Ecological Evaluation of Land Intensive Use Based on TOPSIS-PSOSVM Intelligent Integration and Prospect of the Big Data

Li Chen
Anhui Jianzhu University, Hefei, China
Email: chinalichina@163.com

Chenxuan Wang
Guilin University Of Electronic Technology, Guilin , China
Email: chinaxuanchina @163.com

***Abstract*—In the past ten years, with the development of the economy, the process of urbanization has accelerated rapidly. The urban economy is developing rapidly, the population continues to gather in cities, and the scale of urban land use continues to expand, urban land use in China is expanding flat trend. More and more Chinese scholars focused on the study of intensive land use. But the ecological evaluation of intensive land use was rare. Therefore, ecological evaluation of intensive land use based on TOPSIS-PSOSVM intelligent integration and prospect of the big data would provide basis for the resumption of sustainable management and further land use. It also had positive significance to the management of land use. It can be inferred from the evaluating results that the region of Tibet has got considerable achievement after ten years of ecological restoration. From the analysis of the empirical results, the ecological land intensive use in the top three is Tibet, Beijing and Qinghai. It shows that although the western regions of Tibet and Qinghai are not able to keep up with the eastern and central provinces, but the intensive use of land ecological protection is better. Combining big data with artificial intelligence for land intensive use of ecological assessment, the future has bright prospect.**

***Index Terms*—Ecological evaluation, Intensive land use, TOPSIS-PSOSVM, Big data**

I. Introduction

The land is the foundation of people's livelihood and development. At present, the economy has entered a new normal with the rapid development of the past three decades, more and more economic development by the resources and environment constraints declining during the fast urbanization. Urban economy is confronted with increasing biophysical limitations derived from the exhaustion of natural resources and the depletion of environmental capacity. Especially in the past ten years, with the development of the economy, the process of urbanization has accelerated rapidly. The urban economy is developing rapidly, the population continues to gather in cities, and the scale of urban land use continues to expand, urban land use in China is expanding flat trend. The land issue has become one of the most notable issues in the new period, which has not only become one of the important contents of circular economy and economical society, but also is a key work in country land resource management departments. In recent years, the domestic scholars designed several assessment indices system from different perspectives, and applied them to assessment practice. According to the current assessment results of intensive land use of developmental regions, the practice of work and the practical situation of land use of China development regions. In this paper, how to make efficient use of land resources is very critical, land issues related to all aspects of national production is China's modernization process in an overall, strategic and important issue. How to change extensive use to intensive use of land, which largely relies on urban land use status quo and the understanding of land use operation rule, in order to optimize the structure of land use, improve the efficiency of land use, and guide urban land use toward efficient, intensive and green ecological direction.

Due to the urbanization process in China began to develop rapidly since the 1980s, and the research of comprehensive configuration of land resources in the urbanization process is based on the realistic problems on land supply and demand contradiction, therefore ,domestic research on intensive use of urban land started relatively late compared to western developed countries, and most researches developed on the basis of the theories of Riparian .Since the 21st century, China's urbanization has developed rapidly, industrialization and urbanization have been rapidly promoted, at the same time, contradictions of land use between urban and rural has become increasingly prominent, land supply and demand contradictions intensified everyday. Study of land intensive use has been paid more and more attention in China. More and more Chinese scholars focused on the study of intensive land use. But the ecological evaluation of intensive land use was rare. Therefore, ecological evaluation of intensive land use based on TOPSIS-PSOSVM intelligent integration and prospect of the big data would provide basis for the resumption of sustainable management and further land use. It also had positive significance to the management of land use.

II. Connotation of Land Intensive Use and Relevant Research at Home and Abroad

A. The Connotation Of Intensive Land Use

Different scholars put forward different viewpoint basis of different research perspectives. It is generally acknowledged that intensive land use of developmental regions is the medium –level intensive use .The intensive utilization of land is relatively extensive management of land, refers to intensive use of materialized labor and living labor in the unit area of land to improve the yield per unit land area product and load capacity of the mode of operation on the basis of the progress of science and technology. Land intensive use is a relative and dynamic development concept. So far, Chinese and foreign scholars have not reached an agreement on the concept and connotation of urban land intensive utilization. Qin Dawei believes that the land in different spatial scales, the performance of intensive use of land with different emphasis. In terms of the macro level, the urban land intensive utilization emphasizes the comprehensive benefit to cities, it requires cities have reasonable urban scale and urban nature and coordination of industrial structure, etc. The middle level emphasizes the rationality of the function and structure of the land. The micro-level is focused on input and output efficiency of the single piece of land. Urban land intensive utilization highlight the sustainable development of land, therefore, urban land intensive utilization can not be simply interpreted as intensity of urban land intensive utilization, the latter only a unilateral consideration of human land use level, without fully considering the long-term interests of the land and environmental bearing capacity.

B. Intensive Land Use Research At Home And Abroad

In the study of the theoretical basis of intensive land use by foreign scholars, Beckman has discussed the allocation of the two indivisible land resources. He interpreted two resource allocation problems as planting location allocation problem of plants, the first case between the crop and plant transportation costs through neglect, to maintain an optimal distribution system by the rent, form a linear regression problem. The second is the optimal allocation of resources through the cost system of transportation between the plants and the plants. While researching the intensive use of land, western scholars proposed and developed the location theory, the central geography theory, the theory of diminishing returns, and the theory of garden city and so on.

In the field of land intensive use evaluation abroad, it is considered that intensive land use can be evaluated separately from time and space, which is generally divided into using the cross-sectional data and time series data analysis, such as Apostolos Lagarias. (2011) by cellular automaton simulation on the macro scale of city expansion, etc., Lauetal (2005) for evaluation of urban land intensive utilization, the index is selected from the population agglomeration, agglomeration and ecological economic activities the coordination degree of environment three aspects.Taleaieta1 (2007) believes that when the land intensive use evaluation is carried out on the regional level, the connotation of the evaluation index set and the indicators contained are very different from the overall situation .

The domestic research status of land intensive use, connotation and theoretical study on land intensive utilization in China, such as Li Ming dong (2005) argues that the urban land use structure optimization, all kinds of land use ratio, different uses appropriate moderate mixed, compact layout, enhance the overall function of the city land use is more intensive. Xiemin (2006), and other scholars use the quantitative analysis method, respectively, set up index system of urban space scale and intensive utilization evaluation index system, from different levels of space and land evaluation of land intensive use level. Such as Wang Jing (2008) argues that in the process of research of land intensive utilization, we should not only consider the number of input costs, but also covers the land utilization efficiency as the investment of capital and improve the dynamic process of gradually. Zhang Qianjin (2009) and other scholars emphasized the comprehensive benefit, and said that the use of urban land use should focus on the integration of economic, social and ecological benefits.

Huang yujie and other people, using principal component analysis comprehensive evaluation model of land economic evaluation of land use of land resources in Fujian province.Wang Wengang, Song Yuliang, analysis qualitative analysis of the influence factors of land intensive use, and through the natural, economic, administrative and three dimensiona spatial overlay analysis of land use in China are analyzed the contradiction between supply and demand. Li Can and Zhang Fengrong analyzed the land use performance status of Beijing, Shunyi District from the 3 aspects of economic efficiency, social effects and ecological security, based on the entropy weight evaluation model. Xie Min, Hao Jinmin, using the fuzzy comprehensive evaluation method, respectively, for residential land and commercial land and industrial land 3 types of land intensive utilization degree evaluation methods are discussed .

In the existing land intensive evaluation methods, the expert evaluation method is convenient, and subjective is strong, and it is applied to the evaluation and comparison of the less complex object system. Mathematical statistics methods, such as principal component analysis is suitable for the evaluation index system of more mature, but the correlation between the evaluation index is larger, and the result of evaluation only have ideal effects on the target decision or comprehensive ranking, evaluation factors of the object should have specific data requirements for its application. The emergence of information technology will promote the development of the evaluation method of land intensive use. From the analysis of the literature, the evaluation of land intensive use much attention at home and abroad, and to the ecological assessment of land intensive use less attention. This paper used TOPSIS-PSOSVM intelligent to evaluate the ecological of intensive land and prospect of the big data .

III. Method of TOPSIS -PSOSVM Intelligent Integration

A. TOPSIS Method

There are many methods about comprehensive evaluation, such as index method, analytic hierarchy process (ahp) and fuzzy comprehensive evaluation method, technique for Order Preference by Similarity to an Ideal Solution (That is TOPSIS), and artificial neural networks. The advantages and disadvantages of various methods and the purpose of research, this paper selects the TOPSIS comprehensive evaluation method [1].

TOPSIS method was first put forward by C.L.H Wang and K Yoon in 1981, the TOPSIS method was based on a finite number of evaluation objects and the idealized goal of proximity sorting method, carried on in the existing object relative merits.

The basic idea of this method is that based on the original data matrix after normalization, the cosine method is adopted to find the optimal scheme of limited scheme and the worst scheme with the optimal vector and the worst vectors respectively, and then calculate the evaluated object and the optimal solution and the distance between the worst plan, obtain the evaluated object and the optimal solution of relative proximity, as the basis of evaluation quality.

We set an ideal point for the system metrics $(x_1^*, x_2^*, \cdots, x_m^*)$, and compare each of the evaluated objects with the ideal point. $(x_{i1}, x_{i2}, \cdots, x_{im})$ is evaluation objects for the best. If an object $(x_1^*, x_2^*, \cdots, x_m^*)$ of evaluation is closest to the ideal target in some sense, the object of evaluation $(x_{i1}, x_{i2}, \cdots, x_{im})$ is the best.

B. Method of PSOSVM intelligent integration

1) SVM and PSO

In the concrete application of SVM, a prominent problem is how to set up some key parameters such as impact algorithm performance penalty factor c and kernel parameters γ . The penalty factor c controls the degree of punishment of the misclassified samples. The parameters of the radial basis kernel function are the width of the Gaussian distribution, controlling the radial scope of the function and determining the nature of the nonlinear mapping. However, there is no obvious functional relationship between the learning performance of SVM and the parameter c, which is often time-consuming and has certain blindness. Therefore, the optimized method is adopted to realize the effective choice of the support vector machine parameters, and the function of particle swarm algorithm is to find the optimal solution of these two parameters.

Particle Swarm Optimization (PSO) is an intelligent algorithm developed by Kennedy and Eberhart in 1995. It simulates the flock foraging behavior. When the flock searching a goal, every individual always refers to the individual, which is in the optimal position in the flock at present, and the optimal position achieved to adjust the search direction of next step. The basic idea of particle swarm algorithm is to speed up the whole group to find the optimal target by mechanism the sharing of information between individual groups. The algorithm takes each feasible solution to search the n-dimension without the weight and volume of the particles in the space, it is a certain speed flight, and according to the dynamic flight experience itself and the other members of the group adjust the flight speed, the particle's fitness is judged whether it has been the best position to achieve continuous optimization by iterative calculation [2,3].

2) Principle of PSO-SVM

①PSO-SVM

By searching for the best solution through collaboration and information sharing among groups, the convergence speed of this method is not only fast, but also the parameters need not be adjusted too much and easy to implement. In this paper, using the advantages of particle swarm algorithm to optimize the parameters of SVM, and by combining particle swarm algorithm and SVM, thus constructing the particle swarm support vector machine model, in this model, SVM using radial basis function as the kernel function, through the real number coding method for parameter optimization, the optimal penalty coefficient C and the kernel parameter are optimized as the final model parameters of SVM [4].

②The basic process of the PSO-SVM

Step1. Collecting all kinds of data and dividing samples into training samples and test samples. The kernel function used in SVM and parameters of SVM is determined. The initial parameters of particle swarm algorithm are determined, which including the group size N, initial position and velocity, maximum evolution, iteration number and fitness accuracy requirement.

Step2. Using the data of each particle, the training samples is trained and the regression model was established

Step3. By training the sample, the error value of each particle is obtained to calculate the fitness function value of each particle

$$F(X_i) = \frac{1}{m}\sum_{i=1}^{m}(f - y_i)^2 .$$

Step4. To calculate current fitness of each particle $F(X_\mathrm{i})$ and compares it with the particle's own current optimal adaptive value $F(P_\mathrm{tbest})$, if $F(X_\mathrm{i}) < F(P_\mathrm{tbest})$, the adjustment $F(P_\mathrm{tbest}) = F(X_\mathrm{i})$, and takes the current position as the optimum position of the particle at the moment.

Step5. Each particle's the current optimal position adapt to the value $F(P_\mathrm{tbest})$ and $F(P_\mathrm{gbest})$ the optimal position of all particles in the current adaptive value comparison, if $F(P_\mathrm{tbest}) < F(P_\mathrm{gbest})$, the adjustment

$F(P_{\text{gbest}}) = F(P_{\text{tbest}})$,which the adjusted position as the optimum position for all particles.

Step6. New parameters of SVM are obtained by using the evolutionary equation of PSO to adjust the velocity and position of the particles.

Step7. Determining all the optimal position of particle fitness or number of iterations can meet the requirements, if satisfied, then stop the calculation, and preserving the value of the whole PSO position. If not, the process is returned to the second step of the process.

Step8. Optimal parameter is substituted into the SVM model and the test sample is tested with the trained SVM [5,6].

IV. ECOLOGICAL EVALUATION OF LAND INTENSIVE USE OF INTELLIGENT INTEGRATION IN CHINA BASED ON TOPSIS--PSOSVM

A. *Index system construction*

The ecological assessment of intensive land use is a very important task. Therefore, the following principles should be reached in the process of selecting evaluation indicators.

1） Systematic principle

A logical relationship between the indicators and the construction of indicators system is hierarchical, which include top, bottom, macroscopic and microcosmic, ect.

2） Representative principle

Land intensive use evaluation involves the construction of public facilities, the characteristics of the industrial layout, and the city's economic development orientation. From the evaluation of urban land intensive use, the most important factor that can reflect the actual situation is the most.

3） Forward-looking principle

The urban land intensive use should keep pace with the development plans of the city, the development plans of the enterprise and the process of land development, and can foresee the enterprise and the subsequent development plans of urban.

4） Scientific and operational principle

The evaluation index system should be selected with regional theory and land utilization rate theory as the basis, at the same time to ensure the measuring method is reliable. We should take into account the index of data acquisition, data processing and analysis method should be scientific and reasonable, practical and workable [7].

5 ）Sustainable development principle

Choosing objects of evaluation, should pay attention to select the object for the sustainable development of environment, and cannot destroy the current levels of production, and at the same time can't destroy our next generation and the next generation rights of using land, so as to develop the most intensive land utilization [8].

B. *Indicators of land intensive use ecological assessment*

In this paper, we selected eight indicators, such as the completion of land and forest investment, the per capita park green area, urban green coverage rate, the proportion of natural reserve areas, forest coverage, per capita available grassland area, per capita a forestation area and per capita water resources [9]. (TABLE I)

TABLE I
INDICATORS OF LAND INTENSIVE USE ECOLOGICAL ASSESSMENT

rovince	the completion of land and forest investment	the per capita park green area	urban green coverage rate	the proportion of natural reserve areas
shanghai	0.1744	0.0000	0.5111	0.1140
beijing	1.0000	0.4335	1.0000	0.1989
tianjin	0.0525	0.3131	0.3004	0.2017
jiangsu	0.1020	0.5928	0.7509	0.0794
shangdon	0.1854	0.8407	0.7478	0.0982
zhejiang	0.0891	0.4878	0.6082	0.0000
liaoning	0.1127	0.3448	0.6273	0.3354
chongqing	0.0703	1.0000	0.7985	0.2715
fujian	0.2074	0.4543	0.7423	0.0488
hubei	0.0313	0.3095	0.5464	0.1115
guangdon	0.0389	0.7910	0.6928	0.1606
anhui	0.0355	0.4380	0.5426	0.0689
henan	0.0653	0.1946	0.4252	0.0886
hainan	0.0464	0.4462	0.6904	0.1680
jingxi	0.0505	0.6353	0.9845	0.1859
beibei	0.0389	0.6262	0.6774	0.0642
hunan	0.0675	0.1584	0.4320	0.1402
shanxi	0.0401	0.4072	0.6391	0.1272
cichuan	0.0406	0.3357	0.5358	0.5253
shanxi	0.0735	0.3385	0.5303	0.1825
guangxi	0.3331	0.3928	0.4623	0.1374
jilin	0.0421	0.3511	0.2423	0.3366
heilongjia	0.0423	0.4226	0.3684	0.4114
neimengg	0.0114	0.7638	0.3801	0.3101
ningxia	0.0224	0.7810	0.5161	0.2721
yunnan	0.0238	0.3032	0.5735	0.1828
guizhou	0.0232	0.2081	0.1718	0.1198
Tibet	0.0000	0.2100	0.1477	1.0000
xinjiang	0.0030	0.2643	0.3622	0.3527
qinghai	0.0021	0.2471	0.1533	0.8857
gansu	0.0175	0.2208	0.0000	0.4521

rovince	forest coverage	per capita available grassland area	per capita a forestation area	per capita water resources
shanghai	0.0912	0.0000	0.0000	0.0055
beijing	0.4689	0.0006	0.0536	0.0069
tianjin	0.0714	0.0003	0.0105	0.0053
jiangsu	0.1093	0.0001	0.0215	0.0866
shangdon	0.2150	0.0005	0.0636	0.0630
zhejiang	0.9037	0.0016	0.0240	0.3426
liaoning	0.5266	0.0031	0.1777	0.1282
chongqin	0.5218	0.0027	0.2218	0.1114
fujian	1.0000	0.0022	0.0819	0.3585
hubei	0.4590	0.0037	0.1081	0.1919
guangdon	0.7688	0.0010	0.0308	0.4816
anhui	0.3731	0.0010	0.0218	0.1649
henan	0.2732	0.0018	0.0759	0.0609
hainan	0.8118	0.0041	0.0623	0.0845
jingxi	0.9191	0.0036	0.0966	0.5169
beibei	0.3092	0.0024	0.1352	0.0537
hunan	0.6896	0.0036	0.1927	0.4726
shanxi	0.5626	0.0050	0.2707	0.0907
cichuan	0.5127	0.0095	0.0427	0.6885
shanxi	0.1710	0.0054	0.2660	0.0228
guangxi	0.8241	0.0060	0.0999	0.4961
jilin	0.5909	0.0068	0.0311	0.1074
heilongji	0.6495	0.0068	0.1335	0.1984
neimengg	0.2705	0.1108	1.0000	0.1193
ningxia	0.0985	0.0175	0.4658	0.0000
yunnan	0.7360	0.0110	0.3713	0.4011

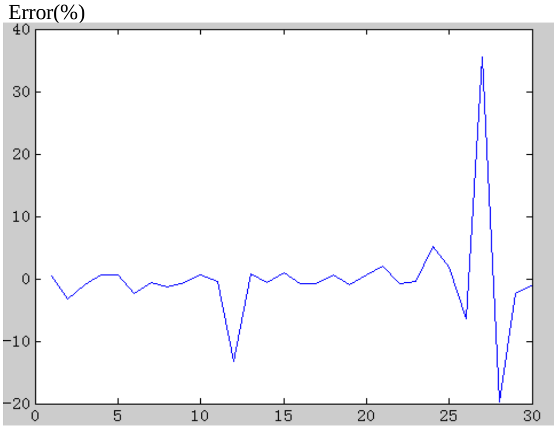
guizhou	0.4670	0.0046	0.1337	0.2301
Tibet	0.1335	1.0000	0.7497	1.0000
xinjiang	0.0000	0.0892	0.2989	0.2126
qinghai	0.0093	0.2388	0.7535	0.2113
gansu	0.1083	0.0270	0.2179	0.0612

C. Results of Intelligent integration based on TOPSIS – PSOSVM

TABLEII
INTELLIGENT INTEGRATION RESULTS

Province	TOPSIS	PSOSVM	Weighted average result	Comp rehens
shanghai	0.1271	0.1757	0.1514	27
beijing	0.4191	0.4175	0.4183	2
tianjin	0.1045	0.1079	0.1062	31
jiangsu	0.1742	0.22	0.1971	21
shangdong	0.2215	0.2246	0.22305	13
zhejiang	0.2262	0.2087	0.21745	14
liaoning	0.2039	0.2618	0.23285	11
chongqing	0.2602	0.2663	0.26325	8
fujian	0.2629	0.2063	0.2346	10
hubei	0.1618	0.2594	0.2106	16
guangdong	0.261	0.1627	0.21185	15
anhui	0.152	0.1526	0.1523	26
henan	0.1102	0.1247	0.11745	30
hainan	0.2064	0.2048	0.2056	18
jingxi	0.286	0.2876	0.2868	5
beibei	0.1797	0.178	0.17885	23
hunan	0.2094	0.2109	0.21015	27
shanxi	0.1923	0.1938	0.19305	22
cichuan	0.2753	0.2737	0.2745	7
shanxi	0.1592	0.1607	0.15995	25
guangxi	0.2802	0.2785	0.27935	6
jilin	0.1702	0.1668	0.1685	24
heilongjiang	0.2048	0.2064	0.2056	19
neimenggu	0.333	0.3345	0.33375	4
ningxia	0.2291	0.2174	0.22325	12
yunnan	0.2421	0.2377	0.2399	9
guizhou	0.1336	0.1421	0.13785	29
Tibet	0.5646	0.3644	0.4645	1
xinjiang	0.1817	0.2177	0.1997	20
qinghai	0.3461	0.3543	0.3502	3
gansu	0.1501	0.1515	0.1508	28

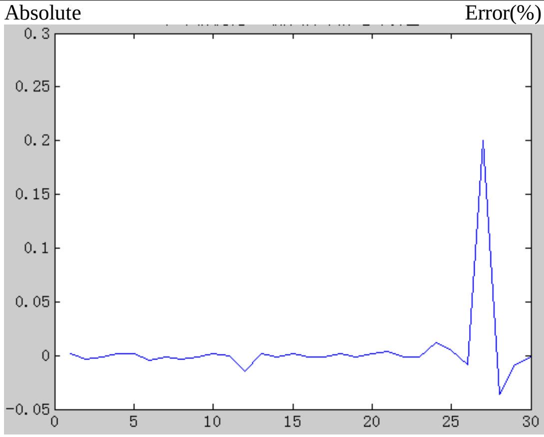
Relative Error(%)



Sample

Figure 1. Relative error of optimization by PSO-SVM

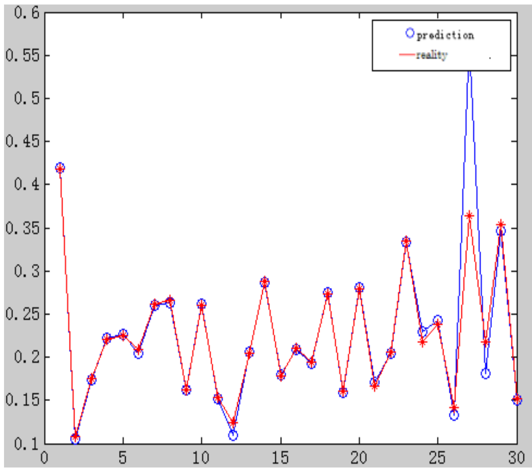
Absolute Error(%)



Sample

Figure2. Absolute error of optimization by PSO-SVM

Assessed Value



Sample

Figure3. Comparison between optimization value and actual value

Cross Validation Mean squared error = 0.0244889
Cross Validation Squared correlation coefficient = 0.876542
Cross Validation Mean squared error = 0.0245736
Cross Validation Squared correlation coefficient = 0.875978
Cross Validation Mean squared error = 0.0244889
Cross Validation Squared correlation coefficient = 0.876542
bestc =8.0780
bestg =0.0382
Mean squared error = 0.000729358 (regression)
Squared correlation coefficient = 0.996415 (regression)
Mean squared error = 0.056516 (regression)
Squared correlation coefficient = 0.862487 (regression)
Mean square error =0.00072936, Squared correlation coefficient =99.617%

Figure 4. ACO-SVM program running feedback results

V. CONCLUSION

It can be inferred from the evaluating results that the region of Tibet has got considerable achievement after ten years of ecological restoration. From the analysis of the empirical results, the ecological land intensive use in the top three is Tibet, Beijing, Qinghai. It shows that although the western regions of Tibet and Qinghai are not able to keep up with the eastern and central provinces, but the intensive use of land ecological protection well.

VI. Evaluation Framework Based on Big Data

In recent years, the rapid development of internet information technology has led to the all-round progress of the society and improved people's living standards greatly. Cities produce huge amounts of information in the constantly running, global produce 2 EB biological data every day, the development of big data which is based on cloud computing indicates that the intensive utilization of land ecological evaluation is coming into a new information age.

Large data is divided into "structured data" and "unstructured data". At present, unstructured data is proliferating, and about 80% of enterprise data is unstructured. MapReduce is a programming model for parallel operations of large data sets (greater than 1TB). Concept Map "(Map)" and "Reduce (reduction)", is their main ideas, borrowed from functional programming language, and borrowed from the vector programming language features.

The traditional PSOSVM is a serial processing data set on a single machine, resulting in slow convergence speed, longer training time. For some of the big data issues, the training time required for the PSOSVM algorithm can be very long. The combination of MapReduce and PSOSVM algorithm, in the decomposition of task mapping (map) variation of output stage is calculated for each weight, and then the total weight change is calculated at the summary (reduce) stage of the result, then to adjust weights. In the process of training, the method of batch training can be used to update the weight of the weight faster, thus speeding up the convergence rate. Map reduce algorithm PSOSVM can significantly reduce the size of intermediate results, improve the convergence speed.

After the Map function receives the sample data, the sample data is equally distributed to the computer cluster, which is the positive propagating input of the data from each computer in their respective PSOSVM .Local gradient reduce function of each weight change were summarized by the global gradient change, by constantly updating weights, get the final output, the output error to an acceptable range, the whole learning process is over, if not, then iteration again, until the iteration times of maximum and end of the algorithm.

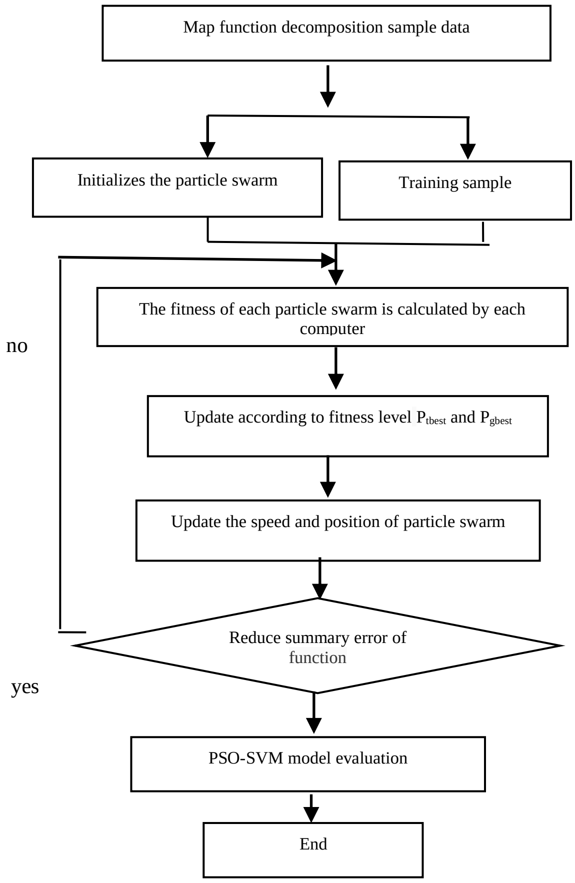


Figure 5. Evaluation Framework Based on Big Data

As a result of network technology, communication technology and the combination of the computer technology, artificial intelligence can appear a explosive data processing ability in the era of big data, the use of artificial intelligence can effectively alleviate the current shortage of information processing ability, and also can take the initiative to take countermeasures to the problems found in the information, to ensure the safety of the premise, to accelerate the speed of information processing. The combination of big data and artificial intelligence will release more energy. Artificial intelligence also requires the support of big data.

Combining large data with artificial intelligence for land intensive use of ecological assessment, the future has bright prospect.

Acknowledgements

Foundation item: The project was financially supported by Study of new-type of urbanization evaluation based on the intelligent integrated optimization of SVM parameters (2015 Natural science fund project in Anhui province, number: 1508085MG144)

References

[1] C. Li, FR. Zhang, TF. Zhu, T. Feng, and PL. An, "Evaluation and correlation analysis of land use performance based on entropy-weight TOPSIS method," *Transactions of the Chinese Society of Agricultural Engineering*, vol. 5, pp. 217–227, 2013.

[2] L. Ni, JC. Jiang, and Y. Pan, "Leak location of pipelines based on transient model and PSO-SVM," *Journal of Loss Prevention in the Process Industries*, vol. 26, n6, pp. 1085-1093, 2013.

[3] NN. Li, ZH. Qie, and H. Furutal, "PSO-SVM model for pipe bursting diagnosis of water supply network," [J].Xi tong Gongcheng Lilun yu Shijian/System *Engineering Theory and Practice*, vol.9, pp. 2104-2110, September 2012.

[4] WW. He, ZZ. Wang, and H. Jiang, "Model optimizing and feature selecting for support vector regression in time series forecasting," *Neurocomputing*, vol. 72, pp. 600-611, 2008.

[5] SC. Huang and TK. Wu, "Integrating GA-based time-scale feature extractions with SVMs for stock index forecasting," *Expert Systems with Applications*, vol. 35, pp. 2080-2088, 2008.

[6] Y. Yao, "The Credit Scoring System Based On Support Vector Machine," *Journal of system simulation journal*, vol. 26, n6, pp. 1085-1093, 2013.

[7] M. Wang and FT. Qu, "Indicator System for Land Use Intensity Assessment of Industrial Enterprises in Kunshan Development Zone," *China Land Science*, vol. 18, n6, pp. 22-27, 2004.

[8] H. Peng and G. Zeng, "Evaluation of intensive land use of development zones in Shanghai," *Economic Geography*, vol. 29, n7, pp. 1f177-1181, 2004.

[9] HX. Zhao, DM. Zhu, FT. Qu, et al, "Indicator Selecting and Threshold Confirming of Environmental Admission," *Urban Environment & Urban Ecology*, vol. 22, n2, pp. 37-40,2009.