Application of Data Analysis Method in Geotechnical Engineering

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Abstract

Geotechnical seismic engineering belongs to the cross field of geotechnical engineering and earthquake engineering. Due to the dual effects of the variability of geotechnical objects and the complexity of dynamic loading, the scientific problems involved in this field have to face more uncertainties. Through the analysis on the status quo of uncertainty analysis methods in geotechnical earthquake engineering in the field of non-deterministic analysis clear difficulties, weak links with all kinds of uncertainty analysis method to solve the inherent weakness of determining geotechnical earthquake engineering uncertainty problem, and can determine the establishment and improvement to provide some ideas and direction analysis model for non.

Keywords: Data analysis, methodology, geotechnical engineering, application, research and analysis

Introduction

In the analysis of the strength and stability of geotechnical engineering, conventional methods are deterministic methods. At present, the application of the theory of probability and statistics in the field of geotechnical engineering and earthquake engineering has gradually formed a research method which is parallel to the conventional deterministic design methods. Here, we call it a mathematical analysis.

Mathematical analysis method has a mature theoretical system, its application scope is relatively clear. Many analytical methods in structural engineering are often applied in the simplified calculation of geotechnical engineering, and the idea of non-deterministic analysis is no exception. The premise of this application is that it can simplify the process of the mechanical behavior of rock and soil object into a series of structural elements. However, there are significant differences between the geotechnical object and the structural object, and how to control the error of the analysis result, the research in the field of geotechnical engineering is facing more difficulties. Usually, the mechanical characteristics of the unit structure is relatively simple, rich in rock fracture or directly is granular soil, due to the strong nonlinear and may even have extremely strong uncertainty (random and discrete) factors, comprehensive intuitive performance of mechanical behavior is more complex than. For the solution of the nonlinear problem, the problem of uncertainty has a larger solution space, because the method is more mature.

The mechanical behavior of rock and soil mass is complex, and its dependence on natural conditions, the complexity of the structural system and the complexity of the calculation system, the uncertainty of the boundary conditions. In addition, it is necessary to take into account the actual physical background to solve the specific scientific problems, which makes the non-deterministic analysis methods have great limitations in geotechnical engineering. In

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theory, the engineering geological characteristics of rock and soil are not completely random variables. However, in the practice of engineering geological investigation and laboratory test, it is impossible to achieve the required amount of work. Therefore, it is necessary to analyze the occurrence characteristics of rock and soil as a random variable, and use the theory of probability and statistics.

In the field of geotechnical seismic engineering, the characteristic attribute of the earthquake is not a standardized random variable, but it is supposed to be in a certain range. In short, the limited number of samples under the premise, can through the uncertainty analysis of the sample quantity expansion, making the results more credible, even if only this is to confirm the credibility theory, but at least in the logic to obtain this credibility is worth trying.

Although the practice of geotechnical engineering and seismic engineering requires the analysis results to be expressed in the form of certainty, it does not constitute an obstacle to the application of. One thing for sure, the application range of only the non deterministic analysis method and the simplified conditions can be clarified, at present the level of theoretical research more simplified, reflect the mechanical behavior of the actual seismic results of rock and soil, and even can be transformed to engineering practice is more willing to accept the form of. Therefore, it is necessary to clarify the application of the non deterministic analysis method in the field of geotechnical seismic engineering and its research status.

![Diagram](image)

Figure 1. Data analysis method.
The Proposed Methodology

Application and research of data analysis in geotechnical seismic engineering. The application of the reliability theory in the civil engineering structure is earlier, mainly by means of probability theory and statistical method, which can be applied to the research methods of the target scientific problems. These ideas have been gradually introduced into the research and practice of geotechnical engineering since 70s. From 70s to 80s, the theory of probability (including stochastic process theory) has made great progress in earthquake engineering. For example, the seismic risk analysis of building sites, the artificial seismic wave synthesis, the seismic safety evaluation of structures (dynamic reliability theory). These facts show that: the Chinese academic community has long been aware of the importance and feasibility of introducing non deterministic analysis methods in solving complex problems.

With the accumulation of geographic space data, enhance the earth environment, social and health data monitoring capabilities, the development of geographic information systems and computer networks, generating a large number of spatio-temporal data sets, spatio-temporal data analysis and practice show rapid growth. This paper analyzed and summarized, summed up the 7 main methods, analysis of spatio-temporal data including spatio-temporal data visualization, the purpose is through the visual inspiration hypothesis and selection analysis model; analysis of temporal and spatial statistical indicators, reflecting the spatial pattern changes with time; when the air change index, comprehensive statistics reflect the temporal and spatial variation; spatial pattern and the anomaly detection, constant and changing part reveal space-time process; spatio-temporal interpolation, to obtain numerical without sampling points; space regression, established by the statistical relationship between variables and explanatory variables; temporal process modeling, the mechanism of establishing mathematical model of spatio-temporal process; spatio-temporal evolution tree, using spatial data reconstruction of temporal and spatial evolution path. This paper introduces the basic principles of these methods, the input and output, the conditions of application and the software realization.

Contrastive analysis. Comparative analysis is to compare two or more data, and analyze the differences between them, so as to reveal the development and change of the things represented by these data and the regularity of the. Comparative analysis of the characteristics are: it can be very intuitive to see things in a certain aspect of the changes or gaps, and can accurately and quantitatively show that the difference or the difference is how much.

Comparative analysis can be divided into static comparison and dynamic comparison. Static comparison is the comparison of different general indicators at the same time, such as the comparison of different departments, different regions and different countries. Dynamic comparison is the comparison of the index values of different periods in the same general condition.

These two methods can be used alone or in combination. Comparative analysis can be used alone, the total amount of indicators, relative indicators or average indicators, but also can be combined to compare them. The results of comparison can be expressed by relative numbers, such as percentages and multiples.

Structural analysis method. Structural analysis refers to the study of the relationship between the various parts of the whole and the overall analysis method, that is, the proportion of each part of the overall proportion of the overall. The larger the proportion of a certain part, indicating that the higher the degree of importance, the greater the impact on the overall. For example, through the analysis of the composition of the national economy, the national economy can be obtained in the production, circulation and distribution of all sectors accounted
for the proportion of the national economy, the proportion of each department or contribution, reveal the mutual contact between the parts and its variation.

The advantage of structural analysis is simple and practical, in the actual business operation analysis, the market share is a very classic application.

Cross analysis is usually used to analyze the relationship between two or more groups of variables (field), and to make a comparative analysis of the relationship between variables in the form of cross table, so it is also called the method of cross table analysis. Of course, there are more than two dimensions, the more dimensions, the more complex the cross table, so the choice of several dimensions need to be determined according to the purpose of the analysis.

The principle of cross analysis is to subdivide the data from different dimensions, so as to understand the composition and distribution of data.

Matrix analysis refers to things (such as products, services etc.) two important properties (indicators) as the basis for the analysis of classification and correlation analysis, then find out a method to solve the problem, also known as the matrix correlation analysis method.

The comprehensive evaluation analysis method is a kind of analysis method which is based on the quantitative characteristics of different aspects of things, using mathematics, statistics and so on. The basic idea of the comprehensive evaluation analysis method is to transform a number of indicators into an index which can reflect the comprehensive situation. Such as the economic strength of different countries, the level of social development in different regions, the evaluation of the economic benefits of enterprises, the performance evaluation of employees within the enterprise, can use this method.

In the field of geotechnical seismic engineering. In the past 20 years, the application of probability and statistics theory in geotechnical seismic engineering has been developed into a new branch of "probability analysis method of geotechnical seismic engineering", or "probability soil mechanics", which is a new branch of geotechnical engineering. In this way the research, from the survey to test and calculation, from the selection of parameters to design each link from field monitoring to inversion analysis, from first to last throughout with a "random" concept, and not only in the form of probability calculation methods. The reliability analysis of geotechnical engineering, is one of the calculation methods of probability calculation in the link metric building safety degree, but the reliability analysis of the word does not completely contain the probability in geotechnical earthquake engineering analysis of all methods.

The theory of probability and statistics is more mature in the field of structural engineering. In our country, although the method of half probability has been included in the code of architectural design, it has not been widely used in geotechnical seismic engineering. Due to the complex nature of rock and soil is not only difficult to control, but it is not easy to correctly understand it, especially the nature of some types of "special soil", which has been known so far, but it is very clear.

The variability of the soil itself, determines the geotechnical engineering especially some basic problems in geotechnical earthquake engineering field to make a breakthrough in theory, must only in non-deterministic analysis methods for help.

At the beginning of the 1970s, the fuzzy mathematics method was applied in seismic engineering abroad. The fuzzy mathematical analysis method is mainly used to solve the problem that the traditional deterministic theory cannot be solved in geotechnical engineering. In the field of geotechnical engineering and structural engineering, there are many kinds of fuzzy analysis methods, such as fuzzy pattern recognition, fuzzy clustering analysis, fuzzy control and fuzzy comprehensive evaluation. In recent years, the research and practice of using fuzzy mathematics to solve engineering problems is increasing. For example, the earthquake liquefaction potential application of fuzzy clustering analysis method to study the classification
of sand ground; fuzzy comprehensive evaluation method to analyze the stability of underground cavern rock, stability and foundation bearing capacity of slope evaluation.

Although some achievements have been obtained in the application of fuzzy mathematics in geotechnical engineering, it is still in the mature stage and the application field is still expanding. In the specific application, the results of the different fuzzy operations are very different, which requires the use of different operations according to the situation and experience. The results of fuzzy analysis and data reliability analysis in engineering are less, so it is urgent to solve the problem that the fuzzy analysis method is widely used in engineering problems. With the help of the finite element program of the fuzzy finite element method, which is beneficial to the calculation of fuzzy analysis and back analysis, the finite element program can be developed which is more suitable for the fuzzy mathematical method.

Conclusion

At present, the application of probability analysis in our country has gradually penetrated into the code of architectural design, which indicates that the probability of soil mechanics will have fertile soil to grow and develop. The probability analysis of geotechnical engineering has aroused wide concern. Many scholars have been groping forward, but because of the complexity and particularity of geotechnical material composition and engineering properties and mechanical properties, as well as various uncertain factors, greatly increasing the application of uncertainty analysis method of the difficulty, many people for this non deterministic method of research is still relatively unfamiliar.

Reference