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The Research of Building Fuzzy C-Means Clustering Model based on Particle Swarm Optimization

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Abstract

Particle Swarm Optimization algorithm is based on iterative optimization tools, system initialization of a group of random solutions, through iterative search for the optimal value. The basic idea of the fuzzy C-means clustering algorithm is to determine each sample data belonging to a certain degree of clustering, and the degree of membership of sample data is grouped into a cluster. Favor optimal solution in the sense of multi-objective particle swarm algorithm is efficient search capabilities. The paper presents the research of Building Fuzzy C-Means Clustering Model Based on Particle Swarm Optimization. Fuzzy c-means clustering is determined membership to each data point belongs to a cluster of a clustering algorithm. Particle Swarm Optimization is the process of the simulated social animals foraging moving group activities work of individual and group coordination and cooperation.

Keywords: *fuzzy C-means clustering, particle swarm optimization (PSO), clustering*

1. Introduction

PSO, particle swarm optimization algorithm (Particle Swarm Optimization), abbreviated as PSO, is an evolutionary technology (evolutionary computation) 1995 by Eberhart and Dr. Dr. kennedy from the study of the behavior of predator birds. PSO algorithm starting from random solutions are in order to find the optimal solution by iteration, to evaluate the quality of the solution through fitness. However, PSO is simpler than the genetic algorithm rules; it is not a genetic algorithm "cross" and "alternative" operating it by following the current search for the optimal value to find the global optimum [1]. This algorithm is its ease of implementation, high accuracy, convergence faster, etc., and demonstrated its superiority in solving practical problems.

Clustering is an important data analysis techniques, the search for and identification of a limited kind of collection or cluster collection, and then to describe the data. Cluster analysis as a branch of statistics, has been extensively studied for many years. Moreover, clustering analysis has been widely applied to many fields, including data analysis, pattern recognition, image processing, and market research. Through clustering, one can recognize the dense and sparse areas, thus found interesting relationship between the global distribution patterns, and the data attribute. In the business, the clustering can help market analysts found a different customer base from a library of basic customer information and buying patterns to characterize the different characteristics of the customer base. In biology, clustering can be used to derive a classification of plants and animals, the gene classification, to gain understanding of the inherent structure of the population.

Particle Swarm Optimization algorithm to generate background, imagine a scene: the random distribution of a flock of birds in an area, in a region where only a piece of food. All the birds do not know where the food is. But they know the current location how far away from the food. So what is the optimal strategy to find it? The simplest and most effective way is to pursue own vision bird from food recently. If the food as the most advantages, and the distance of the birds away from the food as the fitness function, then the process of birds foraging for food on the optimization process can be used as a function. Was inspired particle swarm optimization algorithm is simplified.

Fuzzy clustering algorithm computing technology and is based clustering algorithm for optimal function method, the use of calculus. The optimal is cost function. The probability density function clustering method based on probabilistic algorithms will use this to assume

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that the appropriate model vector of fuzzy clustering algorithm can belong to more than one cluster, so as to get rid of the above problem. Fuzzy clustering algorithm, defined the neighbor function between the vector and clustering, and the degree of membership of the vector clustering collection by the membership function. Fuzzy method, and it is in different clustering vector membership function value are interrelated. Hard clustering can be seen as a special case of the fuzzy clustering method.

For more local extremism point function, it is easy to fall into local extreme point, can not get the correct result. In addition, due to the lack of precision with search method, PSO method often can not get PSO accurate results. Furthermore, PSO method provides a global search may be strict, but can not prove its convergence on the global optimum. Therefore, PSO is generally applicable to a class of high-dimensional, there are many local extreme points and does not need to be very high-precision optimization problem. The paper presents the research of Building Fuzzy C-Means Clustering Model Based on Particle Swarm Optimization.

2. The analysis of Particle Swarm Optimization

Particle Swarm Optimization (PSO) was originally inspired by the results of the artificial life research in 1995 by Kennedy and Eberhart Dr. simulate birds foraging process migration and cluster behavior when a swarm intelligence-based evolutionary computing technology [2]. The algorithm has a parallel processing robustness characteristics greater probability to find the global optimum solution, and the computational efficiency than traditional random method. Its biggest advantage is that the programming is simple, easy to implement, fast convergence, and profound intelligent background, both for scientific research, but also for engineering applications. Therefore, PSO was put forth, immediately aroused widespread concern in the field of evolutionary computing researchers, and in just a few years time, the emergence of a large number of research results, the algorithm has been international evolution Computation Conference "as one of the main topic of discussion.

PSO simulate a flock of birds of prey behavior. Imagine such a scene: a flock of birds in a random search of food. All the birds do not know where the food is. But they know the current location how far away from the food. Then the optimal strategy to find the food is what it. The simplest and most effective is to search the surrounding area from the nearest food bird. PSO inspiration from this model and used to solve optimization problems. PSO, each optimization problem is the search space of a bird. We call it the "particles", as is shown by Equation (1).

$$\frac{\partial F}{\partial a} = -2\sum_{i=0}^{n} x_i (y_i - ax_i - b) = 0 \quad (1)$$

All of the particles have a fitness value is determined by the function to be optimized (fitness value) of each particle, there is a speed determine the direction and the distance that they fly. The particles were then following the current optimum particles in the solution space search. PSO is initialized to a group of random particles (random solution). Then find the optimal solution by iteration. In the each iteration, the particle through track two "extreme" to update yourself a particle itself to find the optimal solution, this solution is called pbest pest. Another extremism entire population to find the optimal solution, this extremism is the global minimum gBest.

PSO is inspired by social behavior of flocks of birds or schools of fish and the formation of a population-based random optimization Technology. It is a class of stochastic global optimization technique, optimal region found in the complex search space through the interaction between particles [3]. The algorithm is a new swarm intelligence-based evolution of technology, with a simple and easy to achieve, set a few parameters, global optimization capability advantages. Particle Swarm Optimization in function optimization, neural network design, classification, pattern recognition, signal processing, robotics and many other areas of successful application, as is shown by Equation (2).

$$SNR = 10 \times \log_{10} \frac{\sum_{i=1}^{M}\sum_{j=1}^{N} F(x_i, y_j)^2}{\sum_{i=1}^{M}\sum_{j=1}^{N} [R(x_i, y_j) - F(x_i, y_j)]^2} \quad (2)$$

Particle Swarm Optimization, Particle Swarm Optimization process is as follows: (1) in accordance with the initialization process, the initial set of random position and velocity of the particle swarm; (2) Calculate the fitness value of each particle; (3) for each particle, its fitness value of the best position Pi adaptation value comparison, if good, is as the best position; (4) for each particle, its fitness value compare global experience best position Pg adaptation value, if better, then it is as the global best position; (5) the speed and position of the particles based on two iterative formula evolution; (6) fails to reach the end of the condition is usually good enough to adapt to the value or reach a preset maximum algebra (Gmax), return to the step (2); otherwise perform step (7) output guest.

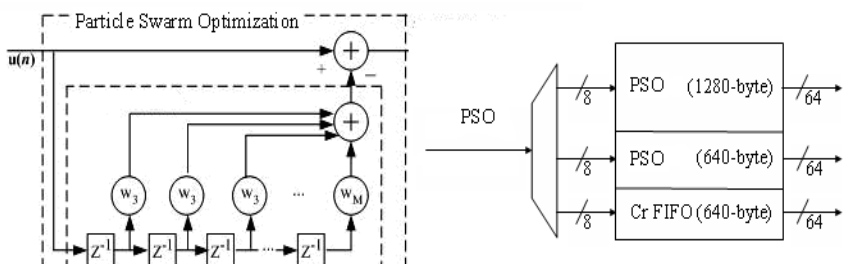

Figure 1. Mesh Particle Swarm Optimization process

Particle Swarm Optimization is a special case of w = 1. Called standard PSO with inertia is weight particle swarm algorithm. As can be seen by the evolution equations of elementary particle swarm optimization model in particle position, the position of particles at different times is mainly determined by the flight speed, that is, k+1 flight speed of the particle is equivalent to searching step: xij = xijthe size of the vim flight speed directly affect the global convergence of the algorithm [4].

When the flying velocity of the particles is too large, the initial each particle will fly at a faster rate for global optimal solutions in a region adjacent, but when the approximation to the optimal solution, since the flying velocity of the particles is the lack of effective control and constraint, over the optimal solution will easily turn to search for other regions, so that the algorithm is difficult to converge to the optimal solution, local optimal solution; too small when the flight speed of the particles, the particles adjacent to the global optimal solution in the early the region close to the search time would need to be very long. The convergence is slow; it is difficult to reach the optimal solution. Based on this reality, the two of them raised the standard particle swarm optimization [5].

Improved particle swarm algorithm for solving the optimal power flow problem in solving the optimal power flow problem, the use of standard PSO will inevitably fall into the local extremism prematurely I try to expand the number of particles in particle swarm PSO algorithm some of the parameters to be modified, want to avoid prematurely, but learned through experiments that the standard PSO algorithm is not sensitive to the amount of particle populations, modification of the algorithm parameters on the performance of the algorithm has some improvements, but the improvement is not ideal To overcome the shortcomings of the standard PSO algorithm, the particles can be as large as possible within the scope of the search, with consideration of the search range and the number of iterations to obtain more satisfactory results within a short period of time. Therefore, the author draws on genetic algorithm thinking, put forward a kind of roulette wheel selection mechanism double-population particle swarm optimization algorithm, as is shown by Equation (3) [6].

$$\Phi_{j,k,m}(x,y)=\phi_{j,k}(x)\phi_{j,m}(y) \quad , \quad \Psi^{1}_{j,k,m}(x,y)=\phi_{j,k}(x)\psi_{j,m}(y)$$
$$\Psi^{2}_{j,k,m}(x,y)=\psi_{j,k}(x)\phi_{j,m}(y) \quad , \quad \Psi^{3}_{j,k,m}(x,y)=\psi_{j,k}(x)\psi_{j,m}(y) \tag{3}$$

PSO genetic operations are such as crossover (crossover) and mutation (mutation). Decided to be search but according to their speed. The particles also an important feature is the memory. PSO information sharing mechanism is different compared with the genetic algorithm, genetic algorithm, chromosomes (chromosomes) to share information with each other, so the movement of the entire population is relatively uniform move to the optimal region the PSO in, only gBest the (or lBest) gives information to other particles, this is a one-way flow of information the entire search update process is to follow the current optimal solution. Compared with the genetic algorithm, in most cases, all of the particles may be faster converge to the optimal solution.

Also do not use the entire population, but only with the part as a neighbor of the particle, then all neighbors extremes is local extremis. Description of the particle swarm algorithm, the particle swarm consists of n particles, the position xi representatives of each particle to optimize the potential of the solution of the problem in the D-dimensional search space [7]. The particles in the search space, flying at a certain speed, this speed is dynamically adjusted according to its own flying experience and companion flying experience to the next step of the flight direction and distance. All particles have a decision by the objective function fitness value, and know yourself so far found the best position (pbest pi) and the current position (xi)., as is shown by Equation (4).

$$\begin{cases} a = \dfrac{n\sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i y_i}{n\sum_{i=1}^{n} x_i^{\,2} - (\sum_{i=1}^{n} x_i)} \\ b = \dfrac{1}{n}\sum_{i=1}^{n} y_i - \dfrac{a}{n}\sum_{i=1}^{n} x_i \end{cases} \tag{4}$$

Global search step; w is smaller, the smaller the particle speed step, the particles tend to fine local search elements. W of the trend is just equivalent to the change trend of the particle velocity. With inertia weight particle swarm algorithm improvements at the two combine to make the particles can move closer to the optimal solution area as soon as possible, without getting near the area of the optimal solution is reached over the optimal solution. Current research on the particle swarm algorithm usually takes inertia weight particle swarm algorithm as the basic model of the PSO algorithm. ax, D, prior knowledge, unconstrained optimization problem min f (x) nx Rx = (x1, x 2, ···, xn) T R n, usually known as variable x1, x 2, ···, xn which is decision variables (decision variables), said the objective function (objective function).

Application of PSO to solve the optimization problem, there are two important steps: encoding and fitness function PSO Solutions, an advantage is the use of real-coded do not need to be like genetic algorithm is a binary encoding (or for the genetic manipulation of the real number [8]. Example problem f (X) = X1 ^ 2 + x2 2 + x3 ^ 2 solution, the particles may be encoded directly into (x1, x2, x3), the fitness function is f (x). then we can use the previous.

Ant colony optimization algorithm is in order to simulate the behavior of the ant colony in the path selection and transmission of information, and particle swarm. Optimization algorithm to simulate the process of individual and group coordination and cooperation is in social animals foraging migratory group activities. Type of draw on the analog life functions and features of the behavior of the system of scientific computing method is called artificial life [9]. Artificial life calculation includes both content to study the use of computing technology study biological phenomena and study the use are of biotechnology research computing problems. Artificial neural networks, particle swarm optimization algorithm, genetic algorithm, and it are ant colony excellent.

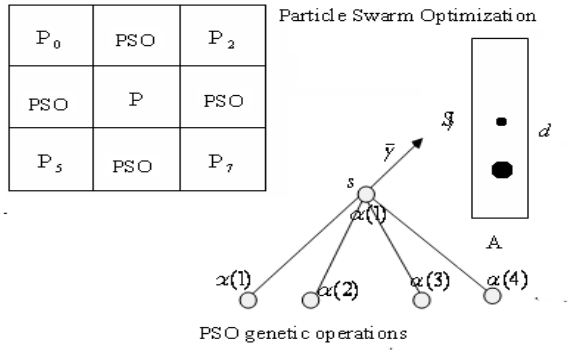

Figure 2. Particle Swarm Optimization Genetic Operations Application

Particle Swarm Optimization algorithm principle, the principles of particle swarm optimization particle swarm optimization algorithm, a bird in the search space each potential solution of the optimization problem, called "particles". Random search within the area of all the particles have a decision by the optimization function fitness value of each particle, there is a speed determines their flying food. All the birds do not know where the food is. But they know the current location and distance of food [10]. Then looking for the most simple and effective strategy is to search for the smallest and food distance around the area of the bird, as is shown by Equation (5).

$$OC = \sum_{t=0}^{T}\left(\sum_{j=1}^{n+1}\sum_{k=1}^{n+1} c_j(t)c_k(t) \Big/ x^2(t)\right) \tag{5}$$

In addition, each particle also knows so far found that the best position of all the particles in the group as a whole (the global extremism pg). The mathematical description of the particle swarm algorithm is as follows: each particle i contains a D-dimensional position vector xi = (x i1, x i2... x iD) and velocity vector vi = (v i1, v i2, ..., v iD), the particle i search solution space, save for its search to optimal the experienced position pi = (P i1, p I2 ..... PID) [11]. At the beginning of each iteration, the particles according to their own inertia and experience and groups optimal experience position pg = (p g1, p g2, ..., p (gD)) to adjust their speed vector to adjust its position's 1, c 2 is the normal number, called accelerating factor; r 1, r 2 is [0, 1], the uniformly distributed random number, d is the number of dimensions in the D-dimensional; ω inertia weight factor.

3. Fuzzy C-Means Clustering Algorithm and Achieves

Fuzzy C-Means clustering algorithm FCM algorithm, fuzzy partition concept originated in Rossini article, the FCM algorithm analysis and improvement is accomplished by Dunn and Bedeck. Cluster analysis is a multivariate statistical analysis, but also non-the supervision pattern recognition is an important branch, pattern classification, the most widely used in many areas of image processing and fuzzy rules processing. A category labeled sample set some guidelines are divided into several subsets (classes), similar samples classified as a class as much as possible, and will not be similar to the sample is divided into different classes as much as possible. Hard clustering each object to be identified strictly divided into three sorts, either-or nature of fuzzy clustering due to is able to describe the sample.

In many fuzzy clustering algorithms, the fuzzy c-means clustering algorithm (FCM) is the most widely used [12]. According to some criterion, the clustering of the data into a nonlinear optimization problem is solved by iteration, has become a non-supervision of pattern recognition, an important branch of. Cluster analysis in data mining is focused in an effective and practical clustering method study clustering method for massive data scalability, high-dimensional cluster analysis, the Category attribute data clustering and mixed attribute data clustering, non-distance fuzzy clustering. Therefore, cluster analysis, data mining has its special requirements; scalability to handle different types of properties, strong anti-noise, high-

dimensional input order sensitivity, interpretability and availability. This article is in this context clustering data mining analysis discussed, and focuses on the FCM algorithm, as is shown by Equation (6).

$$\Sigma_{\varepsilon(k)} = \mathrm{diag}[\sigma^2_{\varepsilon_1(k)}, \sigma^2_{\varepsilon_2(k)}, \ldots, \sigma^2_{\varepsilon_q(k)}] \tag{6}$$

Fuzzy clustering algorithm can be broadly divided into three categories: 1) variable number of categories, according to the different requirements of dynamic clustering of things, such a method based on fuzzy equivalence matrix clustering called fuzzy equivalent matrix dynamic clustering analysis. 2) the number of categories given, to find out the best analysis scheme of things, such method is based on the objective function clustering, called mode c-means clustering. 3) in the case of perturbation meaningful clustering based on fuzzy similarity matrix such methods as based on the perturbation fuzzy clustering analysis.

The fuzzy C-means clustering algorithm is (FCM) fuzzy C-means clustering algorithm. The basic idea is to determine each sample data belonging to a certain degree of clustering, the degree of membership of sample data is classified as a cluster. FCM of the n-th sample set X = {x1, x2... xn} be divided into c fuzzy group and demand in the cluster center of each Ci (i = 1,2, ..., C), such that minimizes the objective function, the algorithm is iterative process optimizes the objective function [13]. This process started from a random membership matrix to determine the cluster centers objective function through an iterative process of sample classification. Initialization: Given the number of samples n, the number of clusters c [2, n], the blur degree m = 2, iteration stopping threshold, as is follows.

$$\begin{aligned} V_j &= V_{j-1} \oplus W_{j-1} \\ &= V_{j-2} \oplus W_{j-2} \oplus W_{j-1} \\ &\cdots \\ &= V_0 \oplus W_0 \oplus W_1 \oplus \cdots \oplus W_{j-2} \oplus W_{j-1} \end{aligned} \tag{7}$$

Although the genetic algorithm is a global stochastic optimization method, but there are also disadvantages. Wholly dependent on the probability of the algorithm is finished (1) random optimization operation, avoid getting into local minimum, but subject to the constraints of the optimization is generally only get suboptimal solutions in the global scope, it is difficult to get the optimal solution ; artificially by reference to (2) the number of binary encoded string indirection continuous space discrimination, leading to the contradiction between the calculation accuracy and the string length, amount of computation; genetic algorithm uses stochastic optimization techniques, (3) want to spend a lot of time, the time complexity. In response to the above problems, this paper proposes an improved genetic algorithm (Improved GA IGA), a real variable chromosome crossover and mutation, and further with the FCM algorithm combining fuzzy clustering analysis (IGA-FCM), as is shown by Figure 3.

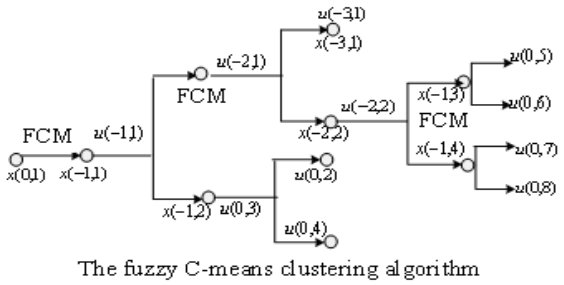

Figure 3. The Fuzzy C-Means Clustering Algorithm Analysis

From the hard C-means algorithm (denoted as HCM). Its unique is advantages. Although the genetic algorithm is applied to the field of engineering optimization has become

increasingly widespread in practical applications, but the traditional genetic algorithm to be further improved. In this paper, an improved genetic algorithm, and applied fuzzy clustering algorithm. Promotion from, has become one of the most commonly used clustering algorithm and discuss more. The description thereof is as follows: Order X = {xi, i = 1, 2 class center.

The genetic algorithm (Genetic Algorithm, in recent years, rapid GA) developed an effective global optimization algorithm, it borrowed the mechanism of natural selection in the biological genetics genetic mutation, individual adaptability can be improved in the optimization process the basic idea is: First generate the initial solution group, select the better individuals from the solution group and then some indicators, the use of some genetic operators (such as crossover and mutation) to computing, a new generation of candidate solvable groups, repeat this process until you meet certain convergence indicators [14]. Compared to many other optimization methods, genetic algorithm is global search, and the robustness problem solving, is widely used in the relevant combinatorial optimization, pattern recognition, machine learning and image processing and other optimization methods can not solve or difficult to solve the problem.

C means clustering algorithm parallel design optimized design 3.1 basic flow of C means clustering algorithm serial program can be divided into the following stages: First, the IPA high-performance tool hotspot function to spend time and parallel analysis string line program parallelism; then use TBB and OpenMP parallel optimization design; compare test the effect of the performance of parallel programs last IPA compare Results feature.

Clustering similar determination of the region, the grouping of the auto insurance policy holders, and depending on the type of housing, the grouping of the value and location of housing in a city, can also play a role in the Earth Observation database. Clustering can also be used to classify the documents on the Web to find information, as is shown by Equation (8).

$$\begin{cases} w_{j,\min}^{\xi}(m,n) = \dfrac{1}{2} - \dfrac{1}{2}\left[\dfrac{1 - M_{j,AB}^{\xi}(m,n)}{1-T}\right] \\ w_{j,\max}^{\xi}(m,n) = 1 - w_{j,\min}^{\xi}(m,n) \end{cases} \tag{8}$$

IPA (Intel Parallel Amplifier), the following three types of performance analysis. The hot spot analysis (Hotspot): run the hot spot analysis of the different types of data can be collected to determine the time consumed by the application is running, as well as to identify the most time-consuming function. When the program is executed, the IPA regular sampling and data collection program to collect data and collaboration of the operating system interrupt. By sampling each CPU core instruction pointer (IP) to obtain the entire program, to calculate the running time for each function, and then to create a call tree for the program call stack sampling.

Fuzzy C-Means clustering algorithm is based on the sum of squared errors objective function criteria, the first given initial program iteratively by (3a), 3b), so that the objective function reaches its minimum. From the above fuzzy c - means clustering algorithm process point of view, so that the minimum objective function value, the first derivative method, the membership value depends on the location of the training samples, the result is usually an iterative solution is locally optimal solution and initial classification, training sample selection sequence of closely related. On the other hand, between the fuzzy set and cross contains computation adopted to define the design universe X on fuzzy sets A, B corresponding to the degree of membership.

The FCM have no constraints to limit the emergence of this situation. The above analysis shows that the FCM algorithm clustering results are often meaningless set, and the final result corresponds to the objective function value may be a local optimal solution.

4. Building Fuzzy C-Means Clustering Model based on Particle Swarm Optimization

Particle swarm algorithm with efficient search capabilities, help to get the optimal solution in the sense of multi-objective; through on behalf of the population of the entire solution set, parallel to simultaneously search multiple non-inferior solutions that search multiple Pareto optimal solution; the same time, the versatility of the particle swarm algorithm is

better suited to deal with more than one type of objective function and constraints, and is easily combined with traditional optimization methods, so as to improve their own limitations, to solve the problem more efficiently. Therefore, the particle swarm algorithm is applied to solve the multi-objective optimization problem has a great advantage.

Particle Swarm algorithm ideology is described as follows: initial population, population size is denoted by N. Based on the idea of fitness dominated the population was divided into two subgroups, one called the non-dominated subset A, another called disposable subset B, the cardinality of the two subsets, respectively n 1, n 2, satisfy the two subgroups the cardinality and as N [15]. External elite set used to store non-inferior solutions subset A per generation, each iteration of the process only the particles B, the speed and position of the profile, and the particles in the updated B based on the fitness of disposable Thought A the particles in the comparison, if xi B, any xj a such that xi disposable xj, delete xj, to make xi adding the a update external elite set; elite set size to take advantage of technology to maintain an upper limit of the range, such as density assessment techniques, dispersion technology. Finally, the algorithm terminates criteria can be the maximum number of iterations T max, maximum stagnate step t calculation accuracy ε optimal solution, as is shown by Equation (9).

$$W_{2j} f(n) = 2^{-j/2} \int_{-\infty}^{\infty} f(x) \overline{\psi(2^{-j} x - k)} dx \tag{9}$$

Fuzzy C-Means clustering algorithm is quite simple step, fuzzy c-means clustering (FCM), known as the fuzzy ISODATA membership determine each data point belongs to a cluster of a clustering algorithm. In 1973, Bezdek proposed the algorithm, an improved method as early hard c-means clustering (HCM).FCM n vectors xi (i = 1,2, ..., n) is divided into c fuzzy group, and seeking the cluster center of each group, so that the non-similarity values of the indicator function reaches a minimum.

Particle Swarm Optimization algorithm introduced inertia weights w eliminate the basic particle swarm algorithm needs of Vmax. When an increase of Vmax, by reducing W to reach equilibrium search, and w of the decrease can make the number of iterations needed becomes small [16]. Therefore, it is possible to each dimension of the variable V is fixed, but only to be adjusted to it. The larger the flight speed of the particles, the greater it than optimal mathematical model, as is shown by Equation (10).

$$F(x, y) = \frac{\sum_i w(d(x, y)) I_i(x, y)}{\sum_i w(d(x, y))} \tag{10}$$

This optimization process is an iterative process, halting condition is generally set to reach the maximum number of cycles or minimum error PSO and there is no need to adjust the parameters, these parameters, as well as experience set are listed below. Particle number: 20-40 general admission. Fact, for most of the 10 particles have enough you can achieve good results, but for the more difficult problems or the problems of a particular category, the number of particles can be taken to a length of 100 or 200 particles: this is determined by the optimization problem, range: Solving the length of the particles is determined by the optimization problem, each dimension, but set a different range Vmax: maximum speed, determines the particles in a loop the largest mobile distance is normally set to particles range width, for example, the above example, the particles (x1, x2, x3) x1 belonging to [-10, 10], then the Vmax of the size is 20 learning factor: c1 and c2 are usually equal to 2 but in the literature there are also other timers. But generally c1 equal to c2 and in the range between 0 and 4. Termination conditions: The maximum number of cycles, and the smallest error requirements, as is shown by Figure 4.

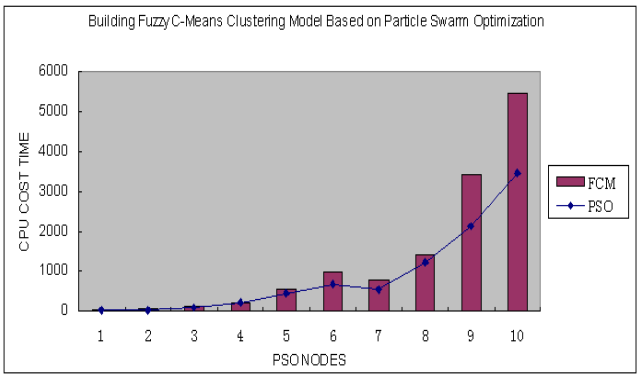

Figure 4. Compare of Mechanism of Building Fuzzy C-Means Clustering Model based on Particle Swarm Optimization

The paper presents the research of Building Fuzzy C-Means Clustering Model based on Particle Swarm Optimization. Through experimental learning algorithm, it is not difficult to find the strengths and weaknesses of the FCM algorithm: First of all, the fuzzy c-means functional Jm traditional hard c-means functionalism J1 natural generalization. J1 is a very broad application of clustering criteria; its theoretical studies have been quite perfect, which provide good conditions for Jm research. Secondly, from a mathematical point of view, the Jm and Rs Hilbert space structure (orthogonal projection and mean square approximation theory) closely associated than other functional Jm more profound mathematical foundation. Finally, FCM clustering algorithm is not only very successful in many neighborhood, and the basis of the algorithm.

5. Conclusion

Particle Swarm Optimization (PSO) is based on the iterative optimization tools, system initialization, a group of random solutions, through iterative search for the optimal value, not only has the ability of global optimization, and has strong local searching capability. Particle Swarm Optimization (PSO) and genetic algorithms (GA) is optimization algorithm, trying to simulate the natural characteristics based on the adaptability of individual populations, they are solving certain transformation rules through the search space. The basic idea of the fuzzy C-means clustering algorithm fuzzy C-means clustering algorithm (FCM) is determined for each sample data belonging to a certain degree of clustering, the degree of membership of sample data is grouped into a cluster. The paper presents the research of Building Fuzzy C-Means Clustering Model Based on Particle Swarm Optimization.

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