# RESEARCH OF ESTABLISHMENT AND APPLICATION FOR SPATIO-TEMPORAL DATA MODELS OF AN OPEN-PIT STOPE

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**Abstract**

With the technology of Geographic Information System (GIS) as the core and establishing the spatio-temporal database of an open pit stope for the goal, abstracted the change process of 3D geographic-spatial information on a time sequence from the open-pit exploitation production process, through the construction of the stope spatio-temporal database, dynamically described the open-pit exploitation production process, provide comprehensive spatial information support for the optimal pre-control decision-making of an open-pit exploitation ,such as planning, design, production scheduling management. Brought forward the TIN theory and method of an open-pit stope considering its step feature, established the stope spatio-temporal database with essential status revision and continual snapshot model, through GIS and Virtual Reality (VR) technology, actualizes the exploitation-process playback and production-plan ahead demonstration, establishes the framework and platform of basic geographic-spatial information for the digital open-pit construction.

**Key words:** strip mine; spatio-temporal data model; virtual stope; digital elevation Model (DEM); geographic information system (GIS)

## 1 Introduction

Strip mine production carries out according to production plan, in the process of mining design, an engineer need to know how many soils, rocks and coals can be removed, Where soils and rocks can be placed as the best project, How much each soil field can exhaust, and which shape of the heap can satisfy the technique request for land cultivation. Finally the virtual 3D model of an open pit stope according to those data can be automatically established finally. so according to produce plans, continuously three-dimensional of an open pit stope based on time dimension can be established, the produce plan can be performed before it can be done, and the virtual mine can be realized. Making use of measured data monthly in the practical production, the accurate three-dimensional model of stope can be established, this model can be contrasted with the virtual model, and check the circumstance of production, adjust to control the produce plan of shelling and picking in time, assurance produces to carry out according to the best plan. Making use of the measured data monthly, the real three-dimensional

model can be established, and the real 3D scene can be made to play back. Be showed from this, establishing the spatio-temporal data model and the spatio-temporal database for a strip mine, it is very important for a strip mine to manage, product, and design. That is the foundation of digital open cast mining.

## 2 Establishing the spatio-temporal data model of an open pit stope

### 2.1 Obtaining source data for three-dimensional models of an open pit stope

The measure of a stope monthly is a direct data source for a 3D model, and it is also the main job for a strip mine; therefore the jobs of stope surveying, data checking and processing, drawing the present map of an open pit stope, are the chief task for strip mine. Because of the terrain complications, accurate description difficulty, various conditional restrictions, this will influence the data processing, establishment of the three-dimensional model, and the accuracy of data. The method that GPS-RTK replaces Electronic total station will increase the observation efficiency and survey accuracy.

### 2.2 Establishing the three-dimensional models

The different modeling method corresponds with the different modeling precision, the terrain modeling of an open pit stope must consider the features of steps, describes the steps by the line of ascent bottom and ascent crest, and adopt the method of TIN to establish the three-dimensional models with constraint condition. When triangle generates network, it must guarantee constraint line can not be passed through, otherwise the terrain modeling will be distorted, and the accuracy will decrease.

### 2.3 The establishment of spatio-temporal database of open pit stope

Spatio-temporal data model adds time element in the three-dimensional space database, and makes the object studied possess 3D(x, y, t) or 4D(x, y, z, t) attributes. In the practical application, the different functions of time GIS demand different organization of data and spatio-temporal data models, which have a big difference from usual organization of spatial database and methods of processing. Because the relationship and organization structure of space, attribute and time are extremely complex, the ideal spatio-temporal database and the time GIS system have not appeared at present. At present the common spatio-temporal model includes: space-time cube model，continual snapshot model，essential status revision model, and space-time compound model.

## 3 The application of spatio-temporal data model of an open pit stope

The establishment of spatio-temporal data model of an open pit stope has widespread application for classification in exhausted quantity of rocks and soils, three dimensional dynamic playing back of mining, realization of virtual mining which show the course of

mining ahead, the degree of slope and direction of slope, the generation of contour line of mining area, hydrographic analysis of mining area surface, and so on..

## 4 Conclusions

According to surface characteristic, the production and working conditions of the strip mine, it is a kind of high accuracy, fast data acquiring method that adopted the GPS-RTK technology to gather feature points and encode the attribute in terms of ascent bottom, ascent crest, and points at the step. Aiming at mining design, the productive planning and the acceptance of engineering survey for the strip mine, the terrain 3D modeling and spatio-temporal database theories of geography information system can be adopted to create the precise 3D model and the spatio-temporal database of the strip mine, then the important data about production and management of the strip mine can be extracted, which can serve for the mining production and decision-making.