The New Urbanization Quality Assessment of PCA-ACOSVM Intelligent integration and the Future of Big Data

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***Abstract*—Urbanization quality is a concept relative to the level of urbanization, which is the urbanization level of the urbanization rate. Urbanization level pays more attention to the speed of urbanization. New urbanization quality is the concept of a system, considering the influence factors of various aspects, combined with the definition of quality of new urbanization connotation, from economic development, social progress, population employment, living, resources and environment in five aspects, constructing the new urbanization development quality evaluation index system. This paper uses PCA-ACOSVM intelligent integration of the new urbanization quality assessment, as well as the future trend of urbanization under big data. From the assessment results analysis, we draw the conclusion that the top three are the two cities, Shangzhi, Haicheng, behind the city is Xinmin, Dengfeng, Xinji.**

***Index Terms*—Urbanization quality, PCA-ACOSVM, big data**

I. INTRODUCTION

Urbanization is not only an important symbol of economic development in a country or region, but also an important indicator of the level of social organization and management in a country or region. China's urbanization rate is from 10.6% in 1949 to 56.7% in 2016, and the experts of the research center predict that China's urbanization rate will reach 60% in 2020.

The 18th party congress of the communist party of China report "obviously improve the quality of urbanization" as a development goal to establish a well-off society in an all-round way, and put forward to promote the "four modernizations" synchronous development. In 2012, the central economic work conference called for improving the quality of urbanization and guiding the robust development of urbanization. In February 2016, premier Li Keqiang of China pointed out that urbanization was the only way of modernization and the country's greatest potential for domestic demand and development.

A. Connotation of the new type of urbanization and relevant research at home and abroad

（1）The new type of urbanization quality

Quality is a comprehensive concept of urbanization, based on the study of relevant literature, this paper argues that quality of urbanization is in the process of the rural population to urban migration, residents quality of life gradually improved, optimization of industrial structure more reasonable, public infrastructure to be more perfect, system and policy more fair, more harmonious city environment, ect. Urbanization quality is a concept relative to the level of urbanization, the urbanization level of the urbanization pays more attention to the speed of urbanization. The features of urbanization quality are as follows.

1) Abstract character

The quality of urbanization has both the ductility of time and the difference of space. It is a more abstract concept. The quality of urbanization needs to be demonstrated by the reality of the current situation, whether the quality of urbanization has been improved or not.

2) Rationality character

In China, because of the difference of economic level, social status, geographical environment and resources, each region has different characteristics in the process of promoting the new urbanization.

3) Comprehensive character

Urbanization quality needs to use several subsystems to reflect, such as residents' quality of life, cultural richness, urban ecological environment livability, comprehensive social welfare, and public infrastructure, industrial structure rationality, the social harmony, and so on.

（2）Research at home and abroad

In 1958, Coale and Hoover found that urban development has led to changes in social structure and economic problems. In 1988, John Friedman, the study found that the problems caused by urbanization, unemployment growth development of urbanization, urban and rural development is not balanced. In 1989,

Daly, puts forward the theoretical framework of sustainable development. In 1994, Theodore Schulman will study of residents' quality of life from the perspective of human development investment, involved in the study of science and technology, education, economy, welfare, etc. In 2012, Michaels studied the relevant data of urban and rural areas from 1880 to 2000, analyzed the structural changes of American urbanization, and analyzed the impact on economic development of rural population change and employment structure change.

Ye Yumin put forward that the urbanization quality should be measured from two aspects, namely the city modernization and integration of urban and rural areas .Niu Wenyuan (2003) defines the quality of urbanization in terms of dynamic characterization, fairness, coordination, and intensive characteristics of urban development. Bai Xianchun (2004) suggests that the quality of urbanization is composed of four subsystems those are population, economy, life and environment. Wang's loyalty (2008) suggests that the quality of urbanization is the modernization of the infrastructure, the social economy and the living standards of the people. Li Mingqiu (2010) believes that urbanization quality requires improving gradually in the process of population urbanization, and is the objective existence.Zhang Chunmei (2013) suggests that the quality of urbanization includes four aspects, respectively, the quality of economic development, urban and rural residents quality.

On the basis of the evaluation index system of the quality of urbanization, domestic scholars have constructed different index systems based on different understandings of the connotation of urbanization. The main findings are as follows.

TABLE I.
INDEX SYSTEMS CONSTRUCTED BY DOMESTIC SCHOLARS

author	Index
Nie su, Chen dongming（1996）	Population structure, economic development, infrastructure, quality of life and social development
Wang hui (1997), European famous, li wuyan, liu xiangnan (2004), Liu dinghui, li rendong, zhu chao hong	The level of economic urbanization, the level of urbanization, The spatial urbanization level, the lifestyle urbanization level
shiyishao（1999）	People's indicators, economic indicators, social indicators Cultural indicators and ecological indicators
lizhenfu(2003)	Urban development potential and urban development economy Urban development equipment
Sun jin, liu jun-e (2004), ouxiangjun, zhen feng (2008), Gu zhaolin (2008), li Chen	Urban development potential and urban development economy Urban development equipment
Xi-Xi Zhang（2010）	Population urbanization, urbanization, urbanization Environment urbanization, science and technology urbanization, guarantee
liwenzheng（2011）	Population urbanization, urbanization, urbanization Environment urbanization, science and technology urbanization, guarantee
Duna,wangping,baixiaoyi（2012）	Population urbanization and economic urbanization Urbanization of life, urbanization of municipal facilities, and urbanization of science and technology innovation
sunxue(2012)	Urban and rural development, the quality of urban and rural development and the development of urban and rural development are fair
liye，qinmeng（2013）	Population urbanization and economic urbanization Life style, quality and environment, urbanization and urbanization
Zhang dong, li changming, gao xiaoqiu（2013）	Infrastructure, economic development and urbanization Lifestyle, environmental status, urban and rural planning

This paper used PCA-ACOSVM intelligent integration to assess the new urbanization quality, as well as the future trend of urbanization under big data.

II. METHOD OF PCA-ACOSVM INTELLIGENT INTEGRATION

A.Intelligent integration concept

Intelligent integration refers to two or more than two to describe the process of related objects, such as genetic algorithms, ant colony algorithm and neural network intelligent algorithms. The purpose of integration is the effective use of the advantages of each method, so that the intelligent integration algorithm can more accurately forecast the research object, evaluation, etc.

Among them, in order to obtain a better intelligent integration algorithm, used to integrate the algorithm should be chosen under the status quo has been relatively mature, and more used in the practice to solve the problem of related algorithms, these algorithms can be directly used in the research object, and analyzes problems, prediction, can also be integrated together by the way of integration used in the study of the problem.

In the application of support vector machines (that is SVM), a prominent problem is how to set some parameters that affect the performance of the algorithm. This paper adopts the method of ant colony algorithm optimization (that is ACO) to achieve the effective parameters and improve the ability of SVM learning. This paper combines principal component analysis and ACOSVM intelligent integration algorithm(that is PCA-ACOSVM) to evaluate quality of new urbanization 15 cities in China.

B. PCA- ACOSVM method

PCA is also known as the principal component analysis or matrix data analysis. It transforms the dependent variable into a number of unrelated synthetic indicator variables by means of variable transformation. For large system indicators, the number of such indicators is often very large, and these indicators often exist between the links, and a lot of linear correlation. Because of the large number of indicators and the linear correlation between the indicators, the application of the analytical methods, especially the quantitative methods, is very difficult and can not be applied. In this case, the PCA method of this feature, that is, a large number of linear correlation indicators can be converted into a few linear unrelated indicators, those shows its application value. As a result of linear independence, PCA method makes the analysis and evaluation of indicators of variables, can cut off the

relevant interference, to find the dominant factor, to make more accurate estimates [1].

SVM is based on the statistical theory of VC dimension theory and structural risk minimization principle to build up the machine learning method, through the sample information between the model complexity and ability to learn to find the optimal methods, will achieve optimization problem change for classification and regression problems so as to obtain the optimal solution.

The basic idea of supporting vector regression is as follows.

$$z_t = \{(x_1, y_1), \cdots, (x_t, y_t) \qquad x \in R^n, y \in R^m\} \tag{1}$$

In this case, x_t is the input sample, and y_t is the output sample.

Using support vector machine, the data information contained in the sample is transformed into a function $f(x)$, and make the function calculates the output values and the corresponding input sample error is less than or equal to ε between the target, at the same time, make the function of regression curve flattens.

When using support vector machine to solve practical problems, how to effectively select the parameters C and their kernel function parameters σ are more critical issue. Among them, the parameter C determines the penalty degree of the pair of wrong samples, and the parameter σ determines the range of the radial action of the function. C and kernel function between σ have no obvious functional relationship, so it is necessary to use the ACO algorithm to search the global characteristics to achieve effective SVM parameters [2].

ACO - SVM is a new evaluation model based on the global search ability of ant colony algorithm to find the optimal parameters of support vector machine and improve the learning ability of support vector machine. The continuous domain ant colony algorithm based on grid partition strategy is an improved algorithm based on the principle of ant colony algorithm. First of all, the range of parameters is estimated according to the nature of the problem , $x_{j1} \le x_{j2} \le \cdots \le x_{jn} \quad (j = 1,2,3\cdots, n)$.Secondly, the designated area is divided into several equal grids, The artificial ants foraging between the grid points, through the artificial ants foraging trajectory to get the objective function value of the grid points [3,4].

There is m ant altogether. $\tau_{ij}(t)$ is used to represent the information of the nodes at the point of time t, the amount of information from i level to j node and the ant m determines the next path according to the pheromone concentration in the path of the foraging process. $P_{ij}^m(t)$ represent the state transition probability between the first and N levels of the artificial ants m at the time point:

$$P_{ij}^m(t) = \begin{cases} \dfrac{\tau_{ij}^{\alpha}(t) \cdot \eta_{ij}^{\beta}}{\sum_{r \in T_m} \tau_{ir}^{\alpha}(t) \cdot \eta_{ij}^{\beta}(t)} & j \in T_m \\ 0 & otherwise \end{cases} \tag{2}$$

In the formula, T_m represents the set of paths that the artificial ants m can choose next, which changes dynamically with the movement of the artificial ant m. The information quantity $\tau_{ij}(t)$ indicates that the pheromone concentration decreases with the increase of iteration number, and $1-\rho$ represents the attenuation degree of pheromone concentration at each grid point. After n iterations, the pheromone on each grid point is updated according to the formula (3).

$$\tau_{ij}^{new} = (1-\rho)\tau_{ij}^{old} + \frac{Q}{f} \tag{3}$$

Formula, τ_{ij}^{new} is for the updated pheromone quantity, τ_{ij}^{old} is the pheromone quantity before updating. f is as the objective function value, and the constant f is used as the constant to adjust the pheromone increment.

For the parameter initialization of ACO -SVM, the parameter variables are divided into discrete n equal parts, before the program runs, the initialization parameters are set, and the initial search path of each artificial ant is randomly distributed. Each artificial ant selects the node according to the probability (2), and selects three parameters in turn; Follow the formula (3) to update the pheromone concentration of each grid point, determine the next step according to the SVM model stability [5,6].

III. New type of urbanization quality assessment analysis based on PCA-ACOSVM

A. Index system of the new type of urbanization quality assessment

On the basis of highlighting the two concepts of urbanization and quality, this paper designs a set of scientific index system which can reflect the quality of new urbanization in China. The research object is Xinmin, Haicheng, Donggang,Yushu, Dehui, Panshi, Shuangcheng, Shangzhi, Wuchang, Xinji, Zunhua, Jinzhou, Gongyi, Dengfeng, Jiyuan.

New urbanization quality is the concept of a system, considering the influence factors of various aspects, combined with the definition of quality of new urbanization connotation, from economic development, social progress, population employment, living, resources and environment in five aspects, constructing the new urbanization development quality evaluation index system. The index system is as follows：

The added value of economic development: The X_1 non-agricultural industries share of GDP (%), X_2 value added of the tertiary industry of GDP (%), the X_3 industrial enterprises above designated size advocate business income (ten thousand).The collection of social development: X_4 per capita public library (copies/person), X_5 per thousand mouth health technical personnel number (name/one thousand), the X_6 tech spending accounts for the proportion of public spending (%).Population employment: X_7 non-farm payrolls account for the proportion of the total employed population (%), and X_8 the proportion of employment in the third industry (%),X_9 The number of full-time teachers per thousand people in primary and secondary schools . Resident life: X_{10} urban

and rural residents per capita savings account balance (RMB/person), ten thousand urban residents were X_{11} households (families), X_{12} Internet telephone penetration rate. Resource environment: X_{13} exhaust smoke (powder) dust emission (tons)

TABLE II
NEW URBANIZATION QUALITY EVALUATION INDEX SYSTEM

County territory	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13
xinmin	0.83	0.45	0.14	0.03	0.19	0.05	0.12	0.21	0.47	0.16	0.01	0.21	0.08
haicheng	0.96	0.85	0.16	0.02	0.18	0.06	0.34	0.47	0.58	0.31	0.16	0.25	0.01
donggang	0.87	0.73	0.06	0.03	0.22	0.02	0.16	0.27	0.47	0.31	0.1	0.15	0.04
yushu	0.74	0.86	0.02	0.01	0.11	0.03	0.13	0.19	0.6	0.09	0.05	0.1	0.03
dehui	0.82	0.75	0.04	0.01	0.12	0.04	0.15	0.21	0.73	0.14	0.08	0.17	0.01
panshi	0.85	0.69	0.04	0.02	0.26	0.04	0.2	0.38	0.78	0.13	0.14	0.2	0.02
shuangcheng	0.73	0.86	0.02	0.02	0.22	0.08	0.17	0.34	0.48	0.1	0.1	0.19	0.06
shangzhi	0.79	0.76	0.02	0	0.28	0.07	0.2	0.44	0.75	0.15	0.13	0.21	0.32
wuchang	0.74	0.81	0.04	0.03	0.26	0.16	0.16	0.27	0.46	0.1	0.08	0.15	0.14
xinji	0.88	0.43	0.1	0.03	0.17	0.12	0.33	0.36	0.66	0.3	0.11	0.14	0.02
zunhua	0.93	0.73	0.08	0.03	0.23	0.22	0.32	0.49	0.64	0.32	0.16	0.24	0
jinzhou	0.88	0.59	0.06	0.02	0.12	0.17	0.24	0.23	0.52	0.21	0.13	0.16	0.07
gongyi	0.99	0.53	0.2	0.07	0.31	0.29	0.32	0.33	0.61	0.19	0.18	0.23	0
dengfeng	0.98	0.51	0.12	0.01	0.29	0.11	0.09	0.09	0.7	0.21	0.14	0.21	0.01
jiyuan	0.96	0.39	0.17	0.16	0.28	0.21	0.35	0.56	0.67	0.19	0.24	0.26	0.09

B.The main component analysis process and the result

Use SPSS to get the correlation coefficient matrix. There is a certain correlation between the indicators, which is the premise of the principal component analysis. The characteristic root and variance contribution rate of principal component correlation coefficient is selected. The cumulative contribution rate of the first six principal components reached 90.220 % > 85 %, so the first six principal components were selected.(Table 3)

TABLE. III
CHARACTERISTIC VALUE AND CUMULATIVE PERCENTAGE

No	Characteristic value	Percentage %	Cumulative percentage %
1	5.9238	45.5677	45.5677
2	1.9123	14.7097	60.2774
3	1.4038	10.7987	71.0762
4	1.0658	8.1985	79.2747
5	0.7956	6.1203	85.395
6	0.6273	4.825	90.22
7	0.5449	4.1912	94.4112
8	0.3352	2.5781	96.9893
9	0.1955	1.5036	98.4929
10	0.1356	1.0431	99.536
11	0.0498	0.3832	99.9192
12	0.0092	0.071	99.9902
13	0.0013	0.0098	100
Principal factor number M=6			

Appears in the factor loading matrix calculation will be the principal component steps, we can obtain the variance of each of the main components, namely the characteristic root, which is the size of the corresponding principal components to describe all information of the original. In order to reduce the dimensionality, we only extract the first few principal components. The cumulative contribution rate of the first six characteristic root is 90.220%. According to the principle that the cumulative contribution rate is greater than 85%, the first six characteristic root are selected.

TABLE IV.
FACTOR LOAD MATRIX AND VARIANCE CONTRIBUTION

	Facto1	Facto2	Facto3	Facto4	Facto5	Facto6
x(1)	0.31	-0.52	-0.54	-0.22	0.36	-0.35
x(2)	0.10	0.26	0.91	0.2	-0.07	0.01
x(3)	0.18	-0.43	-0.63	0.11	0.41	-0.25
x(4)	0.53	0.10	-0.69	0.04	0.19	-0.01
x(5)	0.10	0.13	-0.23	-0.093	0.86	0.18
x(6)	0.48	0.15	-0.58	0.1241	0.31	-0.19
x(7)	0.86	-0.34	-0.23	-0.070	0.07	-0.12
x(8)	0.89	-0.16	0.05	-0.130	0.22	0.21
x(9)	0.14	0.00	-0.04	-0.971	0.09	0.02
x(10)	0.25	-0.88	-0.11	0.012	-0.01	-0.18
x(11)	0.66	-0.11	-0.30	-0.354	0.44	-0.13
x(12)	0.39	-0.30	-0.12	-0.081	0.76	-0.01
x(13)	0.04	0.20	0.10	-0.014	0.12	0.94
Variance contributi	2.90	1.66	2.62	1.2324	2.04	1.26
Cumulative contributi	0.22	0.35	0.55	0.648	0.805	0.90

The principal component synthesis model is calculated by using the ratio of the characteristic root corresponding

to each principal component to the sum of the total characteristic root of the extracted principal components as weights.（5）

$$F=\lambda_1/(\lambda_1+\lambda_2+\lambda_3+\lambda_4+\lambda_5+\lambda_6)F_1+\lambda_2/(\lambda_1+\lambda_2+\lambda_3+\lambda_4+\lambda_5+\lambda_6)F_2+\lambda_3/(\lambda_1+\lambda_2+\lambda_3+\lambda_4+\lambda_5+\lambda_6)F_3+\lambda_4/(\lambda_1+\lambda_2+\lambda_3+\lambda_4+\lambda_5+\lambda_6)F_4+\lambda_5/(\lambda_1+\lambda_2+\lambda_3+\lambda_4+\lambda_5+\lambda_6)F_5+\lambda_6/(\lambda_1+\lambda_2+\lambda_3+\lambda_4+\lambda_5+\lambda_6)F_6$$

According to the principal component synthesis model can calculate the integrated principal component values as follows.

TABLE V.
FACTOR SCORE TABLE

No	Y(i,1)	Y(i,2)	Y(i,3)	Y(i,4)	Y(i,5)	Y(i,6)	Total score
N(1)	-2.29	-1.14	-2.69	1.49	0.58	2.13	-0.76
N(2)	1.79	-2.08	3.02	0.82	0.85	-	0.88
N(3)	-0.16	-1.65	-0.09	1.13	-0.267	0.78	-0.12
N(4)	0.06	1.25	0.40	-0.37	-2.357	-1.322	-0.27
N(5)	-0.47	0.50	0.33	-1.40	-	-	-0.44
N(6)	-0.58	1.04	1.39	-1.87	0.96	-	0.12
N(7)	0.30	1.16	3.30	1.05	1.19	-1.32	1.04
N(8)	1.18	-0.65	-0.54	-0.95	1.37	4.42	0.62
N(9)	-0.12	1.35	0.50	1.48	0.57	0.67	0.54
N(10)	1.33	-1.39	-3.05	-0.86	-	1.01	-1.00
N(11)	1.71	-0.31	2.21	0.21	0.23	-	0.72
N(12)	0.67	-0.13	-1.47	0.24	-	0.19	-0.48
N(13)	-0.85	1.12	0.06	0.55	1.52	-1.75	0.08
N(14)	-4.57	0.12	-0.93	-	2.98	-	-
N(15)	1.97	0.81	-2.44	-0.405	-0.692	1.19	0.02

C. Results of New Urbanization Quality Assessment of PCA-ACOSVM Intelligent integration(Fig1.- Fig4)

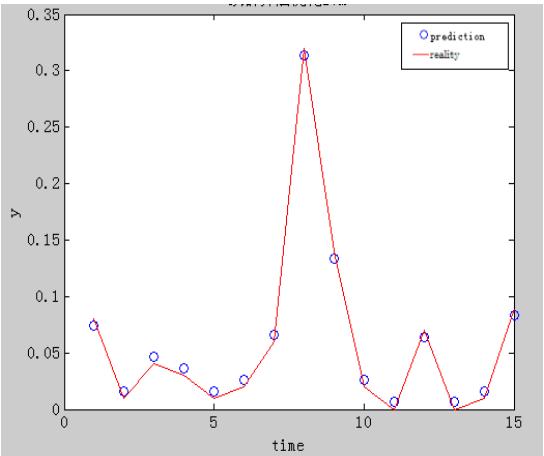

Figure.1 Value of ACOSVM

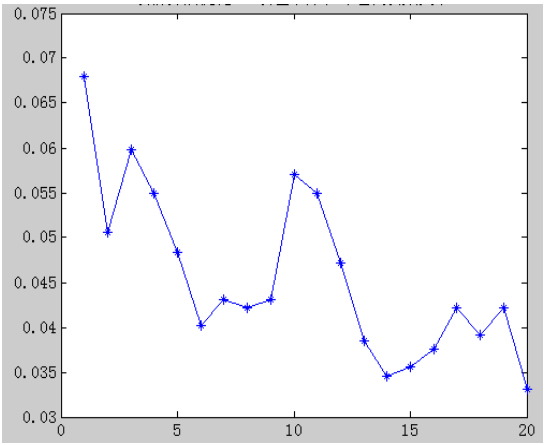
Figure.2 The sum of squared error and the number of iterations

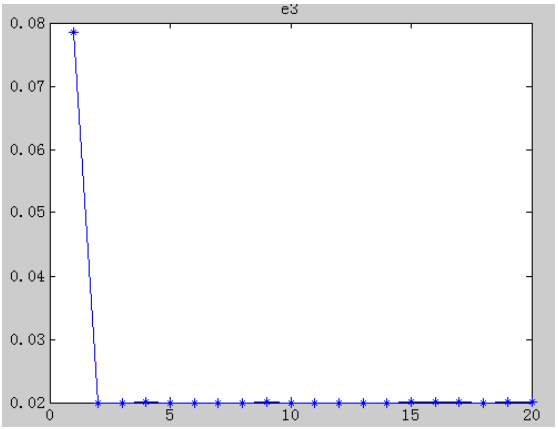
Figure.3 Iterations

```
Optimization terminated.
Optimization terminated.
Optimization terminated.
X optimum solution
ans =
   2.0052
   2.0948
   0.0785
The optimal value of a function
v1 =
    0
Optimization terminated.
Mean squared error=0.02392
Squared correlation coefficient =0.99853
Elapsed time is 116.616594 seconds.
```
Figure 4. ACO-SVM program running feedback results

D. Assessment results of PCA-ACOSVM

TABLE VI.
ASSESSMENT RESULTS OF PCA-ACOSVM

xinmin	haicheng	donggang	yushu	dehui	panshi	shuangcheng	shangzhi
0.073	0.016	0.046	0.036	0.016	0.025	0.065	0.313
13	3	9	10	12	6	1	2
wuchang	xinji	zunhua	jinzhou	gongyi	dengfeng	jiyuan	
0.133	0.026	0.006	0.063	0.006	0.016	0.083	
5	15	4	11	8	14	7	

From the assessment results analysis, we draw the conclusion that the top three are the two cities, Shangzhi, Haicheng, behind the city is Xinmin, Dengfeng, Xinji.(Table 6)

The development of the new urbanization in the county is the cornerstone of the new urbanization, which is the core of the "people-oriented" core. It is also an important part to realize the goal of fully completing the new urbanization in China. Therefore, it is very important to enhance the quality of the new urbanization in the county. The development of new urbanization in the county is a highly integrated and gradual process. Through the accurate evaluation of the new urbanization development quality of some county-level cities, deepen the theoretical understanding of the new urbanization connotation, improve the construction of the new urbanization theoretical system, and correctly guide the development process of the new urbanization and the development direction of the new urbanization in China. Each county area can refer to the new urbanization development quality evaluation system, develop a new urbanization development policy adapted to the region, and strive to improve the quality of new urbanization development.

IV. A NEW TYPE OF URBANIZATION IN THE BIG DATA

How to improve the quality of new urbanization is key. Previous urbanization was accompanied by the industrial revolution. Now, in the age of information revolution, the path of urbanization may be offset by the previous one. Should be taken into consideration in anticipation for the new urbanization construction by some new technology, new policy these future trends to the influence of urbanization, especially considering the big data era impact on urbanization. "National new urbanization large database" in October 2016, jointly sponsored by the national development and reform commission and the university, is the first large database of new urbanization theme, intention to strengthen the construction of big data in the new urbanization of decision support and the comprehensive application, for the new urbanization decision-making, operation management, monitoring and evaluation to provide scientific data to support. Building public information database and sharing platform, realizing the new urbanization data exchange and sharing, explore and promote the efficient operation and management mode of intelligence. The new type of urbanization quality assessment framework for ACOSVM intelligent integration is as follows.

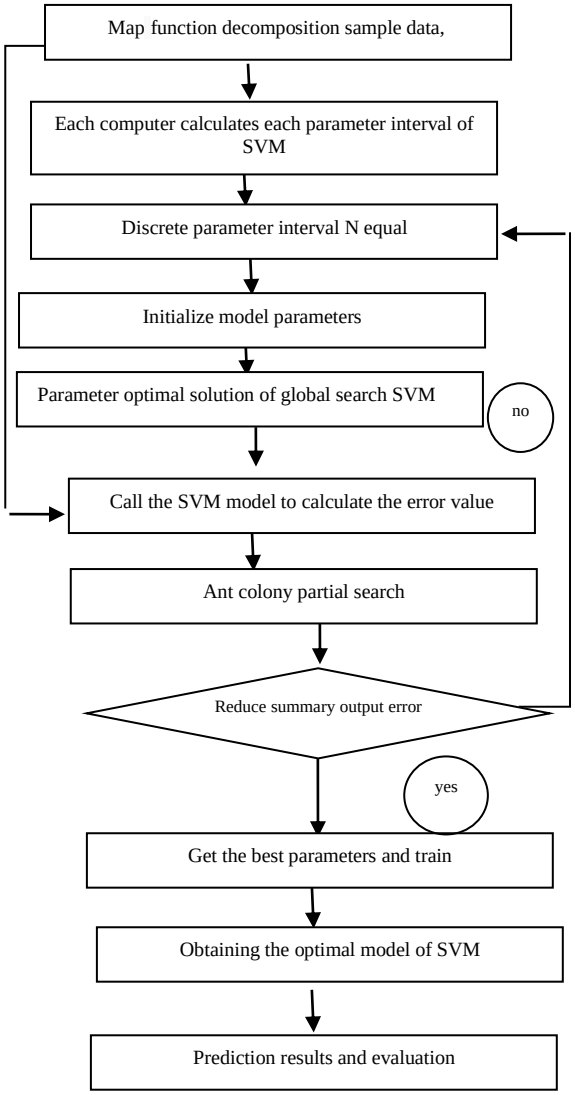

Figure 5. Implementation of ACO - SVM algorithm under big data

Information technology and new energy and new modes of transportation are the main forces that will change the trend of urbanization in the future. Only bring new technologies and new policy trends to the urbanization of the variables into account in the future, in order to improve the accuracy of the predictions about future new urbanization, thus by corresponding policy and the path adjustment, thus improve the quality of urbanization.

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research"(number: SK2017A0548) ;Anhui philosophy and social science planning project(number: AHSKY2017D30)

REFERENCES

[1] Gao Xiaoyong, "Optimal allocation of land use based on multi-objective ant colony algorithm," *Wuhan University*, vol. 5, pp. 12–17, *2*010.

[2] Zhang Bing, Deng Wei, "SVM evaluation method of transportation network in economic circle," *Dongnan Daxue Xuebao (Ziran Kexue Ban)/Journal of Southeast University (Natural Science Edition)*, vol. 42, pp. 1227–1232, *2*012.

[3] Wang Xuejun, Guo Jianfang, "Application research of SVM in the evaluation of scientific research project," *Proceedings2nd 2008 International Symposium on Intelligent Information Technology Application Workshop, IITA* , pp. 12–17, *2*010.

[4] Xu Yaping, Yu Huixin, "Evaluation of New-type Urbanization Quality Based on Principle Component Analysis," *Journal of Industrial Technological Economics*, vol. 7, pp. 153–160, *2*010.

[5] JIANG Hui-Yan, ZONG Mao, LIU Xiang-Ying, "Research of Software Defect Prediction Model Based on ACO-SVM," *China Journal of Computers*, vol. 6, pp. 1149–1154, *2*011.

[6] YU Qianqian, DAI Yueming, LI Jingjing, "Parallel ACO-K-means clustering algorithm based on MapReduce," *Computer Engineering and Applications*, vol. 46, pp. 117–120, *2*013.