3D Modelling and Virtual Reality Management Information System (VRMIS) Application in China

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Developments and Applications of 3D Geological Modelling and Visualization in China
Some Basic Investigations of 3D Geological Modelling
3D Modelling method Study
(Dr Shuming Chen, Guangxi Electric Power Design and Research Institute)

Curved fracture surface modelling

Intelligent strata generation from boreholes
3D Geology Model Visualization Method Study
(Dr. Shuxian Zhao, Institute of Crustal Dynamics, China Seismological Bureau)
3D Geology Model Visualization Method Study

(Dr. Zhao Shuxian, Institute of Crustal Dynamics, China Seismological Bureau)
3D Visualization and Modelling
(Dr Shuming Chen, Guanxi Electric Power Design and Research Institute)
More Complicated Modelling

Intersection generated from arbitrarily distributed boreholes
Excavation of Complicated Geological Body
Karst Rock Strata Simulation
More Complicated 3D Geological Modelling
Mining Engineering Application
(Dr. Liguan Wang, Central South University)
3D Visualizing and Numeric Modelling

(Dr Liguan Wang, Central South University)
3D Visual Analyzing and Modelling
(Dr Liguan Wang, Central South University)
3D Modelling of Hydropower Project
(Tianjing University and CHIDI)

3D Geology Model of Jingping Dam Site & Its Underground Powerhouse
Global 3D Visualization for Seismology Research
(Dr. Shuxian Zhao, Institute of Crustal Dynamics, China Seismological Bureau)
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Virtual Reality Management Information System (VRMIS) and its Application in Xiangjiaba Hydropower Station and Other Projects of China
What is VRMIS and Why need it?

- Integration of VR(virtual reality), GIS and 3D modelling technologies in management information system
- A useful tool in data analysis, data mining, risk management and evaluation, geotechnical design, and decision-making based on the features of geological structure and exploration data.
- Advanced visualization of EG-MIS, good display platform which can not only take full advantage of the investigation data but also save the cost of investigation and design, and reduce the risk.
Engineering Background of Xiangjiaba Hydropower Station

- to be built on the Jinshajiang River, which is one of the 12 hydropower developing bases in China.
- A gigantic station with power capacity of 6000MW
  - the watershed area is $45.88 \times 10^4$ km$^2$, normal reservoir water level is 380m, storage capacity is $49.78 \times 10^9$ m$^3$, the max height of the dam is 161m.
Engineering Demands

- Manage tremendous investigation data of landform, drill holes, trench and adits, stored in the format of tables, characters, charts and drawings.
- Enhance the efficiency of geological investigation and analysis;
- Accelerate the speed of applying alterable designs and informational construction.
- Obtain the information directly and conveniently by flying interactively or automatically in the 3D VR environment.
- Know more clearly the geological structure of the dam site, improve the correctness of analysis and decisions.
Main Frame of VRMIS

- Settings of 3D Scene
- Flying Automatically / Interactively
- Geological Solid Query
- Virtual Operation of the Solid
- Management of Drawings
- Management of Investigation-Data
Some Key Techs

- 3D Geological Modelling
- Data management based on nodes
- Pyramid 3D Data Engine
- Geometry Skin Technique
- Automatic Profile Plotting
Main Functions (1)

- **Flying in the virtual scene**

  - Flying manually, that is using four direction control keys to go forward, back, turn left or right, or even change the viewpoint of the user.

  Flying automatically, that is defining a flying path in advance, and play it back automatically whenever needed.
Main Functions (2)

• **Information Query**

- A database has been connected to the scene. After define the attributes of the object in the virtual scene, users can query the information of strata, faults and drill holes at any time when browsing.

A query to a stratum
Main Functions (3)

• **Virtual Operation**
  - Change the position, direction and scale of the objects in the virtual scene in the real time.
  - Zoom, rotate, translate, split the scene or objects and so on by the tools in the toolbar.
  - Roam and shuttle in the gap to observe every strataums and faults inside the 3D model.

Splitting the 3D geological model into two parts along the axis
Main Functions (4)

- **Automatic Profile Plotting**
  - Borehole plotting.
  - Slice generation
  - Profile and plane section generating from 3D model.
  - Engineering geology profile formatting.
  - Various formatted drawing outputting.
Cut view of the model (1)
Sliced view of the model (3)
Automatically plotted RQD and Testing value
Automatically plotted boreholes with color column of strata
The result of automatic plotting module
Other Application Examples

- Construction management information system of an airport project
- Virtual structure design for Longyou caverns conservation
- Virtual design of anti-rolling-stone shed in Sichuan-Tibet road
Virtual reality construction management of an airport project

A rendered view

Layer managing function used in airport
Best design virtual reality of Longyou caverns, China

The original stone pillar of 1st cavern

The reinforcement design

The reinforcement of 2nd cavern by pillar and beam
Virtual design of anti-rolling-stone shed in Sichuan-Tibet highway
Conclusions

• 3D geological modelling and visualization have widely developed in China but still are not perfect for easy various applications. National and international cooperation are needed.

• VRMIS is a good visualization platform to take full advantage of geological investigation data and to save the cost of investigation, design and construction.

• 3D geological modelling is one of the key technologies used in the building of VRMIS. Its fundamental study is still needed.

• Deep integration of 3D modelling, Virtual Reality and GIS is a very hard and important future task.
Thank you for your attention!