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CREATION OF A KNOWLEDGE BASE FOR SEARCH AND DESIGNING OF ACTIVE ELEMENTS OF FLEXIBLE MANUFACTURING SYSTEMS

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At present high development of information technology and also computer technical and internet show that at organization, design decision and getting right results computer technical have important mean.

In this connection by application of new information technology option of flexible manufacture system elements and design of control system is one of the problems. In the paper for solution of the considered problems, algorithm organization of knowledge bases and option of flexible manufacture system elements are considered.

The creation of the knowledge bases (KB) for designing flexible manufacturing systems (FMS) is considered expedient. The analysis has shown that in intelligent systems the creation of a KB also is necessary for the solution of the following problems:

- Search of active elements (gripper, manipulator, robot, transport systems, lifting-taking up position gears, etc.).
- Designing of active non-standard elements of FMS.
- Development of the management of active elements – manipulators, robots and as a whole FMS.

The procedure for creating a knowledge base for the search of active elements of FMS can be described as follows.

In intelligent systems, as it is known, the following models and tongues of representation of knowledge are used [1]: logical predicate calculus's, frames, semantic networks, production systems.

For construction of most effective KB a production system is used, where the elementary information processes are represerented by the way of production rules depicting, how one chain of characters generates or associates another. The product ional rule (production) looks like [2]:

If <a sample 1>…<a sample n> THEN <operating 1>…<operating n>

Samples are compared to the current contents of base of the facts; by successful confrontation the operating, which can change a set of the available facts and stimulate the application of the new rules are executed. The production rules reflect semantics (regularity) of the given date domain, that gives an advantage as contrasted to formally – logical systems.

In the elementary case the rule is the ordered pair of chains of characters having the left-hand and dextral parts. The DB is a character set. The interpreter browses the left-hand parts of the rules and compares them to characters located in DB. By coincidence the character in a DB is changed to the contents of the right part of a rule. Further processes of interpretation are repeated. The operation of a production system consists in the fulfiment of sequence of steps "identification – operating". Thus each step includes a decision-making procedure about a call of the next rule and implementation of operations which are indispensable for the fulfiment of this rule.

The designing of the software for process of search of active elements of FMS is the ultimate goal of creating of a KB. Generally the sensors on some object, gripper, etc, can be active elements. For construction of KB its structure at first is determined, then the argument list determined the given data domain (active elements) and value of each definite parameter is updated, and the table of knowledge (KB by the way of tables) is further organized [3].

Let as allow, n of active elements to enter into the structure of FMS, and for these n of active elements k of general parameters to be present:

$$X=\{x_i\};\ i=1,2\ldots,k$$

Each determined parameter X_i has a miscellaneous quantity of values by the way of numbers or characters and is described in the vectorial form as follows:

$$\left.\begin{array}{l} x_1 = (x_1^1, x_1^2, ..., x_1^{l_1}) \\ x_2 = (x_2^1, x_2^2, ..., x_2^{l_2}) \\ .... \\ x_k = (x_k^1, x_k^2, ..., x_k^{l_k}) \end{array}\right\} \quad (1)$$

Where $l_1, l_2, \ldots, l_m$ are the quantity of the parameters of (1) the general table of knowledge by the of matrixe (2) is made:

$$\begin{pmatrix} x_1^1, x_2^1, ..., x_k^1 \\ x_1^2, x_2^2, ..., x_k^2 \\ .... \\ x_1^{l_1}, x_2^{l_2}, ..., x_k^{1k} \end{pmatrix} \quad (2)$$

The knowledge instituted by the highly qualified specialists in the given data domain are members of this matrix. Except for this table of knowledge the production system includes also other tables of knowledge, each of which falls into an individual active element.

Apart from the tables of knowledge the KB also includes a list of identifiers of active elements of FMS:

$$Y=\{y_1, y_2, \ldots, y_n\}$$

The concrete values of basic characteristics of active elements are stored in DB.

The user brings the values of inquired parameters in a system:

$$Z=\{z_1, z_2, \ldots, z_q\}, \text{ where } q \le k$$

search of active elements by the following rule is implemented:

$$\text{IF } (z_1 \text{ R } x_1^{l_1}) \&(z_2 \text{ R } x_1^{l_2}) \&\ldots\&(z_q \text{ R } x_1^{l_m}) \text{ THEN } y_j \in Y$$

Where R is the relation connecting the parameter of an element to its value.

The interpreter of the rules checks out, whether the conditions in the left-hand part of a rule are executed, whether i.e. values of parameters, pointed in a condition, coincide with the values of corresponding parameters in the knowledge table, and with a positive result the interpreter implements the operations pointed out in the right-hand part of a rule, and also the information of inquired active elements is given to the user.

Thus,

$$z_i R x_i^{l_i} = \begin{cases} l, if\ the\ value\ of\ z_i\ councides \\ with\ the\ value\ of\ x_i^{l_i}; \\ 0, if\ the\ value\ of\ z_i\ doesn't\ councide \\ with\ the\ value\ of\ x_i^{l_j} \end{cases} \quad (4)$$

As a result of fultiment of a rule (production) quantity of conterminous and distinct parameters (values) is determined on the basis of the basis of the following sums:

$$M=\sum_{i\in P} z_i R x_i^{l_j}\ ;\qquad N=\sum_{i\in Q} z_i R x_i^{l_j}$$

Where M is quantity of conterminous parameters, N is quantity of distinct parameters;

$$P=\{i|\ i\in\{1,2,\ldots,q\} \text{ and } z_i\ R\ x_i^{l_j}=1\},$$

$$Q=\{i|\ i\in\{1,2,\ldots,q\} \text{ and } z_i\ R\ x_i^{l_j}=1\},$$

So, if M=q then there is an active element which is fulfilling conditions of the designer in KB, and if N=q there is no demanded active element in KB.

On the basis of above mentioned it is possible to note the following statements:

The statement 1. If M=q then there is a required active element in KB.

The statement 2. If N=q then there is no required active element in KB.

It is necessary to mark that in remaining cases i.e. by $0<N<q$ or $0<M<q$ some parameters of required active element coincide with some parameters of active elements located in KB. So, there is an alternative judgment in KB which is not completely satisfying the demands of the user. There can be a few alternative judgments in KB. By existence of alternative judgments the intelligent system has a capability to give consultation to the designer.

It gives the basis to mark, that if there are numerical data's for search of the best solution it is necessary to rank conterminous parameters (in quantity M) on a degree of there relevance, using methods of formation selection. It will allow not only to secure the best solution, but also to arrange optional versions of the solutions on a degree of there preference. If the individual parameters are ordered on a degree of there relevance then by the matching of values the solution having the greatest (least) value of this parameter is accepted as the best. If the values of the first parameter for two and more solutions appear equal then the second parameter is applied. The preference is returned to the solution having the greatest value of the second parameter. If the second parameter also does not allow securing the best frame then the third parameter is entered, etc.

During the search for the demanded solution usage of individual parameters results in a series narrowing the initial set. If the problem has the single solution, it is accepted as optimum. In case of ambiguous solutions the final selection it implements solutions the final selection it implements is related to the strong willed act of the designer disposing of experience and information on the designed system.

The usage and the application ob KB on automated design of active non-standard elements of FMS is directed to designing or technical objects. In design works the KB are organized on the basis of knowledge of highly qualified specialists in the fields of design. In design augmented by a computer the declarative –procedural modules (knowledge), which are stored by the way of unites of decision making (base of algorithms), are the basically uses. The tongue of a record of decision boxes allows the designer to formulate design rules in representation customary for him, i.e. in the form close to the reference books, standards and other sources.

As model of representation of data and knowledge for creating intelligent automated design engineering systems it is expedient to select a network of frames. The concept of the frame is also widely used in areas bound with an artificial intelligence. The frame model allows describing both abstract objects and concepts, and concrete objects having precise numeric characteristics. These properties enable it to use the frame model with the purpose of creating KB for the solving of problems of computer-aided engineering of standard and non-standard active elements of robotic complexes, and also the designing of mechanical engineering devices.

The capability of representation of hierarchic by the way of frames also is very essential. The frame consists of slots depicting concrete properties of concepts or objects.

A large number of concepts, definitions and models of the frames is used. Therefore they differ not only in form of a record, but as also their pithy sense.

In a general view the structure of representation of in the following form is called frame:

$$\{n,(v_1,g_1,p_1), (v_2,g_2,p_2),\ldots, (v_k,g_k,p_k)\}.$$

Where n is the name of the frame; v_i is the name of the slot; g_j is the value of the slot; p_i is the procedure, which is an optional member of the slot.

The names of any slots can be the values of other slots, that organizes connection between the frames.

The table of knowledge, considered in the given article, is described by way frame model as follows:

$$\{TAB, (x_1,x_1^i), (x_2,x_2^i),\ldots (x_k,x_k^i)\}$$

Graphically the described frame is shown on figure.

With the purpose of creating KB for designing of parts of active elements the main specifications of designed parts and the area of acceptable values of selected options at first are determined:

$$(s_1,s_2,\ldots,s_k)$$

Further the frame models for designing parts are created as follows:

$$\{DET,(s_1,a_1), (s_2,a_2),\ldots (s_k,a_k)\}.$$

Where S_i are the slots of the frame, a_i are the design values.

It is necessary to note that KB is also used for creating management systems of active elements of FMS and FMS as a whole. In this case the production model of KB by the way "rule-operating" is applied. The combination of commodities is stored in KB. By the control of active elements the required production is selected from KB for organization of the control of active elements separately, and also as a whole FMS.

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