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Holonic Manufacturing system and Its Application

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Abstract –Facing the increasingly diversified customer need and the fierce market competition, manufacturing production mode towards the customization, The AM (Agile Manufacturing) mode is expected to become the trend of the development of the 21st century. This paper studies the main characteristics of agile manufacturing and points out that the holonic manufacturing system to be the important base of realizing AM. And then analyze the function and basic characteristics of the holonic system. Finally, put the concept and the theory into applying in manufacturing system design.

Keywords –Holon; Holonic structure; manufacturing system; Agile Manufacturing

1. Introduction

The fierce market competition on manufacturing put forward severe challenges, make flexible and dynamic changes in the global market of the fast response ability to become the manufacturing competition focus. Holonic Manufacturing System is considered as the basis of agile manufacturing to get serious in-depth study from international cooperation research institutions. This paper on the basis of the concept of Holon, study it in the field of theory application. Holon is a complex system and has the "whole" and "Part" attribute, which has "autonomy" and with "coordination" entity since it is not only contain the whole (Self - contained - whole) and interdependent parts (Dependent - Part). Arthur Koestler Based on the following two starting point puts forward the concept of Holon: (1) some relative stable intermediate form is favorable for the development of complex system, any complex system have some form of hierarchical structure; (2) the whole and part of the concept of relativity.

2. Holonic manufacturing system and the traditional manufacturing system

HMS (Holon Manufacturing system) has three features (1) the processing disturbance stability and reliability; (2) the processing system change the adaptability and flexibility; (3) the effective use of to the service. The difference between Holonic structure manufacturing control system and the traditional manufacturing control system can see table 1.

Tab.1 Contrast of Traditional and HMS manufacture Control System

Traditional Manufacture Control System	HMS manufacture Control System
1.Business objectives in the form of task decomposition is decomposed step by step	1.Business objectives in the form of target decomposition is decomposed step by step
2.Coordinate and integrate lower activity by the upper	2.Through the coordination between the Holon to complete the tasks assigned by the upper
3.Master-slave relation	3.Peer relationship
4.Rigid static structure	4.Flexible and variable dynamic structure
5.Certain communication mode and fixed message transfer structure	5.Variable communication mode and flexible message transfer mechanism
6.Poor reliability, system strain capacity is decided by system design	6.System reliability is high, the system has the ability of dynamic reconfiguration
7.Intelligent decision focused on the control structure of the upper	7.All levels of all-around body have some degree of intelligence
8.Suitable for relatively stable manufacturing environment	8.Suitable for dynamic changeful manufacturing environment

3. Remote service integrated management system structure based on Holon

By introducing the performance of consultation with autonomy Holon concept, construct the face cross-domain enterprise based on the Holon remote service integrated management system structure, as shown in figure 1.

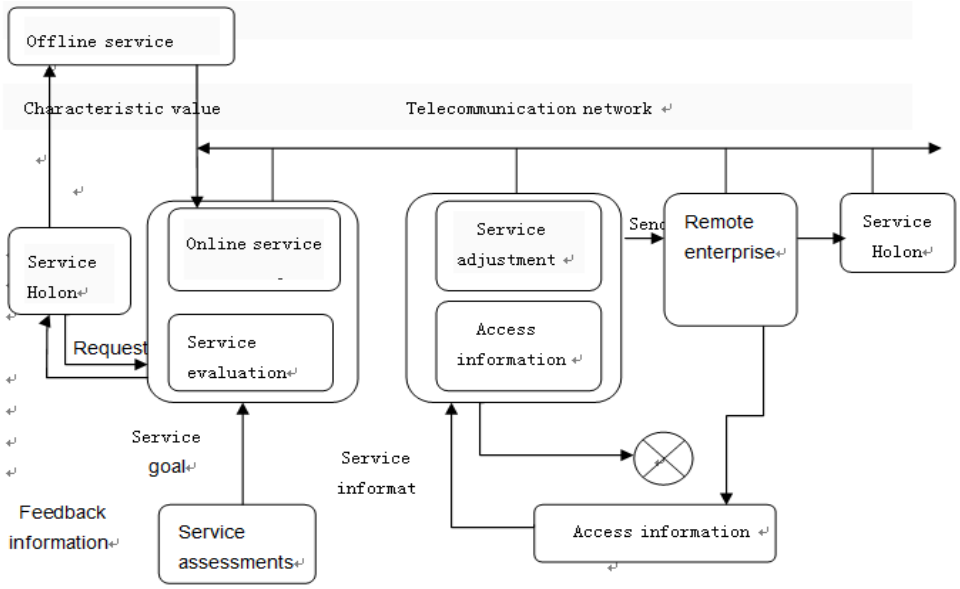


Figure 1 Remote Service Integrated Management System Structure Based on Holon

4. Remote service dynamic allocation and optimization scheduling

Through the service Holon and consultation coordination of Holon an important characteristic is in the application of evolutionary algorithm search to individual process have multiple Holon participation, will Holon internal coordination strategy, target function and evaluation standards and coordination Holon algorithm combining process. Each service Holon packaging the domain knowledge, target, beliefs and strategies, in the design of automatic consultation service Holon strategy mechanism, each Holon strategy module Settings a elastic interval, is the goal function set a variable parameter, in the realization of different goal of the whole supply chain using the corresponding parameter value. The project depends on the coordination of the Holon service target, beliefs and strategies, these strategies and faith by coordination Holon of supervision and guidance, coordination Holon according to service Holon team set goals for project evaluation, make each suit Holon using method of cooperation coordination strategy. Service Holon activity plan receiving standard application of simulated annealing algorithm, can avoid the local search and mess up, service Holon scheme accept standard function :

$$P(A_t(C,C')) = yes = \begin{cases} 1, if \ \ f_i(c') \geq f_i(c) \\ e^{(f_i(c')-f_i(c))/T}, otherwise \end{cases}$$

Type, P represent alternatives receiving probability, At (C, C ') represent the C 'plan instead of C solution acceptance criteria, on behalf of the plan C, C' utility function, T representative (temperature) control parameters, scheme acceptance criteria using utility decreasing principle, if the new scheme C 'utility is greater than the plan C utility, the new scheme C' instead of plan C, otherwise, not to the new scheme all negative, but for the new plan to certain receiving probability, so it can increase the probability of find optimization scheme, and At the same time avoid search stalemate. In the hierarchical control, all decision-making ability is in system design decomposition to hierarchical control of all levels.

Figure 2, for enterprise remote service Holon dynamic allocation mechanism. Scheduling Holon through and order Holon cooperation, the periodic or based on event scheduling adjustment technology, constantly adjust scheduling plan in order to optimize the service distribution. Scheduling Holon first through the order processing module scheduling Holon through and order Holon cooperation, the periodic or based on event scheduling adjustment technology, constantly adjust scheduling plan in order to optimize the service distribution. Scheduling Holon uses the order processing module.

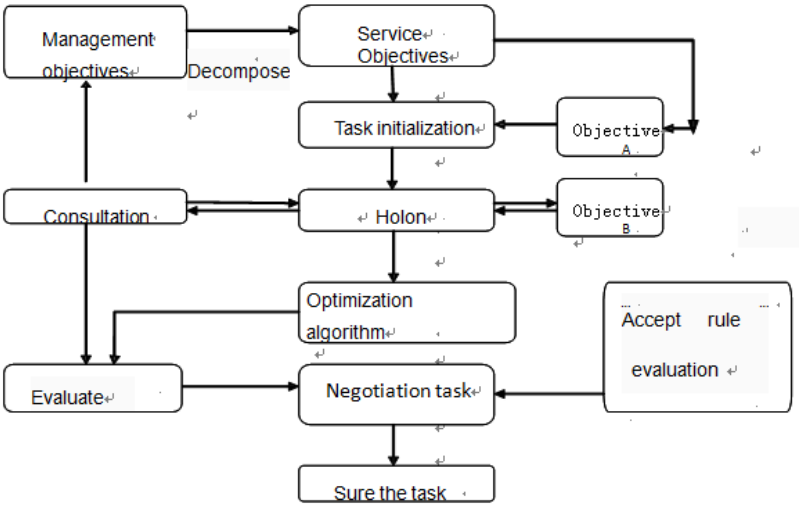


Figure 2. Remote Service of Enterprise—Dynamic Allocation Mechanism of Holon

5 Case

In a certain enterprise remote service platform as an example, based on the genetic algorithm ant clustering kind of remote service allocation methods are tested, analyzed its effect. Based on genetic algorithm (ant clustering algorithm design such as follows:

1) Chromosome selection, coding and generating of initial population: chromosome using ant colony algorithm of parameter: a, beta, p, t, q. This can be used to determine genetic algorithm with ant colony algorithm for the optimal parameter combination; Because the real coded genetic algorithm has high accuracy, large search space, easy into a certain heuristic information field etc, the ant clustering algorithm class USES the decimal number coding; The initial population according to the preset by random number generating way.

2) Fitness function, the selection of fitness function and to solve problems, combining the objective function decided in this paper, the fitness function F is defined as F = Fr. , including Fr to assess clustering algorithm of F - Measure function. F - Measure, the higher the value, the corresponding individual fitness is higher.

3) The selection operator, the tournament selection method, according to fitness function selected cross individual. In the championship choice method, random selected from population reservation number of individuals, and then from these individuals choose to have the best fitness individuals do father individual, this process is repeated, until all the father individual selection.

4) Crossover operator, the uniform cross method, uniform cross more generalized change, each point as potential intersection, the destructive can promote to search the solution space, can search to other cross method can't search to the model. The process is first random generation and elder individual coding long binary cross template string, and then according to this template string to two father individual genes are string cross, get two new generations individual. 5) mutation operator, the gauss mutation methods, this method originated in the evolution strategy. In general evolution strategy of an individual contains two elements (x, or), one of the first vector x says the search space of a point, the second vector or said standard deviation. Future generations (x ', or ') by type generation:

$$\sigma' = \sigma e^{N(0,\ \Delta\sigma)}$$

$$X' = X + N(0,\ \Delta\sigma)$$

The N (0, Δ σ) is mean for 0, standard deviation for its independent Gaussian random number vector. According to the above description, ant clustering kind of algorithm process is as follows:

Step 1 Set the parameters, generate initial population

Step 2 Calculate fitness function value for all individuals

use ACA

Set parameters initialize pheromone trails

While termination iteration not met or clustering center changed) Do

Determinate clustering for each data x with probability p_{ij} (t) given by equation(1)

Update clustering centers for each clustering by equation (3)

Update pheromone on each walked edge by equation (4) and (5)

Calculate fitness function value

Step 3 Genetic operation

Sort all individuals according to fitness function ;

Select individuals through Stochastic Uniform selection method ;

Carries on Scattered Crossover and the Mutation operation to the selected individuals ;

Step 4 Repeat step 2 and step 3 until met the termination iteration

End ACGA

Take the metric value (F - Measure) as a method for clustering algorithm evaluation function. F-Measure fusion of the information retrieval precision rate and recall rate thoughts, F -Measure the higher the value, the clustering, the better the results. A clustering J and related to this classification I of the precision ratio and recall ratio is defined as:

$$P(i, j) = N_{ij} / N_j$$
$$r(i,j) = N_{ij} / N_i$$

Among them is in the clustering j in classification of I prime; J is the prime classification I, J is clustering j of prime, classified I F - Measure defined as:

$$F(i) = \frac{2PR}{(P+R)}$$

$$F_{measure} = \frac{\sum_i N_i F(i)}{\sum_i N_i}$$

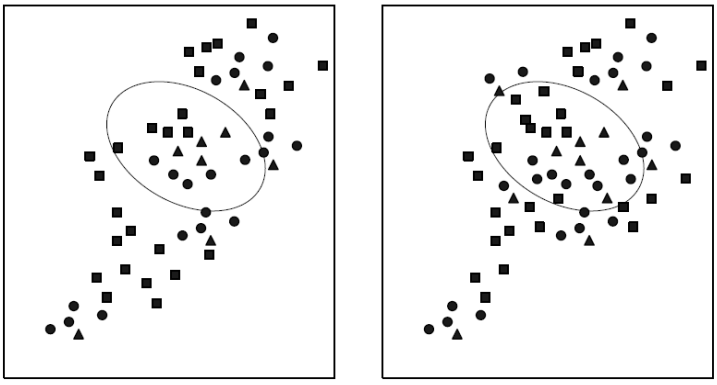
Experimental data using UCI machine learning repository Wine, Iris data set and Cork Stoppers data set, see table 2.

Tab 2 The Description of Test Data Set

Data set	Attribute number	Classificati on number	The number of examples
wine	13	3	178
Iris	4	3	150
Cork stoppers	10	3	150

Test data set respectively with ACA (ant colony optimization) and ACGA (based on the genetic algorithm ant clustering class) testing. In ACA, parameter a, beta, p, t, q respectively take 40100, 0.1, 20300, maximum iterating times take 30 times. In the GACA population size is 30, crossover probability is 0 • 8, mutation probability for O • 2, maximum algebra is 50.

Figure 3 shows the Iris data set in 150 data and clustering results, (a) and (b) respectively is ACA and ACGA examples of clustering Iris data gathering class results in the photo, train, ○ and mouth said Setosa category respectively, Versico - lour and Virginica.



(a) ACA Clustering results. (b) ACGA Clustering results.
Figure 3 the data set of Iris and Clustering results

From the photos can intuitively see ACGA ACA is clustering effect is better, more close to the real classification. Table 2 shows the use of ACA and ACGA respectively on two data sets for 50 times the average test results.

Tab3 The two kinds of test results

	Data Set		
Algorithm	Wine	Iris	Cork Stoppers
ACA	0.721	0.892	0.854
ACGA	0.761	0.920	0.861

According to table 3 comparisons, in the experiment the clustering number hypothesis is known and the data set classification number the same. From the test results can be seen in ACGA accuracy than ACA algorithm are improved to varying degrees, so as to realize the cross-domain between enterprise remote service reasonable configuration and optimization scheduling, achieve enterprise remote service configuration from consultation, the modern enterprise has a good environmental adaptability.

8. Conclusions

This paper will Holon theory is introduced into the remote service configuration management, the first constructs face cross-domain enterprise based on the Holon remote service integrated management system structure, then through the description enterprise remote

service between Holon data and function relationship, constructing service between Holon consultation scheme receiving standard and service between Holon communication protocols, based on Holon enterprise remote service optimization scheduling mechanism; By constructing a Holon based on remote service control model of the communication mechanism, set up based on the Holon enterprise remote service optimization scheduling mechanism, and finally, and on this basis, Holon based on remote service automatic negotiation rules and strategy, so as to realize the cross-domain between enterprise remote service reasonable configuration and optimization scheduling, achieve enterprise remote service configuration from consultation, the modern enterprise has a good environmental adaptability, to solve the cross-domain between enterprise remote service configuration and scheduling problem in the process of consultation, make the enterprise has a good environmental adaptability, improve production efficiency.

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Vitae

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