Spatio-temporal deformation prediction of diversion tunnel based on machine learning multivariate data fusion

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Objectives

In the traditional deformation analysis and prediction of monitoring data, the geometric analysis method is used to construct the relationship model. The accuracy of short-term prediction is acceptable, while the accuracy of long-term prediction is greatly reduced. However, the safety problems mostly occur in the rainy season, so the long-term prediction of deformation prediction is very important. Therefore, it is necessary to find a model with better long-term prediction accuracy.

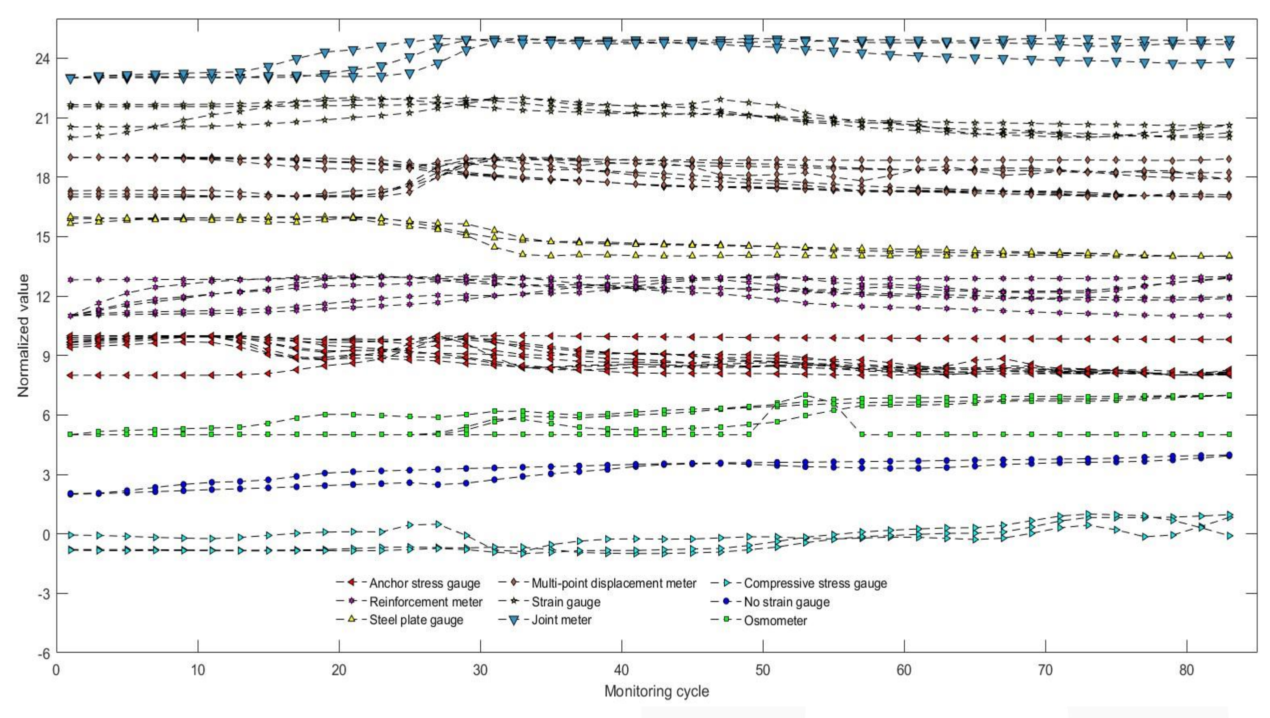

Figure 1 The normalized observation values of a certain section of the diversion tunnel including 3 compressive stress gauges, 2 no strain gauges, 4 osmometers, 10 anchor stress gauges, 6 steel reinforcement gauges, 3 steel plate gauges, 9 multi-point displacement gauges, 4 strain gauges, and 3 joint gauges. Among them, there are no strain gauge values+3osmometer values+6, anchor stress gauge values+9, steel reinforcement gauge values+12, steel plate gauge values+15, and multi-point displacement gauge values+18, The strain gauge value+21 and the joint gauge value+24 are displayed. Considering the display effect, select data with an odd number of cycles for display.

Methods

Multivariate data fusion based on machine learning is proposed, and the spatial position factor of monitoring instrument is introduced to optimize the model parameters, and the analysis and prediction effects of various kernel functions are compared, and the least squares spatio-temporal support vector machine model is established.

Conclusions

The model takes into account the temporal and spatial correlation between multiple monitoring data, analyzes and predicts the geometric deformation, and provides data support for the study of diversion tunnel deformation mechanism.

The spatio-temporal fusion of multivariate data can also better predict the long-term spatio-temporal deformation of diversion tunnel with large fluctuations.

Results

The deformation long-term prediction results based on the least squares spatio-temporal support vector machine model are better than the long-term prediction results of traditional method and the prediction results of multivariate data without spatial relationship.

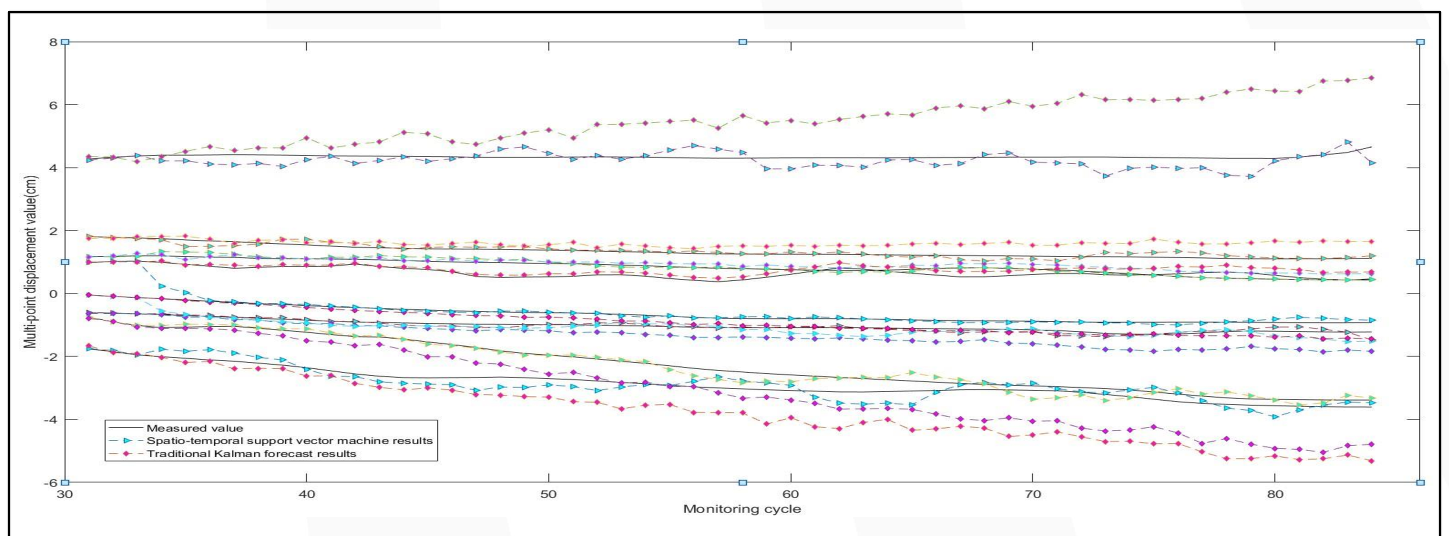

Figure 2 Long-term deformation prediction results of multi-point displacement based on least-square spatio-temporal support vector machine model. The displacement and deformation results of subsequent 54 periods are predicted through multi-source data of the first 30 periods. The figure contains the necessary prediction results of 8 multi-point displacement meters, where the black line is the measured displacement value, which is compared as the true displacement value in the experiment.