Visualization technology in Computer Science

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Abstract. This paper focuses on the analysis of data preprocessing and data periodic regression under the condition of complex data. It includes a linear data projection technology, a nonlinear data projection technology, a data periodic regression technology and a more intuitive data visualization display technology after data periodic regression. Through the above technology, we can make the complex data more intuitive display, and show the details of the relatively dense part of the data.

Keywords: Visualization technology, Computer Science, Data Periodic Regression

1. Introduction
Data visualization technology is a common technical means in the current computer technology and big data technology. Its significance lies in intuitively displaying the statistical and logical relations between data. In addition to simple data visualization by means of histogram, sector chart and radar chart, there are many deep data visualization technologies, including data pre-processing technology and deep data relationship display technology [1].

Data pre-processing technology mainly includes dimensionality reduction technology and data projection technology. There are many deep data relationship display technologies. This paper focuses on the periodic nonlinear regression technology of data [2].

2. Data Pre-processing Technology

2.1. Dimensionality Reduction Technology
The minmax algorithm is the most commonly used mode of data preprocessing technology at present. Its significance is to project the data on the [0,1] interval losslessly according to the data distribution, so that the data under many dimensions and many value ranges, such as area data, length data, speed data, temperature data, dimensionless count data, dimensionless ratio data, can be compared equivalently [3]. That is to say, the problem of comparing the size relationship between 1kg and 1m is solved.

The formula of minmax is:
\[ f_{\min\max}(x) = \frac{x - \min(x)}{\max(x) - \min(x)} \]  

For a sequence \([x]\), take its maximum value as \(\text{Max}(x)\), and its minimum value as \(\text{Min}(x)\). For each occurrence value of \(X\) in the sequence, you can get a data between 0 and 1, where the minimum value of the data is 0, the maximum value is 1, the scale relationship between the data remains unchanged, and the data size sorting remains unchanged. After de-dimensioning the multi-column data separately, the maximum and minimum values are the same, so the logical relationship can be more fully compared.

After the data \(f(x)\) of minmax, interval adjustment calculation can be carried out, that is, if \(f'(x) = f(x) \times 10\), then the projection interval of \(f'(x)\) is between \([0,10]\), the maximum value of its sequence is 10, and the minimum value is 0.

The data after minmax can also be added, that is, if \(f'(x) = f(x) + 1\), the maximum value of the sequence is 2 and the minimum value is 1.

Two columns of minmax data can also be added, and if \(f'(x) = f1(x) + f2(x)\), though the maximum value of \(f1(x)\) and \(f2(x)\) is 1 and the minimum value is 0, the minimum value of \(f'(x)\) is \(\geq 0\) and the maximum value is \(\leq 2\). The maximum value of \(f'(x)\) is 2 only when the maximum values of \(f1(x)\) and \(f2(x)\) overlap, otherwise it is less than 2. Similarly, only when the minimum values of \(f1(x)\) and \(f2(x)\) overlap, the minimum value of \(f'(x)\) is 2 is 0, otherwise it is greater than 0.

2.2. Data Projection Technology

Although the data collated by minmax algorithm can achieve more data visualization functions, it belongs to linear projection and still can not enlarge the details of data. More natural data near 0 is a secret script, so it is difficult to display the details of data directly, so it is necessary to enlarge the data locally to achieve better visualization effect. At this time, non-linear data processing is needed [4].

According to the particularity of some functions, such as log function, we can enlarge the data locally without disturbing the data sequence. For the non-linear projected data, the data scale relationship will be distorted to some extent, but it can make the local details of the data more intuitive.

For example:

\[ f(x,t) = N \cdot \log_e(x + b) \]  

Among:

- \(N\) is the linear magnification of the data on the Y axis.
- \(b\) is the original displacement of the data on the x-axis, under the condition of log function, the function near 1 will be fully enlarged, so it is necessary to move the dense data near 1 through the \(b\)-value.
- \(t\) is the parameter value of log function is generally taken as 10, i.e. In function is formed, or \(e\) is taken. The \(t\) value directly determines the magnification of log function. In the actual visualization project, the value of \(t\) value determines the effect of data amplification.

The \([x]\) sequence in this function is generally the sequence after minmax, because its projection relationship is more regular, and it is easier to realize data visualization. Part of the data will go through the multiplication or addition operation of minmax.

3. Data Relationship Display Technology

In this paper, we use periodic sinusoidal compound regression to study the depth data visualization mining technology. Most of the data will show a certain periodicity, rather than a single change attribute. The common linear regression, polynomial regression, power function regression,
exponential regression and so on all intelligently reflect the single change attribute of data.

The periodic sine compound regression can be used as the regression analysis of weather data, stock index data and other natural data.

Its basic formula is:

\[ f(t) = N \cdot \sum (A_i \cdot \sin(a_i \cdot t_i + b_i) + B_i) + f'(t) \]  
\[ (3) \]

Among:

A, a are The composite correction value on the y-axis, multiple variables joint regression of the y-axis data distribution, that is, joint correction of the data amplitude.

B, b are The compound correction value on the x-axis, multiple variables combine to regress the x-axis data distribution, that is, to jointly correct the wavelength of the data.

N is The linear magnification of the data on the Y axis.

i is i-level iterative waveform characteristics. In order to provide more complex natural law data, the model uses I sin function iterations, and finally forms regression data closer to the status quo of the data.

\[ f'(t) \] is Other regression functions integrated in the regression process, such as linear function, polynomial function, power function, exponential function, etc. By integrating other regression functions, the trend of regression results in a large range can be given.

4. The Application of Fourier Transform in Data Visualization

Fourier transform is a data visualization method to fully display the periodic characteristics of periodic data. After periodic regression, the characteristics of the data may still be difficult to show intuitively in the complex periodic function curve, so it is necessary to Fourier transform the periodic function to get more intuitive results [5].

The general functions of Fourier transform are:

\[ F(\omega) = F[f(t)] = \int_{-\infty}^{\infty} f(t) e^{-i\omega t} dt \]  
\[ (4) \]

\[ f(t) = F^{-1}[F(\omega)] = \frac{1}{2\pi} \int_{-\infty}^{\infty} F(\omega) e^{i\omega t} d\omega \]  
\[ (5) \]

Formula (4) transforms the periodic function into the amplitude information on the frequency transverse axis, and formula (5) transforms the amplitude information on the frequency transverse axis into the periodic function. That is, the whole process of Fourier transform does not lose information.

The complex function, after the arrangement of formula (1) to formula (4), will also become intuitive, without losing any details of the data. Although the data may produce a little distortion in the nonlinear projection, but the distortion at the same time gets a clearer data detail effect, and the non-linear projection data can also carry out inverse operation to get the original data again.

5. Summary

This paper fully studies the process of data visualization which is difficult to be visualized under the condition of complex data, and focuses on the data preprocessing process and complex regression process. Through the data visualization process of this paper, the details of the data can be embodied more significantly, and the deep laws of the data can also be fully displayed. In the actual data visualization process, there are many data pre-processing and data depth analysis tools that may be used, not only the content discussed in this paper, through the comprehensive use of various data visualization tools, we can achieve more intuitive data visualization, make the data more intuitive
display and more convenient analysis.

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