medium”, “small” and “very small” is selected to be the basic one.

In the same language field C, the isomorphism relation between different language value structure can be built.

Definition 2.6 Given language value structures $F_1=<C_1, W_1, K_1>$ and $F_2= <C_2, W_2, K_2>$ of $C = \langle D, I, N, \leq_N \rangle$, if there is a 1-1 mapping $h : R^{K_1} \to R^{K_2}$ that satisfies

1) h is strictly monotonous in lexicography;

2) $\forall n \in N(h(W_1(n)) = W_2(n))$;

3)
$(\exists \varepsilon \in R)(\forall n, n' \in N)(dis_1(W_1(n), W_1(n')) = \varepsilon \bullet dis_2(W_2(n), W_2(n'))$;

in which

$$dis_1 : R^{K_1} \times R^{K_1} \to R$$

$$dis_2 : R^{K_2} \times R^{K_2} \to R$$

then we call F1 and F2 are (dis1, dis2)- isomorphism (the abbreviation is “dis- isomorphism”).

Definition 2.7 Any language value structure F<C, W, K > is called F’s double- expansion, marked as

$$F_{\text{double-}\lambda} =< C, W', \lambda, K >, \text{ if}$$

$$W'(n) = double_\lambda (W(n)) \in R^{\lambda k};$$

in which any

$$(r_1..., r_k) \in R^k, double_\lambda (< r_1..., r_k >) = \left(\underbrace{r_1, ..., r_1}_{\lambda}, ... \underbrace{r_k ..., r_k}_{\lambda} \right) \in R^{\lambda k}$$

When λ=2, $F_{\text{double-2}}$ is called F’s double expansion(simply marked as F_{double}).

Theorem 2.2(dis- isomorphism theorem) [3] Suppose that F is a language value structure of C, then F and F_{double} (the double expansion of F) are dis- isomorphism under the weighting Hamming distance.

The proof is omitted.

From the above : in terms of dis-isomorphism, the language value structure can be built on different dimension space. Moreover, the selection of vectors corresponding to the discrete causal and correspondent states has a comparatively large free degree.

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III. FORMAL DESCRIPTION FOR CELL AUTOMATION MODEL[5, 6, 7]

Definition 3.1 Under discrete Euclid time and space conditions *Ц*= 〈*U, T, E,* η〉 is called as cell automation. where *U* is state space, its element u is called state; *T* is time sequence, its element t is called time; *E* is the set of cell ' its element e is called cell (that is space area); $\eta = \{\phi_1, \phi_2, ... \}$ is the mapping set, its element $\phi_i : E \times T \rightarrow U$ is called endued state mapping.

Definition 3.2 $\rightarrow \subseteq ran\phi_i \times ran\phi_j$ is called as causal inevitability relation. So the next expression is called as causal inevitability law:

$$(\exists e \in E)(\forall t \in T)\ (\phi_i(N(e),t) \qquad \phi_j(e,t')).$$

It shows that the state of cell at time t' $\phi_j(e,t')$ is determined by the state $\phi_i(N(e),t)$ of neighborhood of cell e *N*(e) at time t $\phi_j(e,t)$ (namely the set of cell e and several cells having sharing boundary.)

Definition 3.3 $\pi = (\text{Ц},\quad)$ is called causal cell automation, if causal inevitability law $\phi_i(N(e),t) \rightarrow \phi_j(e,t')$ satisfies the following three conditions:

1) (Limited Variety Theory)causal inevitability law in nature is constructed upon the limited set which is fit to describe the properties of any time and space area. Every time and space area can be the object described by their properties.

2) (Causal Existing Theory) if the law governs some time and space area, it is fit for the most area of automation (fit for cell automation of determinism-like).

3) (Causal Coherence Theory) the law is fit not only for some time and space area but also for the entire cell automation, that is to say, the whole reachable time and space area(fir for cell automation of determinism).

Definition 3.4 Induction logic causal model is the semantic structure $X = \langle S, \pi \rangle$ that satisfies the following conditions:

1) $S = \{S_a, S_1, ..., S_m\}, S_i$ is probable causal world governed by causal inevitability law, S_a is the real causal world; $S_i = \{V_{i1}, V_{i2}, ...\}, V_{ij}$ is different history composing S_i. Every history is the world of different segment of time and space.

2) π is the causal cell automation satisfying Definition 4.3. Each probable causal world is described by the corresponding causal cell automation.

The above model establishes a basis on which the causal relation in random indetermination information system can be studied. By the practical theory, evaluation formula for induction probability will be deduced, which can be expressed by affirmation degree function.

IV. CONSTRUCTING INDETERMINATE GENERALIZED INDUCTION LOGIC CAUSAL MODEL

Definition 4.1. In discrete Euclid time and space, under the condition of transforming state space to language field, $\text{Ц}^* = \langle C, F, T, E, \xi \rangle$ is called as generalized cell automation. Where *C* is language field corresponding with state space *U*; *F* is the language value structure in *C* corresponding with various state (every state can be expressed with language value) ;the meaning of *T* and *E* is the same as Definition 4.1; ξ is left compound mapping set, its element $\phi^* = W \circ \phi_i$, that is the state of cell e at time t' ascertained by endued state mapping ϕ_i in definition 4.1, and describe the state with corresponding language value, then through the mapping W in Definition 2.3, the k dimensions vector discrete type expression state can be ascertained.

Definition 4.2 $\Pi^* = (\text{Ц}^*\ ,\ \rightarrow)$is called as generalized causal cell automation, if causa1 inevitability law $\phi_i^*(N(e),t) \rightarrow \phi_i^*(e,t')$ satisfies the conditions A)-B) of Definition 4.1, and also satisfies the fo11owing relative conditions:

A) (Causal State Theory) In the process of continuous and gradua1ly-changing causal relating, for any swatch space, all probable states of cell at time *t'* (as the result)are certainly conduced by the positive (such as "sma11"oflanguage value)and negative (such as "not small" of language value including various probabilities) of the neighborhood of ce11 *e N(e)* at time *t*.

B) Metamorphism and State Transformation Theory)When metamorphism of reason and result and language field of state are isomorphous, the laws for causal metamorphous relation are fit for the causal state relation ones, and vice versa.

Definition 4.3 Generalized induction logic causal model is the semantic structure satisfying the following conditions $X^* = \langle S^*, \Pi^* \rangle$:

A) $S^* = \{S_a, S_1, ..., S_m\}, S_i$ is probable causal world governed by causal inevitability law and relative theories of $\rightarrow$. S_a is the real causal world; $S_i = \{V_{i1}, V_{i2}, ...\}, V_{ij}$ is different history composing S_i .Every history includes different segments of time and space. Every segment of time and space conceals every kind of causal relation, but reson and result correspond to respective structure of language field and language value.

B) Π^* is generalized causal cell automation satisfying Definition 4.2. Every probable causal world is described with corresponding generalization causal cell automation.

The above model synthetically processed the two kinds of information of random and fuzzy indeterminacy. Actually, research on reason and result emphasizes particularly on processing individual fuzziness while the one on the relation between reason and result does on processing randomness.

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Constructing generalized induction logic causal model provides both a new quantitative description frame and a new evaluation method for solving causal interference respond which has been difficult to be solved for a long time.

V. CONSTRUCTING PRELIMINARY KNOWLEDGE BASE OF INDETERMINATE GENERALIZED INDUCTION AUTO-REASONING IN STANDARD SWATCH SPACE

Definition 5.1 The midpoint of basic alterable sub-section pertinent to language value and its adjacent area ε is called as standard value (ε is a reasonable error permitted). The swatch of standard value will be standard swatch or be non-standard swatch otherwise. Standard swatch space and non-standard space comprised of standard swatch and non-standard one respectively are called by a joint name swatch space.

A)In generalized induction logic causal model, suppose that the reasons causing the result S are A, B, C, etc. When using generalized causal cell automation to describe state relationship of standard swatch space at time t, we first gain the language value of various states of causal and vector expression of corresponding discrete type. For example, reason A has these five language values: "very little", "little", "moderate", "large", "very large". And the vectors corresponding with its standard value are: $A_t^{(i)} = (a_i, b_i, c_i, d_i, e_i)_t\ (i = 1,2,3,4,5)$, it is called as standard state vector of A at time t; we also can get the standard state vector of result S at time t', such as $S_t^{(j)} = (p_j, q_j, ..., r_j)_t\ (j = 1,2,3,4,5)$, and respective state standard vector.

B)**Definition 5.2** In standard swatch space, suppose that $A_t^{(i)}$ and $S_t^{(j)}$ express the state of reason A at time t and the standard vector of state of result S at time t' respectively, then the causal state inevitability law $\phi_i^*(A,t) \overset{\ominus}{\rightarrow} \phi_j^*(S,t')$ is given out by relation matrix with fuzzy and random state, that is:

$$\phi_i^*(A,t) \overset{\ominus}{\longrightarrow} \phi_j^*(S,t') \triangleq C(H,E) \bullet \left[\left(A_t^{(i)}\right)^T \times \left(S_{t'}^{(j)}\right) \right] \quad (1)$$

Where $C(H,E)$ is inductive confirmation function, it indicates the support degree of proof E to hypothesis H(that is inevitability law of this causal state).

The inductive confirmation function of hypothesis H is the ration of model number of multiply of the two examination matrixes:

$$C(H,E) = \|SE\| / \|AE\|$$

It must be pointed out that: ①Inductive probability function is the maximum of inductive confirmation function, that is $C(H,E) \le P(H,E)$ ② Inductive probability is linear sum of experiential probability and logic probability, that is

$$P(H,E) = \alpha \bullet P(H,E_0) + \beta \bullet P(H,E_1)$$

Under some special conditions, inductive confirmation function may change into inductive probability function.

3) According to causal state theory in the definition of generalized cell automation, the all probable states of result S at time t' can get out using the following equation:

$$(\phi_i^*(A,t) \overset{\ominus}{\rightarrow} \phi_j^*(S,t')) \wedge (\overline{\phi}_i^*(A,t) \overset{\ominus}{\rightarrow} \phi_k^*(S,t')) \triangleq$$
$$C(H,E) \bullet \left[\left(A_t^{[i]}\right)^T \times S_{t'}^{[j]} \right] + C'(H,E) \bullet \left[\left(1 - A_t^{[i]}\right)^T \times S_{t'}^{[k]} \right] ..... (2)$$

Where both $C(H,E)$ and $C'(H,E)$ are induction confirmation function, their calculation formulas are the same as the before one. In formula (2), $\overline{\phi}_i^*(A,t)$ shows that the reason A will not be the state corresponding to $\phi_i^*(A,t)$ at time t. According to the causal state theory, $\phi_k^*(S,t')$ will include all probable results, accomplishing the entire induction in standard swatch space and with recognition limitation. Every matrix formed by formula (2) is called state matrix, all marked with M.

4) one time usage of synthesis rule: Under the construction of generalized induction logic causal model, in standard swatch space of probable causal world, taking state matrix M with causal relation information as background, the inductive reasing(big condition), the states of result *S* resulting from reason *A* with definite state $A_t^{(i)}$ can be gained from the following synthesis rule:

$$A_t^{(i)} \bullet M$$

5) Causal state table and state knowledge base: On account of all combinations of causal state , the following is a causal state table formed by using synthesis rule once.

Table1. Causal Statetable

Big condition		Small condition	Result vector
$A_t^{[1]}$ $\overset{\ominus}{\rightarrow}$	$\overline{A}_t^{[1]}$ $\overset{\ominus}{\rightarrow}$		$\overset{\ominus}{\rightarrow}$
$S_{t'}^{[1]}$	$S_{t'}^{[1]}$	$A_t^{[1]}$ $A_t^{[2]}$ ⋮	$\left(a_1^{[1]}, a_2^{[1]} \cdots a_n^{[1]}\right)$ $\left(a_1^{[2]}, a_2^{[2]} \cdots a_n^{[2]}\right)$ ⋮
	$S_{t'}^{[2]}$	$A_t^{[1]}$ $A_t^{[2]}$ ⋮	$\left(a_1^{[1]}{}', a_2^{[1]}{}' \cdots a_n^{[1]}{}'\right)$ $\left(a_1^{[2]}{}', a_2^{[2]}{}' \cdots a_n^{[2]}{}'\right)$ ⋮
	⋮	⋮	⋮
⋮	⋮	⋮	⋮

6) At local big precondition $A_t^{[1]}$ $S_{t'}^{[1]}$, a matrix called knowledge one can be constructed by selecting the result vector corresponding to small precondition $A_t^{[1]}$:

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$$M_1^* = \begin{bmatrix} a_1^{(1)}, a_2^{(1)}, \ldots\ldots a_n^{(1)} \\ a_1^{(1)'}, a_2^{(1)'}, \ldots\ldots a_n^{(1)'} \\ \ldots\ldots \\ \ldots\ldots \end{bmatrix}$$

When small precondition has ω states, ω knowledge matrixes similar to M_1^* can be gained. When the number of result states involved by local big condition is δ , the number of all knowledge matrix is $\omega^2\delta$, calling the set $\{M_I^*, \ldots, M_{\omega^2\delta}^*\}$ as state knowledge base. Causal state form gathers in the standard swatch space of probable causal world under the construction of generalized induction logic causal model while state knowledge base do all information with random and fuzzy indetermination and causal state relation, establishing an important basis for self-contained and effective indeterminate causal induction auto-reasoning in general swatch space.

VI. INDETERMINATE CAUSAL INDUCTION AUTOMATION REASONING MECHANISM(IN GENERAL SPACE)

A)For reason *A*, the reason state vector α_t corresponding to its swatch can be gained according to "contiguous" reason state standard vector using insert-value formula, that is:

$$\alpha_t = A_t \bullet \left(1 - \frac{\left|t_i - t_i^0\right|}{l_i}\right) + A_d \bullet \frac{\left|t_i - t_i^0\right|}{l_i}$$

Where t_i is the input data in the ith section. t_i^0 is the central data in the ith section. l_i is the length of the ith section. A_t is the reason state standard vector of the ith section. A_d is the reason state standard vector of left and right contiguous section according to the location of t .

Definition 6.1 In generalized induction logic causal model, under the same language value structure, the measure of reason state input vector α_t and reason state standard vector $A_t^{(i)}$ is determined by the following formula:

$$d_H\left(\alpha_t, A_t^{(i)}\right) = \sum_{j=1}^{k}\left|\mu_j\alpha_t - \mu_j A_t^{(i)}\right|$$

Where $\mu_j\alpha_t$ and $\mu_j A_t^{(i)}$ are the j^{th} coordinate of each of them respectively (the corresponding measure of result state may be deduced by analogy). According to Definition 6.1, for reason A, we will calculate the measure of a_t and every state standard vector of A and select the minimum to conform reason state type to which a_t belongs (language value).

B) Two time usage of synthesis rule: in the probable causal world, according to the state type ($A_t^{(\omega)}$)to which reason state input vector α_t belongs to and the type of local big precondition ($A_t^{(\omega)} \to S_{t'}^{(1)}$), we can find the unique knowledge matrix M_o^* matching with it through self-organized mode in preliminary knowledge base. Taking M_o^* as the big precondition, the auto-reasoning procedure of obtaining the result state vector resulting from reason *A* is:

$$\begin{array}{ll} M_o^* & \text{(big precondition)} \\ \alpha_t & \text{(small precondition)} \\ \hline \multicolumn{2}{c}{S^* \hat{=} \alpha_t \circ M_o^*} \end{array}$$

C) Clustering: Calculate and the measure of known result state standard vector, select the minimum to make certain the type(language value) of result state that S^* belongs to. Thus, the whole process of indeterminate causal induction auto-reasoning is completed.

VII. APPLICATION

The reasoning mechanism has been successfully applied to the design and development of intelligent controller of built-up air conditioners. The algorithm flow of the control process is shown as the following.

The control aim of intelligent controller of air conditioners is to control the degree of human's comfort, including integrated guide lines such as temperature, humidity, air cleanliness and velocity of air flow[8]. In the process control, an index like temperature is a reason and the degree of comfort is the result while the index like temperature and humidity show a mutually conditional and no-linear complex relation in figure id's curve . The whole control system is the one that requires harmonious control of multi variables. Based on language field theory frame to represent knowledge, taking causal relation induction reasoning model as the reasoning mechanism and taking control strategy like intelligent language as the means of process control , we build an integrated control model in which mathematic model and knowledge model are mutually connected. According to the model, we can simultaneously collect factor data informati9on such as temperature, humidity and the degree of smoke and dirty, use universal and parallel algorithm and send control statements to the execution units of temperature, humidity and ventilation..

The new intelligent air conditioner is better than fuzzy one in theory base, automation degree, multi-factor integrated control, preventing syndrome of air conditioner and saving electricity. We have accomplished the development and sample machine of new product(the sample machine has been passed the formal examination of Chinese National Examination Center of Household Appliances. The intelligent controller of air conditioner designed by the primary author of the paper has been prized with silver medal of the 46th Brussels Eureca World Invention Exposition, proving the science, effectiveness and universality and exploiting a new way for intelligent control based on qualitative reasoning.

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The algorithm flow of the control process is shown as the following:

1) Initializing system；

2) Sampling and inputting the current state of the system;

3) Adjusting system parameters and selecting either a refrigeration algorithm or a calefaction one according to the input;

4) Inserting value;

5) Synthesizing the matrix;

6) Clustering;

7) Determinating the type of control action;

8) Adjusting the action of temperature control;

9) Adjusting the action of humidity control;

10) Adjusting the time restriction;

11) Self-containing control action;

12) Output the control action to carry out real control on parts of air-conditioner.

VIII. CONCLUSION

(1) For generalized induction logic causal model, we have discussed solution to the problem of response to causal disturbance in terms of causal states and presented a feasible and determinable way of solving the problem. In fact, according to the transformation theory of metamorphism and states in terms of the isomorphism of their language fields, the solution is suitable for causal disturbance response in terms of causal instantaneous state.

(2) The paper comes up with not only a generalized model and its solution but actually a set of induction reasoning mechanism based on random and fuzzy indetermination at the same time, broadening Burks' theory of advance-setting induction probability and L.A.Zadeh's fuzzy reasoning theory on the intersection of disciplines and forming generalized induction logic causal theory whose description frame is language field.

(3) The solution to causal disturbance response is applied to the development of new intelligent controller of air conditioners. In the control system, the factors that influence on human's comfort feeling such as temperature, humidity , the degree of air cleanliness and the velocity of air flow are multi variable control in harmony. The new intelligent controller has passed the formal examination. It is proved that the new one is better than the fuzzy controller on the aspects such as self-organization, self-finding excellence , self-adapting, the automation degree and preventing syndrome of air conditioners.

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