Feedback Analysis of Geotechnical Structure Simulation Based on 3D Modeling and Visualization

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Abstract. In geotechnical engineering, the analysis and calculation of numerical data of geotechnical engineering has great reference value and has been widely used in various fields. In the development of computer technology, 3D modeling and visualization technology plays an important role in geotechnical engineering, in which numerical data is the basis and important data of geotechnical engineering, which plays an important role in the future development of geotechnical engineering. In this paper, the numerical data simulation of geotechnical engineering structure is studied and analyzed.

Keywords: Geotechnical, Data Numerical, Simulation Techniques

1. Introduction
With the economic development in the 21st century information technology era, geotechnical designers in different industries have found a variety of problems. With the popularization and development of computers, geotechnical engineers have found a variety of problems in the development of different industries. The numerical calculation of geotechnical engineering has been greatly improved and developed. The quantitative analysis in geotechnical engineering has been improved quickly, and geotechnical engineering, the technical problems of geotechnical structure are studied.

2. 3D modeling technology
The technology of 3D modeling is to rebuild the real 3D object or scene in the computer by using 3D data, and finally to simulate the real 3D object or scene on the computer [1]. The required 3D data is the data collected by different 3D data acquisition instruments, and various physical parameters in discrete points are recorded on the surface of finite body. The three-dimensional modeling technology also has the same data acquisition function in the field of data engineering. It records the data in the geotechnical structure and keeps the unity and consistency of the data through parameterized technology, so that the size and can be adjusted and modified at any time.

The method of 3D modeling is divided into geometric modeling and feature modeling, while geometric modeling is divided into wireframe modeling, surface modeling and solid modeling. In the numerical analysis of geotechnical engineering data, curve modeling is one of the methods used. In modeling, the complex outer surface is divided into several components to form a basic surface.
element, and then the desired surface is formed by splicing. Inside the computer, the data structure of the surface only needs to build a surface on the basis of wireframe modeling [2]. The surface model is mainly suitable for complex object surfaces that can not be described by simple mathematical models, such as topography, geomorphology, oil distribution and other different resources, while our geotechnical structure belongs to one of the landforms. We use the data acquisition instrument to collect the data of each point and then splice it together to complete the structure of its surface. If modeling technology is used in geotechnical engineering, many parameters are needed, and these parameters cannot be collected by simple data acquisition instrument, and these parameters are not obtained in simple experiments. It is necessary to transform its model into a mathematical problem and calculate the initial value and boundary value according to some of the data to reach the data value of the physical model [3-5]. However, in solving the problem of model, differential equation and geometric equation should be used to complete the numerical analysis.

The first order linear differential equations are as follows:

\[ \frac{dy}{dx} + P(x) y = Q(x) \]

P (x) and Q (x) are assumed to be continuous functions here.

\[ \frac{dy}{dx} + P(x) y = 0 \]

Q(x)=0,

\[ y = Ce^{-\int P(x)dx} \]

Q (x)=0, the general solution is, C is an arbitrary constant.

The geometric equations are as follows:

\[ \varepsilon_x = \frac{\partial u}{\partial x} \]

\[ \varepsilon_y = \frac{\partial v}{\partial y} \]

\[ \gamma_{xy} = \frac{\partial u}{\partial y} + \frac{\partial v}{\partial x} \]

Through these simple equations, the problem of initial value and boundary value in the model is completed by calculating its data according to the equation.

3. 3D visualization technology

3D visualization is a means to depict and understand the model, or the representation form of the data body, rather than simulation technology. It will use a large amount of data, check the continuity of the data, identify the authenticity of the data, discover and propose useful anomalies, and provide useful tools for analyzing, understanding and repeating data [6]. In geotechnical engineering data, 3D visualization is the information of discrete points.

Based on the 3D visualization model, the anatomical section of the position is displayed according to the information.

With the powerful function of computer, the realization of 3D visualization model has been improved. The simplest solution is our mathematical problem, which is applied to the use of spatial
vectors we have learned in mathematics, three different values. The orientation of the representation is different. The basic theorem of space vector is an expression of its spatial concept.

When there are three non-coplanar vectors \( a, b \), there is a unique ordered set of real numbers \( \{x,y,z\} \), \( p=x_1y_1z_1 \). any vector in space [7].

Parallel formula:

\[
\begin{align*}
\frac{x_1}{x_2} &= \frac{y_1}{y_2} = \frac{z_1}{z_2} \\
\end{align*}
\]

Parallel formula is one of the most important formulas in spatial vector. This model will abstract, complex spatial data information, through comfortable and suitable visual angle and visual effect elements to display, easy to remember and transfer data.

4. Geotechnical structures

4.1. Classification of rock and soil

At present, from the engineering point of view, rock and soil are any kind of rock and soil that make up the crust. Rock and soil can be subdivided into five categories: hard (hard rock), subhard (soft rock), weak connected, loose unconnected and with special composition, structure, state and properties. According to daily habits, the first two types are called rocks, and the last three types are called soil, collectively referred to as "rock and soil". Figure 1: Geotechnical classification

![Figure 1: Geotechnical classification](image)

4.2. Selection and classification of geotechnical parameters

One of the important tasks in the research of geotechnical engineers is to analyze and evaluate the geotechnical parameters, and most of the parameters in geotechnical engineering belong to the random variables of normal distribution [8-9].

Normal distribution of random variables:

If the random variable \( x \) obey the normal distribution, its probability density function is:

\[
f(x) = \frac{1}{\sigma \sqrt{2\pi}} e^{-\frac{(\mu - x)^2}{2\sigma^2}}
\]
x range of values is

\[-\infty < x < +\infty\]

The definition of cumulative probability distribution function and the cumulative distribution function diagram of figure 2 are needed in the process of research.

Cumulative probability distribution function:
A cumulative distribution function x, all functions is defined as follows:

\[F_X(x) = P(X \leq x)\]

![Figure 2. Cumulative distribution function diagram](image)

In the actual working process, the total parameters are difficult to obtain. Usually, the sample statistics are used to replace the total parameters, and the sample variance is used to evaluate the reliability of the total parameters, and the reliability evaluation value is guaranteed by a certain probability [10]. The distribution function of our common random variables is discrete.

The formula for calculating the variance of the:

\[S^2 = \frac{\sum (X - \overline{X})^2}{n - 1}\]

Probability distribution of discrete random variables:
Let discrete random variables, let x1,x2,...,xn be the value x the variable, the probability distribution x discrete random variables is p1,p2,...,pn the probability corresponding to the above values

\[P(X = x_i) = p_i, \quad i = 1, 2, \ldots, n,\]

The above data value will affect the selection of geotechnical parameters. In general, the selection of geotechnical parameters can be divided into two categories: one is the test method and the value standard, the other is the evaluation index and the calculation index. The reliability and practicability of the parameters can be guaranteed. The test method and the value standard are the data of a certain part through the process of sample preparation in the laboratory. The experiment has great chance and will cause great error to the experimental results. Therefore, the selection of evaluation index and calculation index has certain reliability and practicability for the selection of geotechnical parameters.
At present, the structure of geotechnical engineering belongs to a part of geotechnical engineering, which includes some parameter values needed in the design, such as low-level foundation design, retaining structure design and so on. In order to support a certain space in the structure design, the formation space of the structure is long-term stable and meets the requirements of use. Therefore, the data source of the structure in geotechnical engineering still depends on the parameter data value of the rock and soil. Only with a certain reliable parameter data value can a certain structural design model be formed in the structure.

5. Conclusion
According to the computer binary language, different techniques and methods will be used to realize the 3D visualization technology of 3D modeling technology, both of which are one of the principles of numerical simulation and analysis of geotechnical engineering structure data. The analysis of geotechnical parameter data will have a certain influence on the structural model of geotechnical engineering. According to different parameter data values and different models, the structural model of geotechnical engineering still depends on the data value of geotechnical parameters. The reliability and practicability of parameters will have a great impact on the future geotechnical engineering structure, and different geotechnical parameter data values are also important reference materials for the structure. The analysis of parameter data in geotechnical structure based on computer plays a great role in research.

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