



FIG Working Week 2024

19-24 May

Accra, Ghana

Your World, Our World:
Resilient Environment
and Sustainable
Resource Management
for All

Presented at the FIG Working Week 2024,
19-24 May 2024 in Accra, Ghana

A Brief Overview of 3D Real Scene Construction in China

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Chinese Academy of Surveying and Mapping

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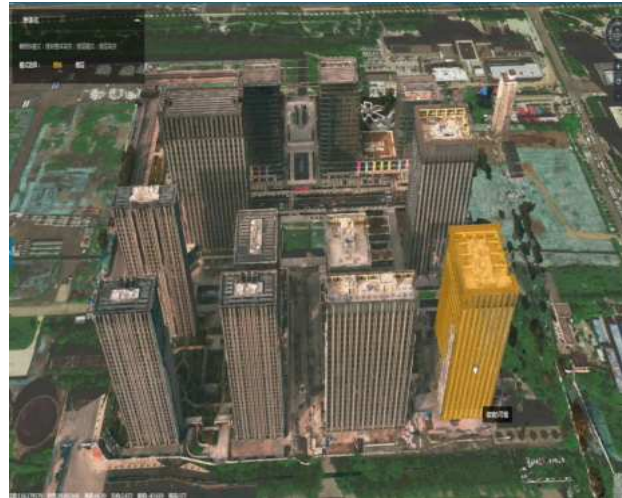
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As a digital space of reflection and expression to human production, life and ecological space in a realistic, stereo, and time sequential way, 3D real scene of China(3DRS) is **a new type of fundamental surveying and mapping product together with a new type of national infrastructures.**

3D real scene will provide **the universal spatial foundation** for all industries of social-economic development



Terrain-level



City-level



Component-level

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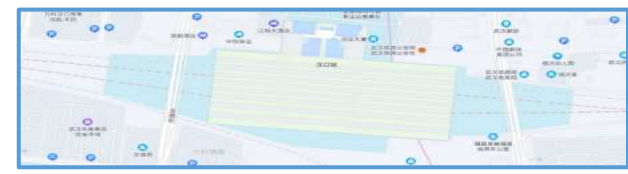
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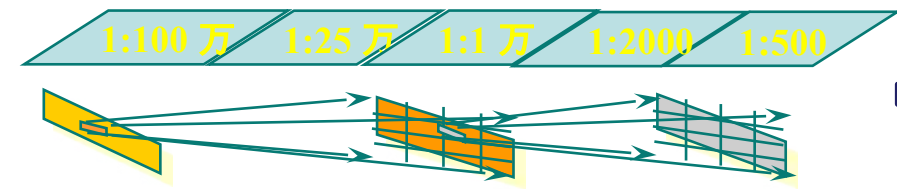
➔ **From abstract to realistic**



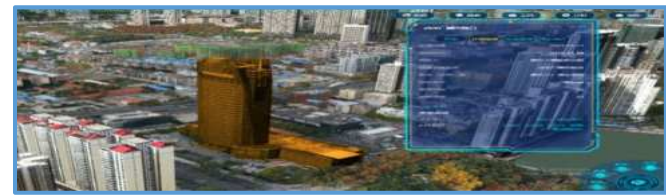
➔ **From static to sequential**



➔ **Object-oriented**



➔ **From interpretation to understanding**



➔ **Whole-space**





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3D real scene of China mainly includes data product , standard and specification, and service application.

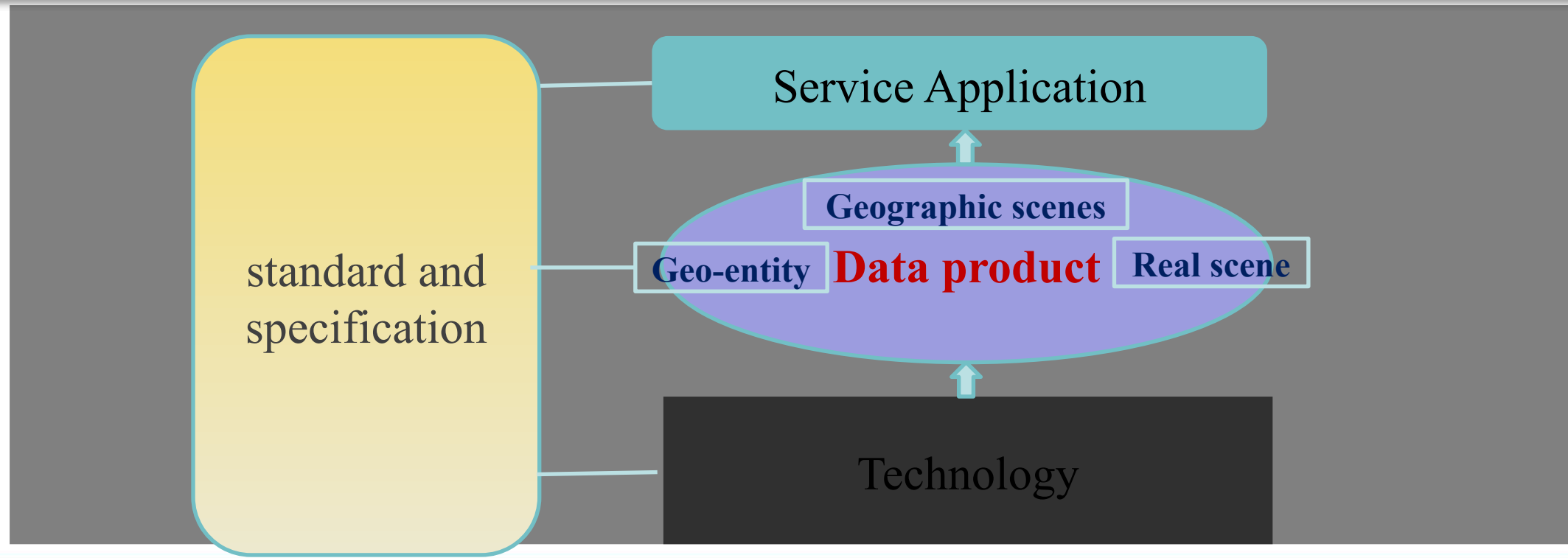




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Fundamental surveying and mapping has shifted from traditional 4D products relying on **fundamental geo-entity databases** to 3DRS products centered on **geographic scenes, geo-entity, and real scene.**

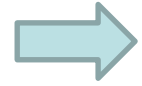
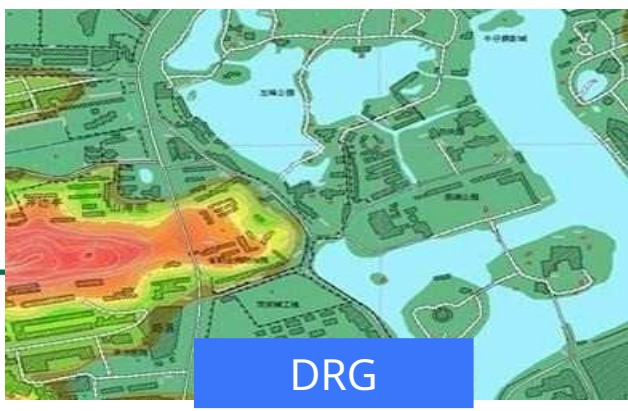
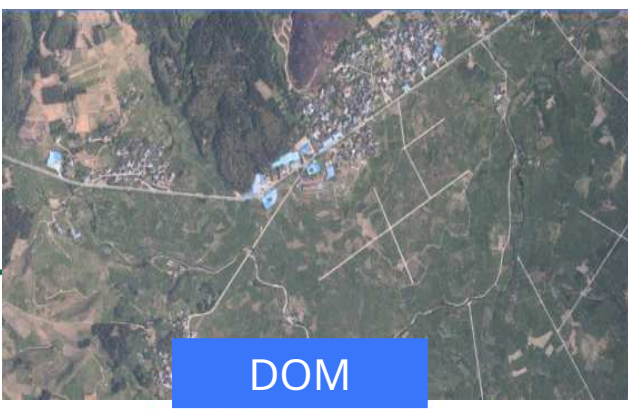
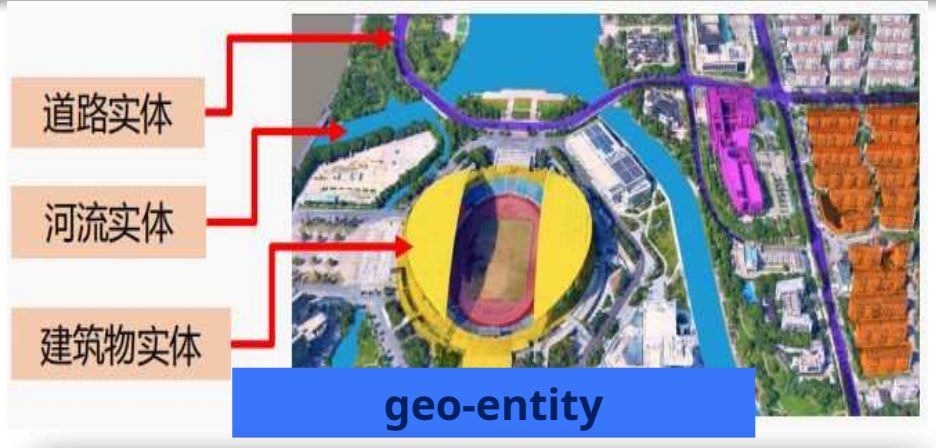
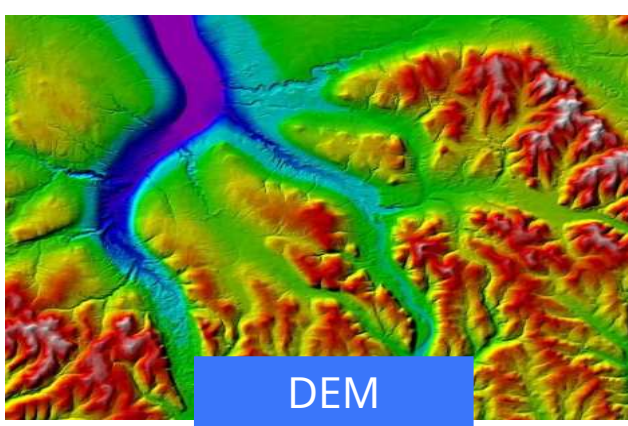
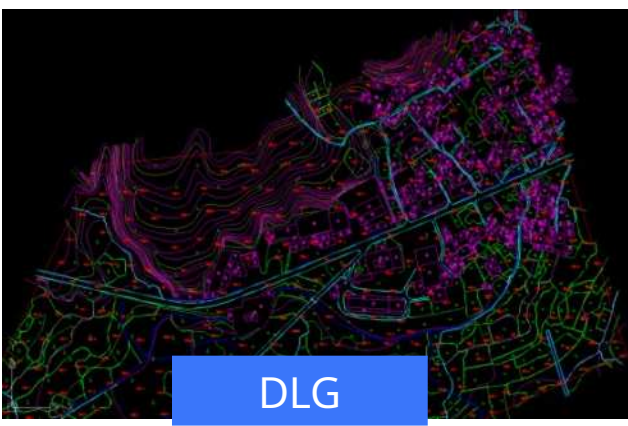




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The goal of 3DRS is to establish the digital foundation for the construction of Digital China.

In the year of **2025**, at least **50%** of government decisions, production coordination, and general planning can be conducted via 3D digital geo-spatial system.

In the year of **2035**, at least **80%** of government decisions, production coordination, and general planning can be conducted via 3D digital geo-spatial system.





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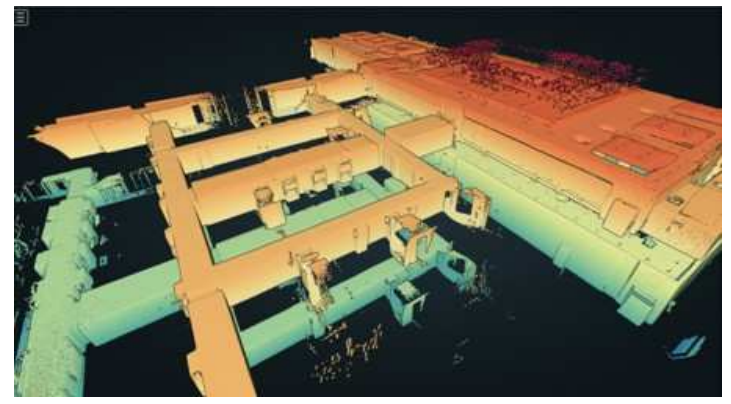
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A set of light-weight mobile laser scanning system supports integrating data collection from indoor to outdoor, from ground to underground.

- ❑ Based on **RTK+IMU+SLAM method**
- ❑ Good quality of point cloud, well distributed, with high precision
- ❑ Solve the problem of obtaining spatial data in indoor or other hidden areas in cities (cost, reliability, etc.)



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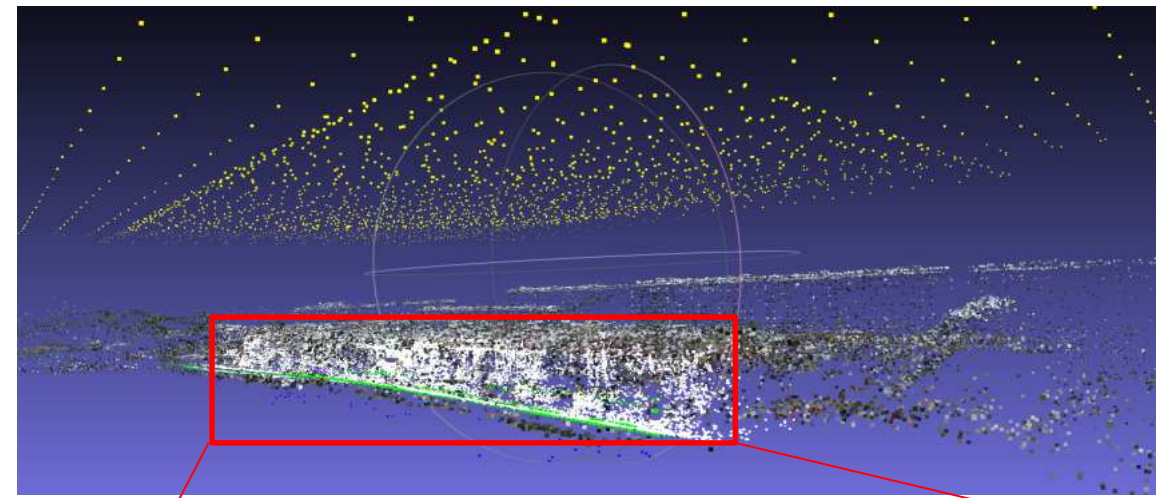
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Using aerial and ground images, automatic coarse registration and fine registration are performed using aerial and ground images with large scale differences.



Aerial Images

Ground Images



SfM + MVS

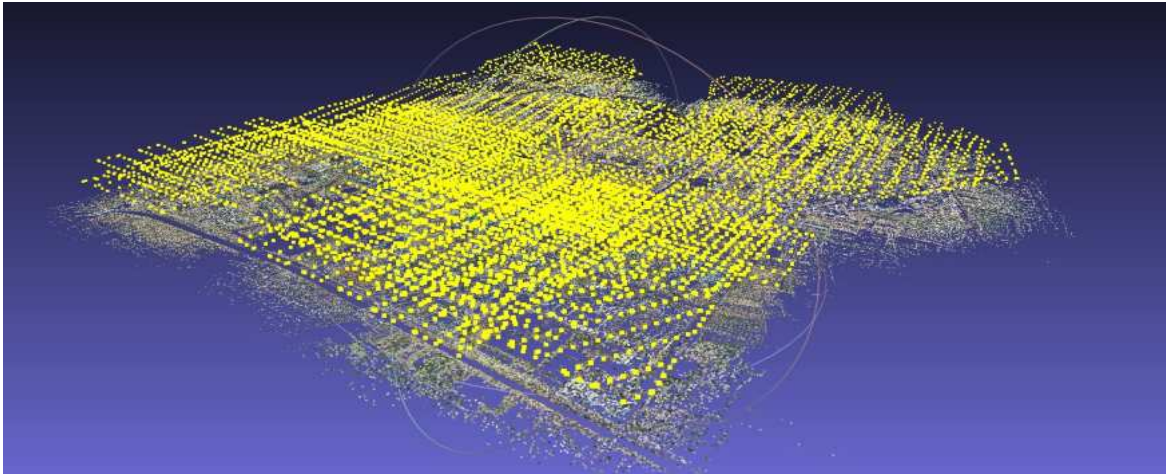
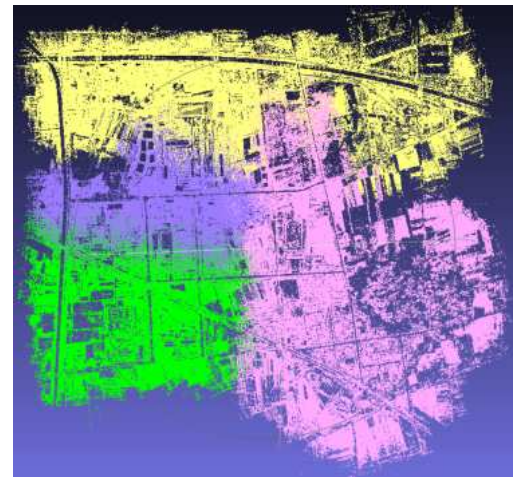
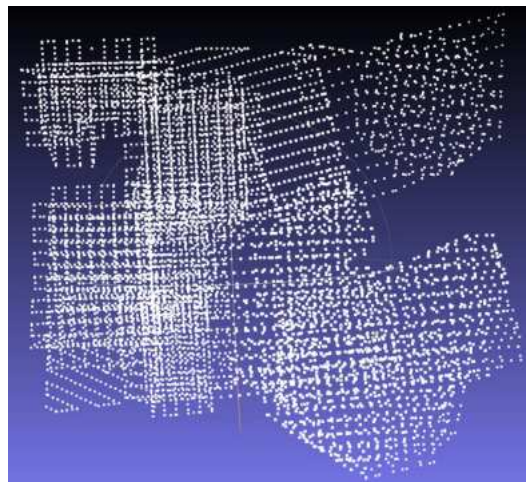


3D surface Models



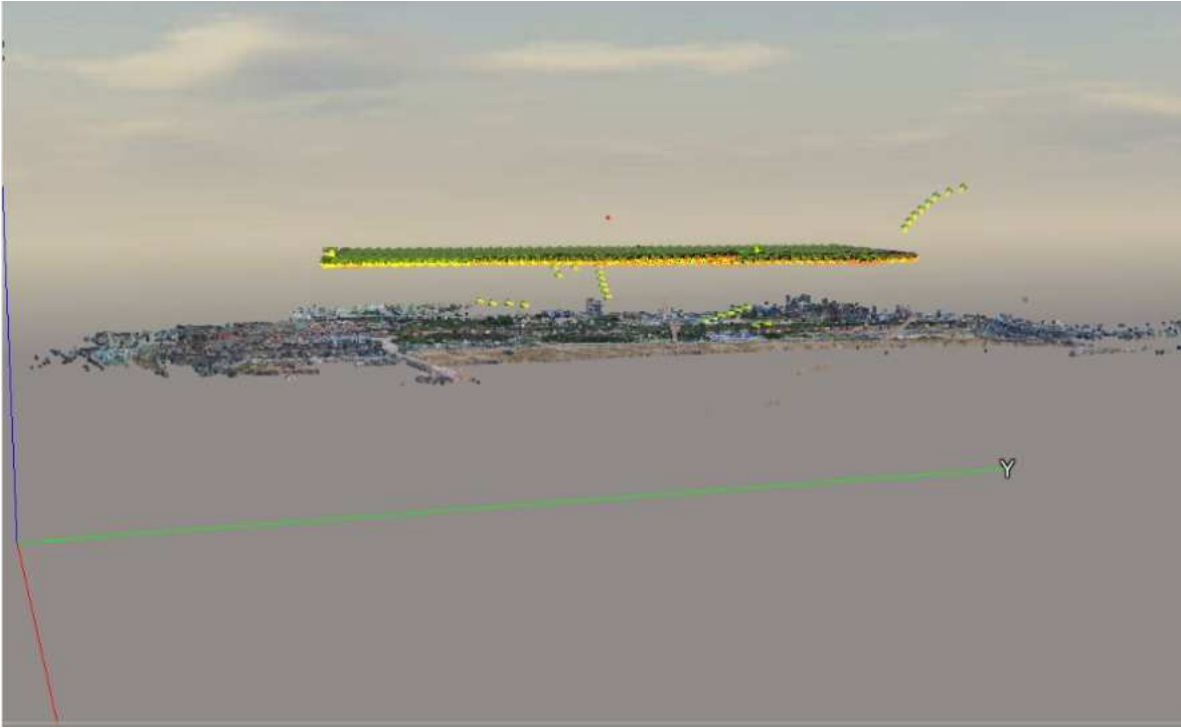
□ Powerful and stable aerotriangulation system

It supports aerotriangulation in one-click, cluster-parallel mode for massive (inclined aircraft/low-altitude drones, ground cameras) disordered images. It also supports GPS-assisted beam method high-precision adjustment, making it take into account the dual advantages of efficiency and accuracy when processing massive data.

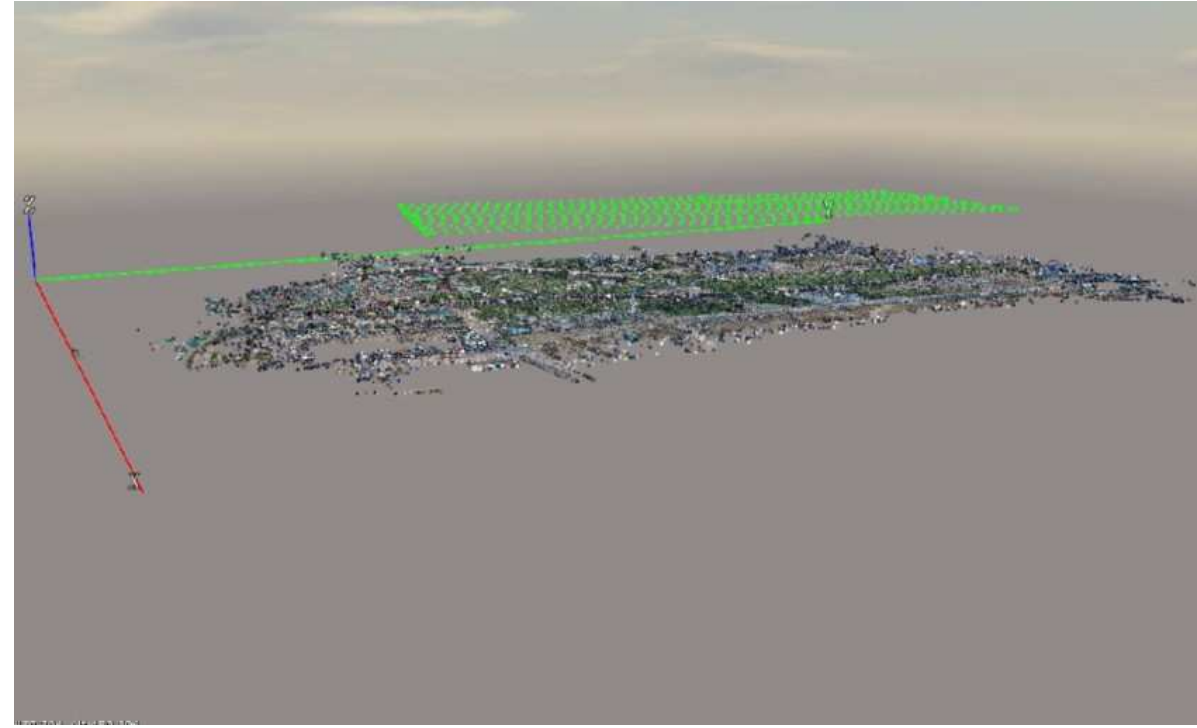


Distributed Bundle adjustment for large-scale scene

- **Robustness (Error tolerance)**



Aerotriangulation Results of a **well-known software** (it has a **layering problem**)



Aerotriangulation Results of **EntityMVE software** (it doesn't have the problem of layering)

- **Higher precision(Reprojection error)**

Keypoints: Median of 34871 keypoints per image

Tie points: 666605 points, with a median of 1379 points per photo.

Reprojection error (RMS): 0.54 pixels

Positioning / scaling: Georeferenced using photo metadata, not using control point

A well-known software

方差统计 Scene RMSE: 0.331021

残差直方图



EntityMVE software

Application of Automatic Repair of Water Surface Holes

The figure below is a comparison of the water surface models. It can be seen that the water surface model of **the well-known software** has many holes. The water surface model of **EntityMVE** has no hole, because it has automatically repaired these holes during the modeling process.



3D Model of **the well-known software**
(it has **some water holes**)



3D Model of **EntityMVE software** (it
doesn't have **water hole**)

Application of High Quality Texture Mapping

The figure below is a comparison of the road models of the two softwares. It can be seen that the textured model of **the well-known software** is more chaotic; the textured model of **EntityMVE** is more complete and uniform.



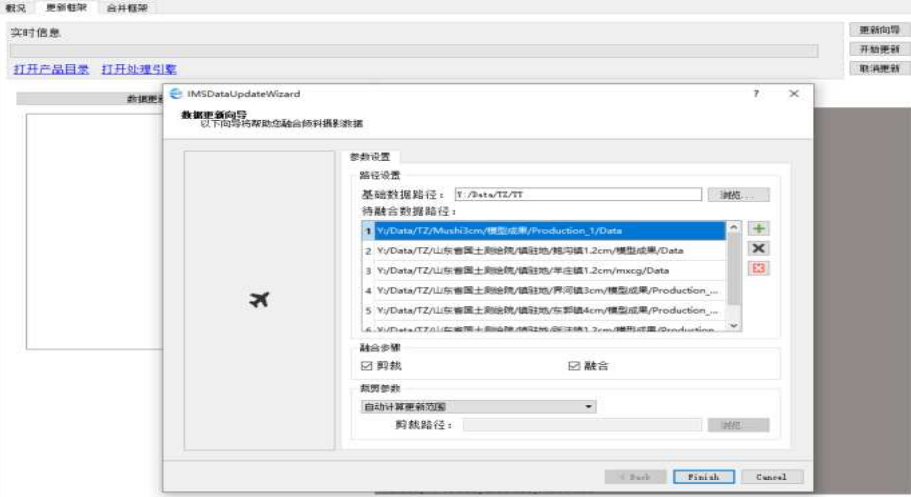
3D road model of **the well-known software**



3D road model of **EntityMVE software**

3D geographic scene automatic cropping and mosaic

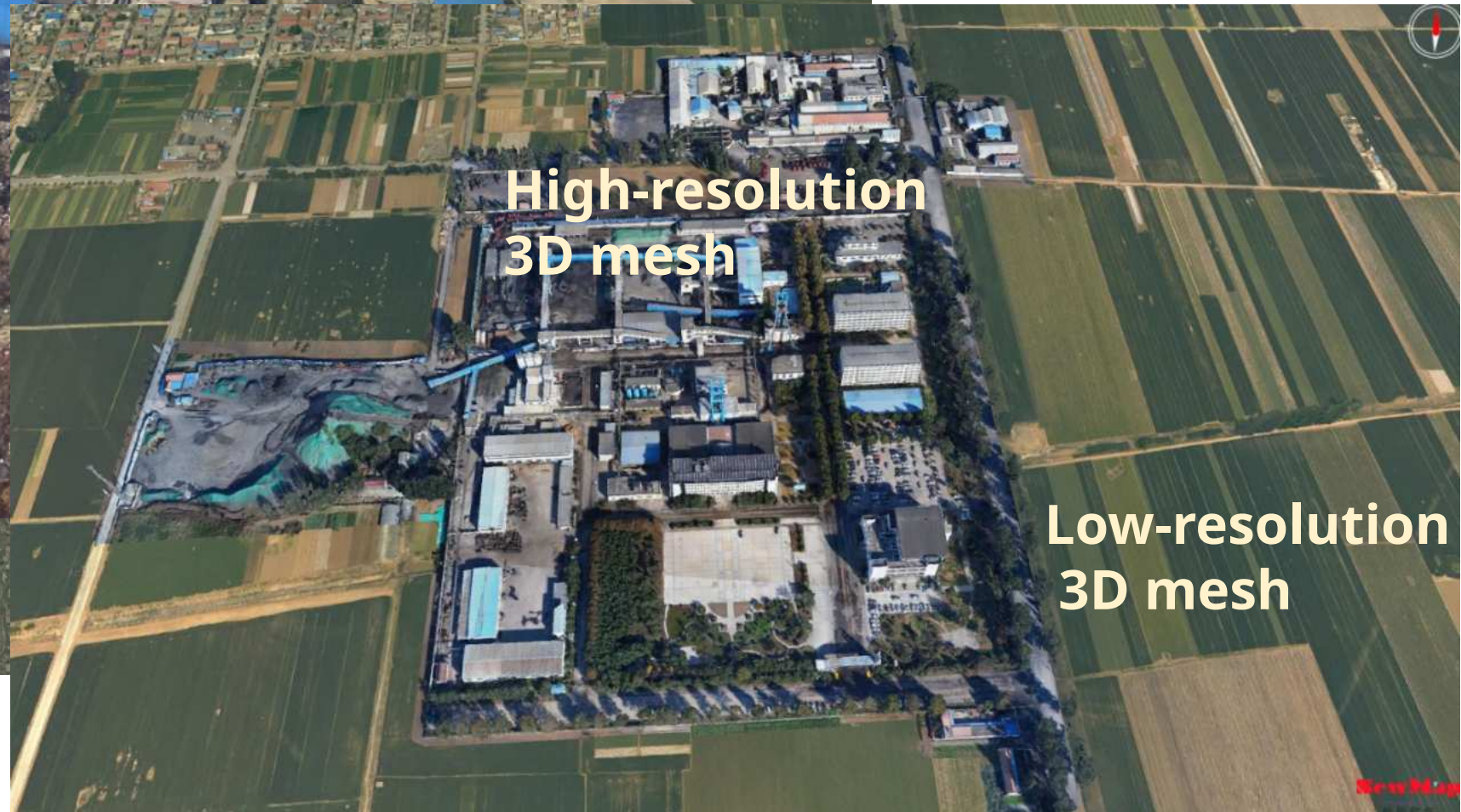
We develop automatic cropping and mosaic technology for 3D mesh models. It supports fully automatic, high-quality seamless mosaic of multiple sets of 3D Mesh models, which is convenient for users to manage multiple sets of data.



Applications of 3D mesh mosaic



Low-resolution tilted 3D model of town such as townships, industrial



High-resolution 3D mesh

High-resolution 3D mesh

Low-resolution 3D mesh

Before mosaic



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- All geo-entities are assigned unique spatial identification code;
- Follow the ISO/IEC1 5459 standard, and establish a globally unique identity for every geo-entity;
- A platform for fundamental geo-entity MA identification has been preliminarily established;

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基础地理实体MA标识管理平台

Basic Geographical Entity MA Marking Management Platform

新闻动态

News and Events

国研中心侯永志谈中国智慧城市建设：应用场景丰富、整体需求较大

由国研院发展研究中心主办的中国发展高层论坛2023年年会于3月25至27日在北京举行。在“投资新机遇：打造智慧城市”一书中，侯永志分享了从智慧城市建设的角度对中国城镇化引领作用的一些观点。

聚焦行业 稳步向前

自动驾驶2025年将有望“图”可依

高精地图前哨战打响 百度、高德、四维图新抢滩布局

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- The geo-entity has developed a globally unique MA identifier and generated a QR code icon
- Geo-entity data and real estate registration unit has been linked by code ;
- Implemented the application of "one code polymorphism" by entity MA identification

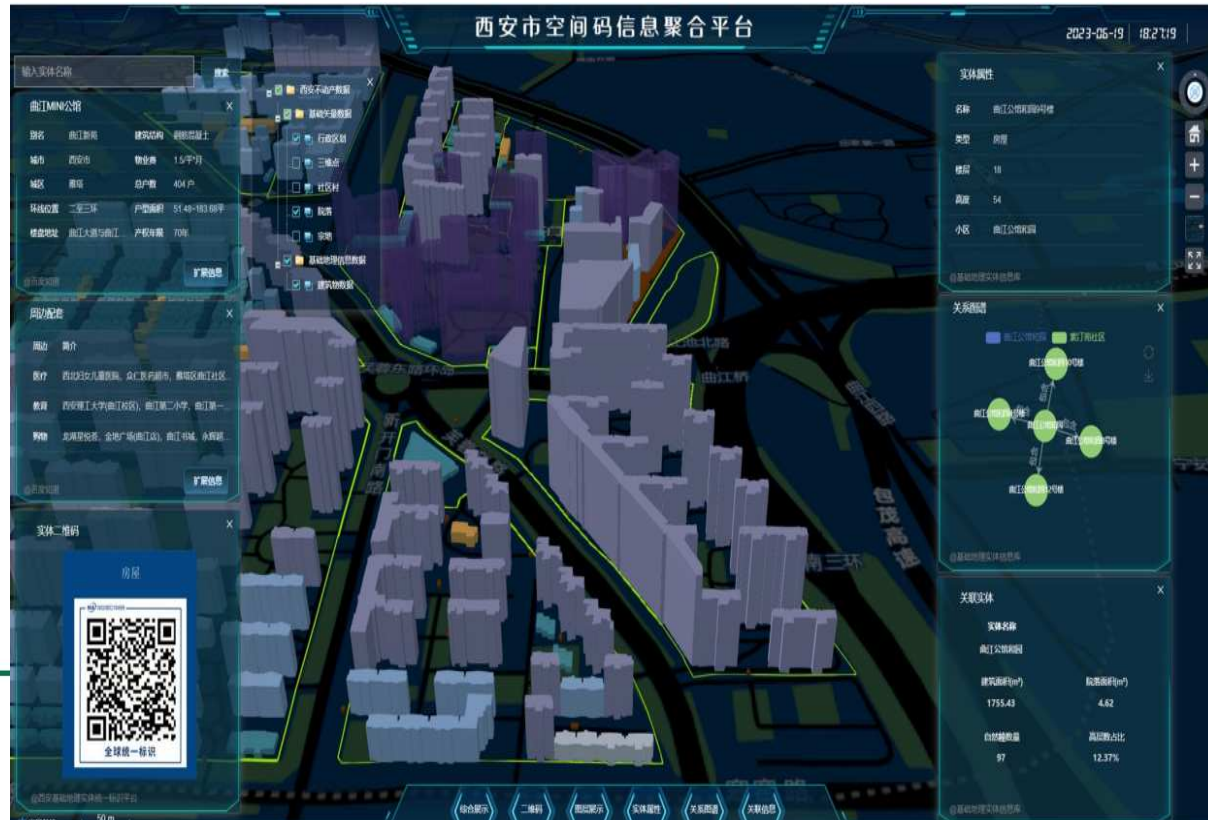


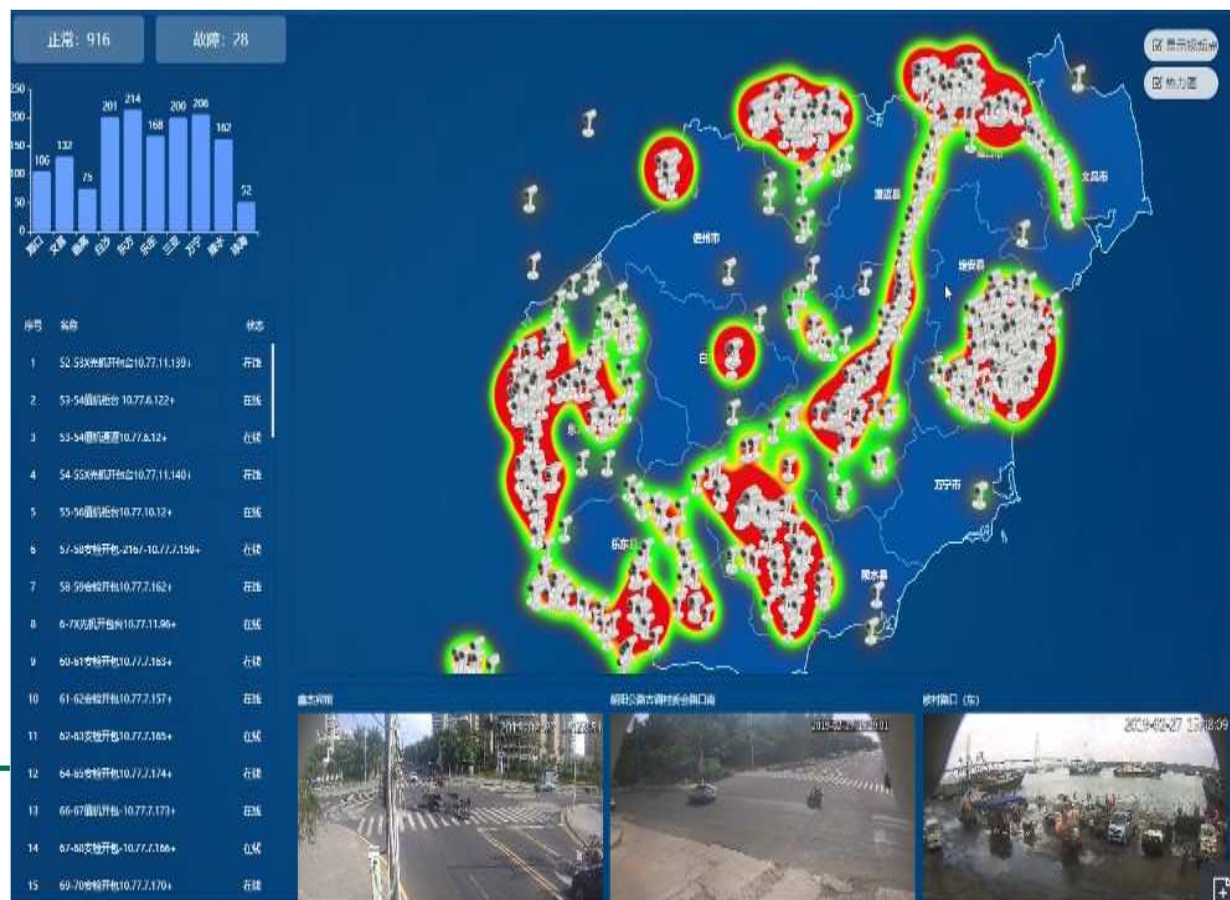


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With the support of AI information, navigation, and data fusion from IoT and Internet, 3DRS will be richer and more intellectual.



主题列表

请输入... 搜索

- 基础设施变化情报
 - 道路变化
- 突发公共事件
 - 地震
 - 火灾
 - 交通事故
 - 食品安全事件
 - 偷盗事件
 - 群体斗殴事件
 - 抢劫事件
- 土地利用违法情报
 - 违法建设
- 洪涝灾害
 - 城市积水

特征词与规则管理

1. 特征词列表:

序号	要素特征词	要素变化特征词	操作
1	主干道、公路、快速路、辅路、交叉路口、道路、高速、路、街、环、道、高架、国道、省道、县道、胡同、巷	新建、开工、动工、施工、新建、改线、拓宽、加宽、增宽、延长、延伸、东延、西延、北延、南延、拓改、大修、中修、小修、修缮、建成、通车、竣工、完成、东起、北起、南起、西起、东至、北至、南至、西至、修彩、交付使用	新增 删除

2. 筛选规则列表:

序号	规则	描述	操作
1	*[路街环道高速国道县道胡同巷]G[0-9][1,4]S[0-9][1,4]国道+[0-9][1,4]高速+[0-9][1,4]*[新建开工动工施工新建改线拓宽加宽增宽延长延伸东延西延北延南延拓改大修中修小修修缮建成竣工完成通车即交付使用]*		删除
2	*[新建开工动工施工新建改线拓宽加宽增宽延长延伸东延西延北延南延拓改大修中修小修修缮建成竣工完成通车即交付使用]*[路街环道高速国道县道胡同巷]G[0-9][1,4]S[0-9][1,4]国道+[0-9][1,4]高速+[0-9][1,4]*		删除



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Based on cloud native technology, build a computing and storage support environment for elastic expansion, high-performance computing, and domestic innovation to meet the needs of large-scale and efficient computing and storage.

The platform supports efficient scheduling and online services for massive (billions/100TB) real 3D tilted mesh, vector tiles, place name addresses, 3D models, and other physical data, supporting cloud management, computing, and cloud services for geospatial big data.

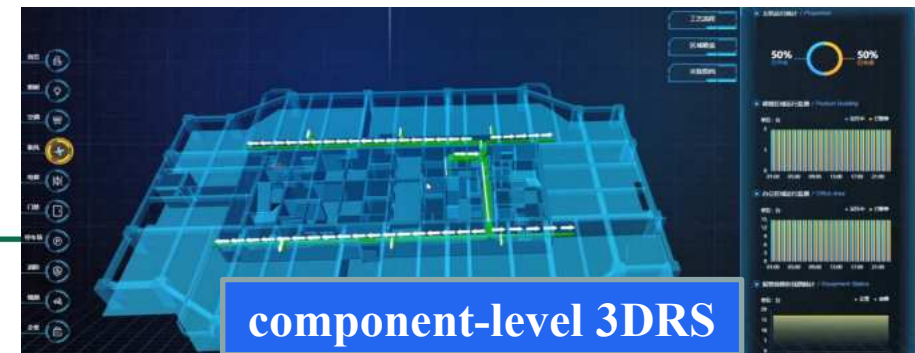




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We have broken through the key technology of large-scale 3D data visualization and built a rendering engine for integrated ground and under-ground, water and underwater, and indoor and outdoor scenes, achieving large-scale 3D interactive computing, dynamic simulation, and visual analysis.

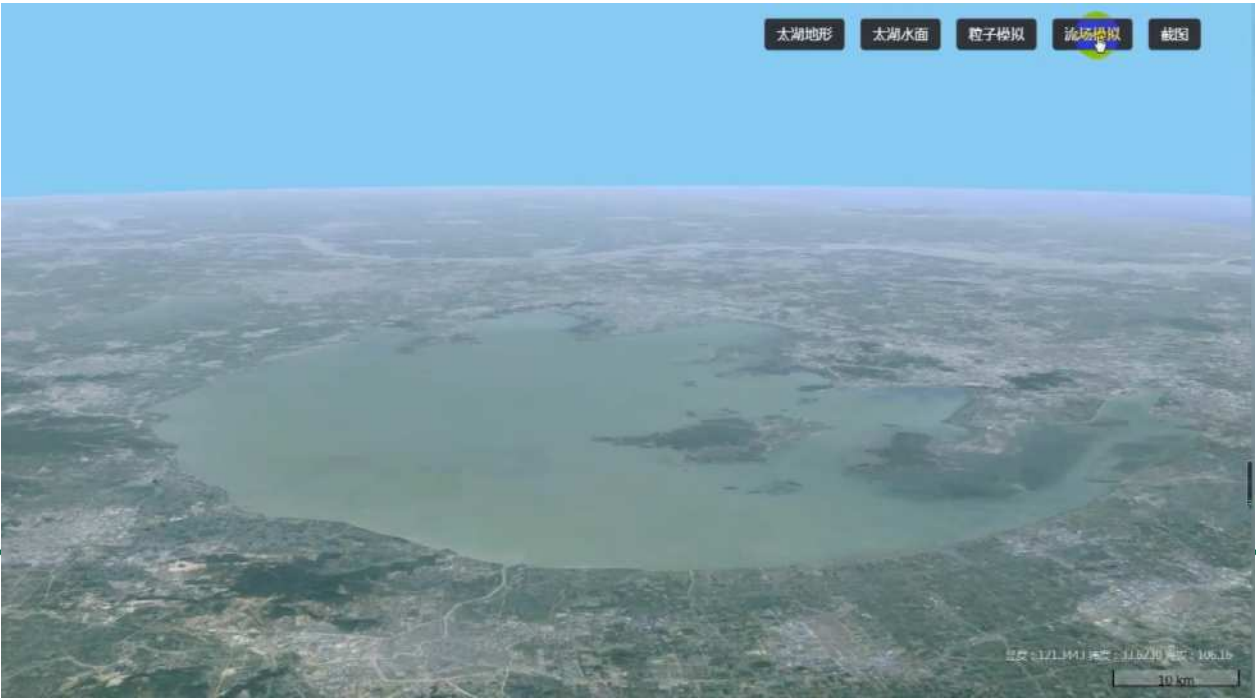




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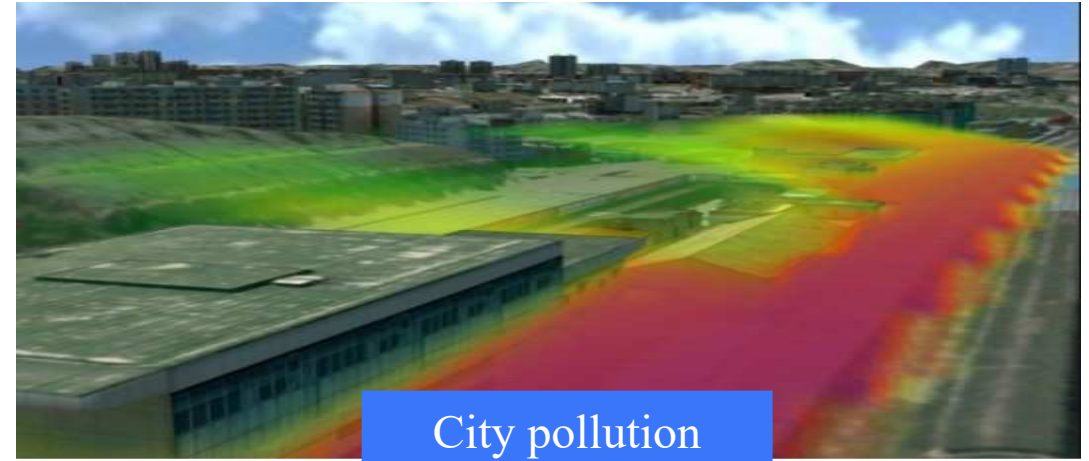
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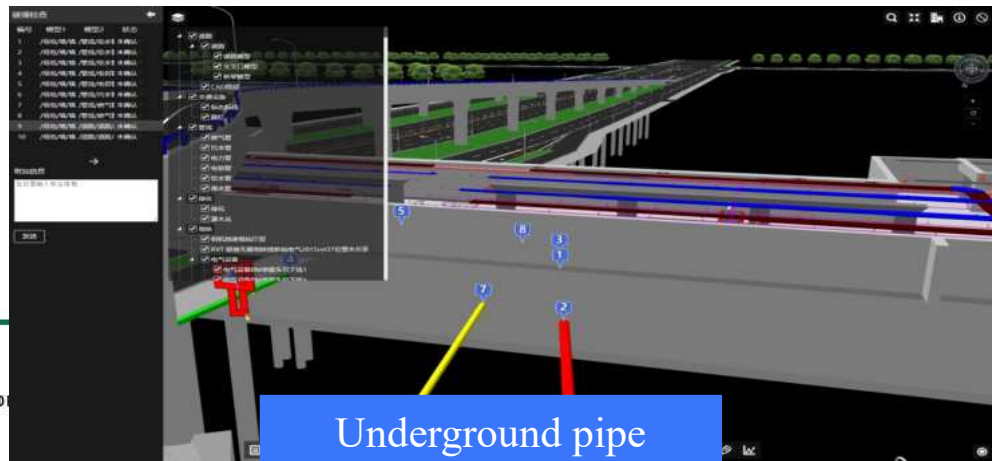
Along the construction of e-government, 3DRS is playing an important role in city planning, decision making and fine city management.



City planning



City pollution



Underground pipe



Fine management



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Key building and engineering safety monitoring : Due to factors such as wind, engineering construction and earthquake, safety accidents have occurred frequently in recent years. The system monitors the overall displacement and settlement of the building and calculates the corresponding indicators. When the inclination or settlement value of the building exceeds the preset threshold value, the system will immediately generate an alarm signal, initiate an emergency plan, and support personnel to evacuate in time.





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Breaking through the fusion processing technology of laser point clouds and panoramic images for complex scenes in substations and power lines, achieving fully automatic/semi-automatic modeling of complex scenes, serving power engineering construction.

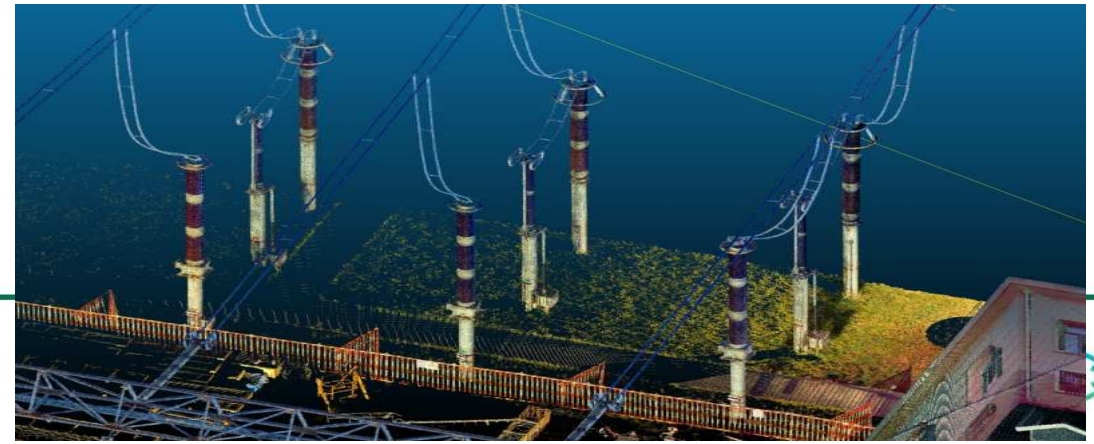




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As a real, three-dimensional and temporal information reflecting the production, living and ecological space of human beings, 3D RS will become an important new infrastructure.





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Thank you !

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