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Research Article

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The research of the grey system theory applied on buildings deformation monitoring

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ABSTRACT

Considering this requirement, this paper based on the Grey System Theory, using the Grey Model in a large bridges deformation monitoring information analyze and forecast, use the new model simulated and forecast the deformation monitoring of a large bridges. Comparing the traditional model with improved one, the result illustrates the reliability and advantage of improved GM(1,1) model.

Keywords: Grey System Theory, bridges deformation, GM(1,1) model

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INTRODUCTION

The fast development of economics promotes the urbanization of China. More and more high-rises appear in our cities. In order to ensure the service life and security of constructional works, it's necessary to monitor the constructional work systematically during its building and operating. The purpose of deformation monitor is analyzing and holding the future deformation characters and rules of the constructional work by using the long-term accumulated surveying datum and forecasting. At present, it has formed a set of mature theoretical systems, and abundant trend approaching and forecasting models have come out, such as regression model, Kalman smoothing model, timing series model, Artificial Neural Networks, Wavelet Analysis, Grey Model and so on.

Grey System Theory is a theory that partial information is known and others are unknown. The uncertain system about small sample and poor information are the study object of grey system theories. The actual world is described and recognized accurately by generating and developing the partial known information. The deformation monitor date is a discrete grey series, so it's ideal and effective to apply the grey system theory to the data processing of deformation monitoring.

this paper analyzed the present methods of deformation analyze andforecast, and illustrated the advantages of Grey System Theory used in deformationmonitoring. After that, we analyze and discuss of the Grey System Theory.Secondly,start from the grey forecast and grey modeling, we analyzed theshortcoming and limitation of traditional GM(1,1) model. Based on it,we modifiedthe model background values and raised the Liner-Grey model at the same time.

The Grey system theory modeling idea is to put the time series into differential equation, thus establishing the development and changes of the Grey Dynamic Model of abstract system,such as the GM Model. The GM model predicts the size of the number of time series, called gray sequence forecast.

In the Grey system theory,GM model is GM (m, n) model, among which m is for the model order, n is the number of model variables.Establishing the Grey forecasting GM model , choosing m = 1, n = 1,that is GM (1, 1) model, referred to as a single sequence of first order linear dynamic model.

The modeling idea and realizing process are as follows
smooth the selected child series
For each of the selected sequence:
$X^{(0)} = \{X^{(0)}(1), X^{(0)}(2), X^{(0)}(3), \ldots X^{(0)}(n)\}$, as

$$X^{(0)} = \{X^{(0)}(i), i = 1,2,\ldots,n\} \quad (1)$$

Accumulating the abovechild series to the selected sequence , generating a new sequence

$X^{(1)} = \{X^{(1)}(1), X^{(1)}(2), X^{(1)}(3), \ldots X^{(1)}(n)\}$, as

$$X^{(1)} = \{X^{(1)}(k), k = 1,2,\ldots,n\} \quad (2)$$

where , $X^{(1)}(k) = \sum_{i=1}^{k} X^{(0)}(i) = X^{(1)}(k-1) + X^{(0)}(k)$,

The new data sequence weakened the volatility of the original data, increased its regularity.

An albino differential equation and accumulate matrix construction
For sequence $X^{(1)} = \{X^{(1)}(k), k = 1,2,\ldots,n\}$, establishing Albino differential equations as follows:

: $$\frac{dX^{(1)}}{dt} + aX^{(1)} = u \quad (3)$$

thedifferential equation of GM (1, 1) model is Formula (3) ,representing one order one variable
Coefficient vector is
$\hat{a} = [a, u]^T$,

Accumulative matrix B is

$$b = \begin{bmatrix} -\frac{1}{2}(X^{(1)}(1) + X^{(1)}(2)) \\ -\frac{1}{2}(X^{(1)}(2) + X^{(1)}(3)) \\ \cdots\cdots \\ -\frac{1}{2}(X^{(1)}(n-1) + X^{(1)}(n)) \end{bmatrix} \quad (4)$$

To solve the coefficient vector
Let $Y_n = (X^{(0)}(2), X^{(0)}(3), \ldots X^{(0)}(n))^T$,

Using the least square method and solving the coefficient vector $\hat{a}$,
As follows

$$\hat{a} = (B^T B)^{-1} B^T Y_n \quad (5)$$

4.Set up GM (1, 1) model, computing is predicted
bring $\hat{a}$ to the albino differential equation: $\hat{X}^{(1)}(k+1) = (X^{(0)}(1) - \frac{u}{a})e^{-ak} + \frac{u}{a}$ (6)
Where ,K is Time series,taking year, quarter or month. This paper takes years.

Number $\hat{X}^{(1)}(k+1)$ from the GM (1, 1) model ,Revert to : $\hat{X}^{(0)}(k)$
The original sequence forecast

$$\hat{X}^{(0)}(k) = \hat{X}^{(1)}(k) - \sum_{i=1}^{k-1} \hat{X}^{(0)}(i) \tag{7}$$

thegeneration of test forecast result
The predicted value near the origin compared with the original data, calculated the accuracy. According to the measure whether precision prediction model is feasible of not.If precision is not high, then analyzing the causes, and modeling and prediction, until satisfying.

Main closed before the monitoring results and analysis
Before the close of a super major bridge, in view of the construction of the bridge's actual situation and closed scheme, the detailed analysis of the bridge has carried onmonitoring group of linear.as shown in fig.1

Fig 1. The bridge's midspan closed

The basic requirement of the construction control in the process of continuous girder bridge construction ensures that the construction of the stress and deformation of the bridge structure is still within the design requirements of safety specifications.Method of the calculation of a super major bridge built around a cantilever construction, the construction stage of girder elevation of the theoretical value can be calculated, but the error is inevitable in the process of construction, after the girder internal force and linear state will be affected by these errors in different degrees.Therefore, using the gray theory has important practical valueto test and control river bridge on the stress and deformation in the process of continuous box girder construction, to ensure the success of the bridge, built and put into operation.

REFERENCES

[1]LanXiaoqi,HuangXiaoshi,Liu Di. Data processing model of GPS damdeformationmonitoring network *Journal of Tongji University*,**2007**,35(12); 1695-1698.
[2] Deng J. L. Common operation and concept number in grey Iheory. *The Journal of Grey Systein*.**2000**,10(2): 184-192.
[3] Li B. Q, Deng J.L. Models for grey series. *The Journal of Grey System*.**2009**,20(3):217-232.
[4]Liu Sifeng. On Measure of Grey Infonnation. *The Journal of Grey System*.**2005**,(7)2:97-101.
[5]Lovse J, WTeskey W.F, Lachapelle G, Camion M. E. Dynamic deformationmonitoring of tall structure using GPS technology. *Journal of Surveying Engineering* .**2005**, 121(1): 35-40.
[6]KuoHsingChia,Wu Li Jen. Prediction of heat-affected zone using Greytheory. *Journal of Materials Processing Technology*,**2002**,120(1): 151-161.