Based on the Optimal Learning Algorithm of Vortex Search, the Prediction of Oil Field Development Index is Studied

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Abstract. Nowadays, with the development of the times, many times we will use high-tech to enrich and facilitate our lives, and as the backbone of our energy system - the oil industry, is no exception. Especially in the current oil field oil storage is insufficient, but also to strictly control oil exploration in the field to ensure the stability of the entire national system. Therefore, in order to strictly control the development forecast of oil fields, this paper uses the optimization learning algorithm based on vortex search to control this. In this paper, with the support of existing technology, sandbox simulation and eddy current algorithm are used to model the future oil field development without disclosing oil field information and actual reserves. The experimental results show that the selection of a suitable algorithm can predict the development index of oil field within a certain range, and the general error rate is not more than 5%.

Keywords: Vortex Algorithm; Oil Field Development; Modeling; Data Prediction.

1. Introduction
In the current era, as new energy is still in the development stage, the cost is too high and the effect is very small. Although the new energy vehicle has been proposed for some years, the actual results obtained are not satisfactory, so the main energy source at this stage is oil. But the oil reserves are limited, so we need to make a production plan so that we can save resources most efficiently. So the purpose of this paper is to use eddy current algorithm to predict oilfield development index.

Downhole operation is an important means of oil production, which is usually carried out before and after production [1]. The downhole operation during construction mainly includes drilling engineering, perforation and fracturing [2]. Ground construction includes station construction, crude oil collection and transportation, road engineering and other system engineering. As many oil wells are far away from villages, and there is no groundwater development and utilization near many oil wells, existing oil wells cannot be found [3]. In groundwater condition monitoring, oil wells in surrounding villages are often relied on, resulting in the distance between monitoring points and actual oil wells, even not within the evaluation range, and the monitoring data are lack of representativeness [4]. In addition, wells in some villages are complex. In the investigation, the number of drinking water wells and non drinking water wells should be investigated respectively, and the water supply population of drinking water wells and the distance from the nearest oil and water wells to the construction project...
should be focused to ensure the accuracy [5]. Prediction results. In this paper, the model value simulation of layered production measurement technology in offshore oilfield is carried out. Pressure gradient analysis is carried out by different theoretical methods, such as Newtonian fluid, gas-liquid two-phase and finite element analysis [6-7]. The results show that there is an error between the pressure calculated by different theoretical methods and the measured value [8].

Therefore, after the use of modern technology, this paper adopts more reasonable intelligent operation to carry out comprehensive monitoring of oilfield production [9]. For the loss of each link, the minimum difference is obtained after calculation, so as to conduct comparative analysis, select appropriate methods to control, and then determine a general range according to the annual oil field production and the changes of various influencing factors to make reasonable prediction [10].

2. Vortex Algorithm
The VS algorithm generates a candidate solution around a vortex center in each iteration, initializing the vortex center Xo according to the upper and lower limits of the actual problem. In each subsequent iteration, the value at the center of the vortex changes to the optimal solution for the current iteration. The VS algorithm then generates a candidate solution around the center of the vortex through the Gauss distribution. This provides simplicity for the algorithm, but it also presents problems. For functions with multiple local minimums, the method of generating candidate solutions using a single point can easily fall into local minimums. The algorithm simulates the eddy phenomenon by using the search behavior of the white adaptation step adjustment scheme, and with the increase of the number of iterations, the locality of the algorithm candidate solution is also increasing. Therefore, if the algorithm does not jump out of the local minimum as soon as possible, it becomes more difficult to jump out of the local minimum as the number of iterations increases. The MVS algorithm overcomes the disadvantages of the VS algorithm. In the MVS algorithm, candidate solutions are generated around multiple centers per iteration. Each center produces a best solution, and one global best solution among all the best solutions. Create a new vortex center based on the global optimal solution. The MVS algorithm increases the range of search space and reduces the possibility of falling into local minimums.

2.1. Initialize the Vortex Search Center
Considering the two-dimensional optimization question first, each iteration of the MVS algorithm produces a candidate solution around the m center. The search behavior of the MVS algorithm can be thought of as constructing multiple parallel vortexes at different centers in each iteration. It is characterized by the staff finding the five optimal solutions from one initial center, then the optimal solutions for each center from the five newly generated centers, and then the global optimal solutions from the newly generated centers.

Represents M(t)(μ) a matrix that stores the central value of each vortex during each iteration, and t represents the number of iterations, with an initial value of 0. Therefore, the initial value of m centers. The initial value of each center M(0)(μ) = \{μ1,2, ..., μM\}

\[ μ_{i0} = μ_{i1} = ... = μ_{iM} = \frac{l_{upper} + l_{lower}}{2} \]  

(1)

Where lupper and are d-dimensional vectors, representing the upper and lower bounds of d-dimensional search space, respectively. llower

2.2. Generates A New Candidate Solution
Initializes the radius value, generating multiple candidate solutions with Gaussian distributions around m centers. The total number of candidate solutions is set to r0n, and these n candidate solutions are generated around m centers. Therefore, each vortex center produces n/m candidate solutions.
represents a subset of the candidate solutions generated around m centers in the tth iteration. All candidate solution sets generated when t is 0. \( H_0^0(s) = \{s_1, s_2, \ldots, s_n \} \) \( C_0(s) = \{H_0^1, H_0^2, \ldots, H_0^B\} \)

The general form of Gauss's distribution is.

\[
p(x \mid \mu, \Sigma) = \frac{1}{\sqrt{(2\pi)^d |\Sigma|}} \exp \left\{ -\frac{1}{2}(x-\mu)^T \Sigma^{-1} (x-\mu) \right\}
\]

(2)

Where \( d \) is the dimension, the work is the \( d \times 1 \)-dimensional random variable, the \( d \times 1 \)-dimensional sample average (the center of the vortex) vector, is the covariance matrix. If the veragonal elements of the co-variance matrix are equal, and the non-versal elements are zero, the shape of the distribution is spherical. The author discusses the two-dimensional problem, which can be regarded as a circle. Therefore, the co-variance matrix. \( \mu \Sigma \)

\[
\Sigma = \sigma^2 I_d \times d
\]

(3)

Where \( \sigma^2 \) is the variance of the Gauss distribution, which is \( \times \) matrix \( I_d \times d \) of \( d \)-dimensional units. The initial standard deviation for gauss distribution.

\[
\sigma_0 = \frac{\max (L_{\text{upper}}) - \min (L_{\text{lower}})}{2}
\]

(4)

During optimization, the standard deviation is used as the vortex search radius. In order for the search space to cover the solution space, you can set a larger value for the initial radius. As the number of iterations increases and the search radius decreases, the decrease is an adaptive adjustment process. The full coverage of the search space is achieved by setting the outer outer circle with a large radius. \( \sigma_0 r_0 \)

2.3. Update the Candidate Solution

Each subset has an optimal solution when selecting a candidate solution. And the candidate solution must be in the search space, out of range of the candidate solution needs to be based on \( s_i \in H_0^0(s) \)

\[
s_k = \begin{cases} 
    a(L_{\text{upper}}^i - L_{\text{lower}}^i) + L_{\text{lower}}^i, & s_k < L_{\text{lower}}^i \\
    L_{\text{upper}}^i, & L_{\text{upper}}^i \geq s_k \geq L_{\text{lower}}^i \\
    a(L_{\text{upper}}^i - L_{\text{lower}}^i) + L_{\text{lower}}^i, & s_k > L_{\text{lower}}^i 
\end{cases}
\]

(5)

Transform into search space. when \( k = 1, 2, \ldots, n \), \( i = 1, 2, \ldots, n \) is a random number that conforms to the uniform distribution. The best solution for each subset is stored during each iteration. When. The best solution in the matrix is the global best solution for all candidate solutions in the current iteration, recorded as . If it is less than the current best solution, it is updated to . \( B_t(s) \) t = 0 \( B_0(s) = \{s_1, s_2, \ldots, s_m\} \) \( G_{\text{best}} \) \( G_{\text{best}} \) \( G_{\text{best}} \)

In the VS algorithm, each iteration center is transformed into the current best solution. However, the MVS algorithm requires m central positions in the next iteration. This is the difference between the VS algorithm and the MVS algorithm. In the MVS algorithm, the m center of these centers is transformed to the current best solution in the next iteration, \( s_{\text{best}} \), and the remaining m1 center is the new location.

\[
\mu_l^t = s_l^t + a(s_l^t + s_{\text{best}}), \quad l = 1, 2, \ldots, m - 1
\]

(6)
where $a$ obeys the random number of normal distributions, and $t$ is 1, the elbow. Determined by the best solution set and the best solution. The algorithm then uses $m$'s new vortex search center to reduce the new radius and generate a new candidate solution around it. Repeat until the termination conditions are met. $\mathbf{s}_t \in B_0(\mathbf{s})M_t(\mu) = \{\mu_1^1, \mu_1^2, \ldots, \mu_1^m\}\mathbf{s}_t \in B_0(\mathbf{s})s_{best}$

3. Experiment

3.1. Select an Oil Field in Northwest China as the Subject of Investigation

For distance reasons, we chose the oil field to investigate it. First of all, we asked the staff of the oil field to conduct a general investigation of the oil field. From the staff we have obtained sample data and development difficulties for each field over the years and so on. Then we went to the Department of Energy press to find data on oil price fluctuations over the years and oil use (both production and imports). Then we started analyzing the oil field data.

3.2. Test Sets and Datasets

Prior to this experiment, it was important to use data sets for test algorithms, and different algorithms needed different data sets to support them, so that better classification accuracy could be obtained. In order to get more effective data, the download data should be pre-processed first, and the suitable data pre-processing method can greatly improve the accuracy of the experiment. Therefore, the data object of this experimental study is the historical mining data of the oil field.

4. Evaluation Results

4.1. Experimental Data Processing Identification

![Figure 1. Vortex algorithm Map A of the processing state of experimental data](image_url)
Figure 2. The eddy current algorithm processes subsequent state distribution b to the unanalysed data.

Figure 1 shows the data, in the experimental data integrated processing and analysis of intelligent, intelligent processing, will lead to the possibility of data breaks and analysis anomalies, the consequences of which are more serious. "Furthermore, in a large number of normal operating conditions and non-normal operating conditions, regulators are primarily concerned with non-normal operating conditions, and the rest of the normal operating conditions have actually been habitually ignored." In data processing, such samples, which are tagged and not to be predicted, play an important role, often incorporating data sets for risk assessment and analysis, and in post-processing, such samples play a significant role in the depiction of data distribution and the construction of learning models. Therefore, through the design experiment, this paper conducts multiple data analysis processing on the same data set with the same marked part, evaluates the performance of the model with consistent evaluation indicators, and finally selects the best performing model to predict the abnormal state of the data.

Table 1. The output value of the model and the two types of error analysis table

|                  | Precise. | Error-1. | Error-2. |
|------------------|----------|----------|----------|
| Training set.    | 82.13%   | 16.31%   | 1.56%    |
| The test set.    | 94.25%   | 4.92%    | 0.83%    |

Table 2. The precision analysis table of the vortex algorithm

| Sample. | Observed. | Predicted. | Correct rate. |
|---------|-----------|------------|---------------|
| Training. | 20 | 18 | 90% |
| Total share | 110 | 91% |
| 100 | 92 | 92% |
| Inspection. | 20 | 18 | 90% |
| Total share | 115 | 93.5% |
| 100 | 97 | 97% |

As can be seen from the data in Table 1 and Table 2, the prediction accuracy of the accuracy model of the vortex algorithm is 90%. Among them, the training set and test set first type of error (normal data as abnormal data) are 16.31 percent and 4.92 percent, respectively, the second type of error (non-normal data as normal data) is 1.56% and 0.83%, the first type of error is larger than the second type of error, indicating that the model is relatively strict, with the possibility of false data.

4.2. Oilfield Exploitation

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After many years of oil field development and construction, most of the construction content at this stage is carried out in the development blocks. In analysing the current state of regional development and existing environmental issues, the discussion was ambiguous, as the blocks were too large and the nature of land use was complex. In the course of the assessment, it is necessary to investigate the existing wells, wells and stations in the development zone, to clarify the emission standards of the existing stations, and to investigate ecological restoration. In addition to urban areas and residential areas, oil field construction projects also occupy grassland and arable land. For these projects, it is necessary to investigate the implementation of the environmental protection measures proposed in the existing environmental impact assessment reports in the area in order to investigate the ecological restoration of temporary land and compensation for cultivated land.

In oil field production, there is a wide variety of data, the scale of the data is very large. Raw data storage technologies do not meet the growing demand for data. Only by establishing an oil field production data warehouse can this problem be solved. With the rapid growth of oil field production data, there will be a large number of data duplication, low correlation between data, information islands and other issues. Vortex search technology can solve this problem by centralizing dispersed resources and organizing confusing data.

In oil field production, accurately predicting oil field output is one of the important research contents of oil field workers. The traditional prediction method produces a lot of complex data in oil field production because of the different prediction principle and application conditions. These methods will show their own limitations and cannot accurately predict the output of the field. Based on the data of oil field production data warehouse, and based on the vortex search method, the gray correlation analysis of various factors affecting production and output is carried out, and the correlation degree is sorted. Then, by eliminating the less relevant factors, the main factors affecting production are filtered out. Then, based on the time series analysis method, the basic production data affecting the main factors of production are predicted, and the prediction model of oil field production is established by using the vortex search algorithm. The oil field output prediction model based on vortex search technique can effectively adapt to the complex and changeable production data. The accuracy of oil field production forecast is greatly improved.

5. Conclusion
In short, vortex search technology relies on network technology, computer technology and communication technology, is the product of the continuous development of science and technology. Vortex technology, as a more advanced science and technology in today's social development, belongs to a kind of iterative algorithm, which brings many new changes to people's learning, life and work, which can better meet people's different needs of life and work. But we can't be at the same time, although the algorithm still has some problems, but we will look for better algorithms or ways to solve the problem, improve the correct rate and fault tolerance, so we believe that with the progress of the times, the new algorithm was proposed, we will certainly solve this problem well.

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