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Atmospheric environment quality assessment based on improved immune algorithm

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ABSTRACT

Atmospheric quality assessment is an important research subject. In order to control the air pollution and to attract more and more attention for the air quality. This paper has proposed an improved immune clone algorithm and applied to atmospheric quality evaluation. The method constructs the function of atmosphere quality evaluation and optimizes the parameters of the evaluation functions. It can ensure the population diversity and improve the algorithm convergence. Experimental results show that the proposed model is effective and feasible for assessing atmospheric quality. It could provide a new reference basis and approach in the field of environment. Therefore it has great potential in the field of assessment the atmospheric quality.

KEYWORDS

Atmospheric environment; Quality assessment; Immune algorithm.

INTRODUCTION

With the rapid development of the economic,industrialization and the improvement of peoples' living situation, Atmospheric pollution has shown a serious, diversified development trend, pollution of the air is a threatening all creatures. People gradually realized the importance of protecting the atmospheric environment. Therefore the studies related the atmospheric quality, such as the assessment and forecasting of the atmospheric quality, have become noticeable increasingly[1,2]. In order to control the air pollution and to attract more and more attention for the air quality. So far, at home and abroad, the many method of atmospheric quality assessment have been putted forward, such as API method, grey clustering method, fuzzy mathematics method, hierarchy analytic method[3]. But these evaluation methods are lack of clear physical hospital, and it is difficult to provide directly scientific basis for environmental renovation planning. Therefore, this paper has proposed an improved immune clone algorithm and applied to atmospheric quality evaluation. The method constructs the function of atmosphere quality evaluation and optimizes the parameters of the evaluation functions. It can ensure the population diversity and improve the algorithm convergence. Experimental results show that the proposed method is the Feasible and effective

THE QUALITY ASSESSMENT OF ATMOPHERIC ENVIRONMENT

Air pollution is the human activities and natural processes which cause certain substances into the atmosphere[4]. It shows a sufficient concentration and reaches a sufficient time. Therefore It harms to the human body comfort, health and welfare or harms the environment phenomenon. Atmospheric pollutants from the source can be divided into two kinds, natural and anthropogenic pollutants. With the rapid development of the industry and the increasingly frequent of economic activities, especially in the densely populated city and industrial region[5], the air pollution is pretty heavy. The harm degree which caused by the pollutants on the environment can be represented by the index growth curve formula as S type through the study of the environmental pollution.

The harm rate of pollution of the *i*th atmospheric pollutant can be expressed as the follows:

$$R_i = 1/(1 + a_i e^{-b_i c_i}) \quad (1)$$

where a_i and b_i are parameters related to the *i*th pollutant, and c_i is the measured density of the *i*th pollutant. Parameter c_i can be replaced with a relative density, namely, $x_i = c_i / c_{i0}$, where c_{io} is a predefined parameter of the *i*th pollutant, usually taken as the natural basic density of the *i*th pollutant. The 3 parameters a, b, c are the universal parameters to be determined which has no relationship with The characteristics of pollutants.

THE IMPROVED OF IMMUNE CLONAL SELECTION ALGORITHM

In this paper, immune clonal selection algorithm is integrated with vaccine autonomous obtaining and vaccination operator. In the process of affinity maturation, one vaccine is produced via memory set of population, meanwhile, vaccine library evolves, and then, new generating individuals are vaccinated using vaccines in vaccine library before they are entered into next generation population, which can maintain the diversity of population, enable the population to evolve with a guided manner instead of random manner and accelerate affinity maturation process.

1) The dimension of clonal antibody

In the good memory was cloned, according to clone size the clone is processed According to the problem of the different,the scale of clone antibody is not the same, The calculation formula of the antibody clone size is as the follow[6].

$$\mathbf{n = p * (int)(\sqrt{N/i})} \quad \mathbf{(2)}$$

Where, P is the constant parameters of cloning, int () is a function of getting integer. N is the population size, I is the ranking number of affinity.

2) The vaccine extraction

Through the introduction of vaccination, excellent antibodies are preserved in antibody variation process, so as to improve the superior production. In the improved immune clonal selection method when each iteration occur, Antibody in good memory X_M is as a candidate vaccine set, candidate vaccine is named as $X_i^Y(p, p_2, \cdots, p_n)$, where,i is the sort number of antibody affinity about the merits[7].

3) The vaccine Selection

The vaccine selection is a roulette wheel selection strategy

$$\mathbf{P_i = F / \sum_i^M F_i (i = 1,2,3,\cdots,M)} \quad \mathbf{(3)}$$

Where, the affinity is F. The population is M

ATMOSPHERIC ENVIROMENT QUALITY ASSESSMENT BASED ON IMPROVED IMMUNE ALGORITHM

1) Constructing the objective function

According to the 5 ambient air quality standard (GB3095-1996), The 7 kinds of pollutants is listed in the standard, C_{i0}, C_{i1}, C_{i2}, C_{i3} and C_{i4} are defined as Level 0, level 1, level 2, level 3 and level 4. Therefore,the objective function is established. as follow.

$$\mathbf{\min f(x) = \min\{[\sum_{k=0}^{K}\sum_{i=0}^{m}(R_{ik} - R_{ke})^2]/Km\}} \quad \mathbf{(5)}$$

Where, The parameter m refers to the kinds of pollutants; parameter K refers to the classification level of atmospheric pollution; parameter R_{ik} refers to the damage rate of K level about I pollutants pollution, the parameter R_{ke} refers to the goal value of K level pollution Damage.

Step of the algorithm

Input: antigens set (training set).
Output: are the memory set and the parameters
S**tep1:** using real coded"
Step2:N is randomly generated. It is made up initial antibody population X (0)
Step3:to calculate affinity f according to the objective function
Step4: if It is satisfies certain number of iterations or reaches a predetermined accuracy, the algorithm terminates, otherwise executing step 5.
Step5: according to the degree of affinity f, antibody population size will be divided into two antibody group, the selection of high affinity f
Step6:According to the degree of affinity f antibody population size will be divided into two antibody group, the selection of high affinity part of the antibody is an excellent memory, Other Is general antibody units.
Step7: All antibody in good memory refer to candidate vaccine antibody

Step8: After selecting the vaccine X^Y of antibody according to formula (3), using binary gene selection method to determine the genes of the cross inoculation G (i)
Step9: the candidate vaccine antibody X and candidate vaccine X^Y, processes cross inoculation of gene, resulting in the new antibodies after inoculation
Step 10: random generating T group antibody, T antibody show as a variation. T is set parameters
Step 11:After the new antibodies obtained in the calculation of affinity f, the good antibody add the good memory. the Lower antibodies will death, returning to the step (3)

EXAERIMENTAL RESULTS AND ANALYSES

In order to test and verify Atmospheric Environment Quality Assessment Based on Improved Immune Algorithm we did simulation experiment. According to the assessment of atmospheric quality objective function formula 5, the paper use improved Immune clonal selection algorithm to optimize parameter a, b, c for atmospheric pollution damage rate. When antibody 100 are randomly generated and the iteration selected is 30 times. The value of the top 20 in the parameter a, b, c are TABLE 1.

TABLE 1 : The target value and parameters value of a, b, c with the improved immune algorithm

序号	目标值	参数 a	参数 b	参数 c
1	0.003263	83.183997	0.353178	0.818494
2	0.003271	81.535691	0.34307	0.777824
3	0.003289	94.817595	0.356259	0.825354
4	0.003298	90.038757	0.36308	0.830082
5	0.003303	92.576896	0.365093	0.854359
6	0.003322	83.570655	0.350494	0.85169
7	0.003341	88.43565	0.357982	0.868591
8	0.003341	71.505606	0.3477	0.86442
9	0.003343	87.35212	0.343333	0.793276
10	0.003352	80.55083	0.343553	0.755233
11	0.003355	65.40757	0.339191	0.868956
12	0.00336	64.631322	0.336711	0.859924
13	0.003362	76.199843	0.335088	0.791138
14	0.003364	64.385677	0.335048	0.860655
15	0.003367	70.656071	0.349617	0.886641
16	0.003376	64.844584	0.333926	0.862081
17	0.003376	66.311745	0.335009	0.823201
18	0.003393	68.529657	0.348563	0.887344
19	0.003395	78.9809	0.341167	0.748032
20	0.003397	62.082801	0.332072	0.846637

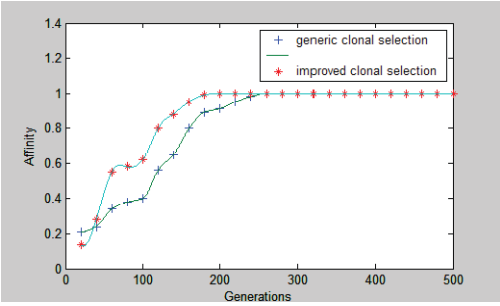

Figure 1 : The experiments for two algorithms

Figure 1 shows that the experiments for two algorithms were run for 10 times, generic clonal selection and improved clonal selection algorithm integrating with vaccination operator. The improved algorithm uses vaccination operator to increase the speed of convergence.

Figure 1, the affinity process of antibody population in the improved clonal selection algorithm is faster than that in generic clonal selection algorithm along with increasing evolutionary generations

CONCLUSIONS

The experimental results obtained show that the proposed improved immune algorithm is feasible and effective for the assessment atmospheric quality. Because the values of parameters a and b for calculating the harm rate of the atmospheric pollution are uniform for different pollutants, the proposed method could have more advantageous when the number of pollutant kinds is more. Since the assessment of the atmospheric quality is performed according to the density values of multi-pollutants and the assessment criterion is according to the average density of multi-pollutants, therefore the assessing process is more objective and has clear physical meaning. Satisfactory results obtained show that the proposed method is effective and applicable for the assessment of atmospheric quality.

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REFERENCES

[1] I.Farago, K.H.Georgiev; Advances in Air Pollution moded for Environmental Security, **(2005)**.

[2] J.D.Martin, Y.T.Morton, Q.H.Zhou; Neural network development for the forecasting of upper atmosphere parameter distributions[J], Space Weather Advances in Space Research, **36(12)**, 2480-2485 **(2005)**.

[3] K.C.Tan, C.K.Goh, A.A.Mamun, E.Z Ei; An evolutionary artificial immune systemfor multiobjective optimization [J], European Journal of Operational Research, **187**, 371-392 **(2008)**.

[4] Xiang Weiguo; The Weather Prediction Method Based on Artificial Immune System rediction Method Based on Artificial Immune System[C]2010 International Forum on Information Technology and Applications, 385-389 **(2010)**.

[5] A.L.Dutot et al.; A 24-h forecast of ozone peaks and xceedance levels using neural classifiers and weather redictions[J], Environmental Modelling & Software, **22(9)**, 1261-1269 **(2007)**.

[6] Anderson Dourado-Sisnando, Luana da Franya Vieira; Artificial Immune Systems Optimization of the Absolute Bandgap of Photonic Crystals[J]. IEEE, 4799-1397 **(2013)**.

[7] Yaping Jiang, Yang Li; Immune accination Model Apply To Network Intrusion Defense[C]. International Conference on Computer Application and System Modeling (ICCASM 2010), 318-320 **(2010)**.