SUPERMAP COMMUNICATIONS

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GIS Empower Intelligent Management of Underground Pipelines

Who is SuperMap?

SuperMap was founded in 1997, is a platform software and application software manufacturer focusing on Geographic Information Software (generalized GIS) and Geospatial Intelligence (GI), and a key player in Information Technology Application Innovation Industry, Spatio-Temporal Big Data, Artificial Intelligence, and Virtual Reality. It consists of SuperMap Software (parent company, stock code: 300036), wholly-owned subsidiaries, and holding subsidiaries, as well as domestic branch offices and agencies. In 2022, the total staff number of SuperMap is more than 4,300 and the annual revenue reached 232 million USD (1.6 billion RMB).

1997
Founded

How has SuperMap performed so far?

Together with more than 3,000 Independent Software Vendor (ISV) partners and hundreds of thousands of developers, SuperMap empowers the informatization of governments and enterprises in nearly 100 industries. It has developed distributors and partners in over 50 countries and SuperMap GIS end users in over 100 countries. Now, SuperMap ranks 1st in the GIS software market in Asia and 2nd globally.

100+
Countries'
Users

What will SuperMap be?

With “Innovate Geospatial Intelligence, Elevate IT Value” as the mission and “Light up Every Corner of the World with Geospatial Intelligence” as the vision, SuperMap will keep providing advanced GIS technologies and products to more global users.

1000+
Partners

4300+
Employees

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FOCUS

GIS Empower Intelligent Management of Underground Pipelines

Infrastructure plays an important part in ensuring the normal operation of a city. With urbanization and the building of modern cities, there is an increasing demand for infrastructure upgrades and the digital transformation in infrastructure management. Underground pipeline can be a typical example as pipelines in most cities in the world were built in early stages and the traditional ways of management such as 2D mode are not "intelligent" enough to meet the needs for efficiency and convenience in modern times. Thanks to technological development, more and more technologies such as digital twin and 3D can be adopted to provide solutions for underground pipeline management to ensure normal operation of underground pipelines and thus further protect a city's lifeline. In this SuperMap Communications Issue 11, let's focus on SuperMap's application cases in underground pipeline management and explore what's the next step in intelligent underground pipeline management.

Using AR+GIS, Beijing City Sub-Center Took the Lead in Implementing a District-Wide Census of Underground Pipelines

Open the mobile APP, and a clear 3D map of the "underground venation" of Beijing's sub-center appears. Click on a road at will, and you'll see the water pipes, drainage, street light pipelines, etc. under the road surface at a glance. In 2021, Tongzhou District, Beijing applied AR technology to its underground pipe network system for the first time to complete the census of underground pipelines. The AR technology has helped solved problems that couldn't be detected and figured out in the past. This 3D platform for underground pipelines in Beijing's sub-center (hereinafter referred to as the "platform") that integrates with AR technology is built on SuperMap GIS platform and was selected as China's Annual Virtual Reality Pioneering Application Case in 2023.

The platform solves three major problems

1. Difficulty in data fusion: the underground pipeline data not only includes traditional structured data such as vectors, terrain, and images, but also unstructured data such as construction drawings at the initial stage, real-time sensing of the Internet of Things, video surveillance, and BIM, so data fusion is difficult.

2. Difficulty in 3D modeling: Underground pipeline data sources are increasingly abundant, and the traditional 2D pipeline management model can no longer meet users' actual needs for analysis, expression, and application of pipeline and its big data information. However, the construction cost of 3D models is high. The matching effect between the nozzles and pipelines of the pipe point model is poor, and the business attribute information needs to be entered into the 3D model again from the point and line data sets. As a result, two sets of data need to be maintained at the same time, which cannot be updated in real time.

3. Difficulty in dynamic supervision: underground pipelines are highly concealed and are mainly maintained through daily inspections. There is a lack of monitoring of the operating status of the pipeline network, making it difficult to identify potential safety risks. When a fault occurs, it is not possible to dispatch maintenance personnel who are close to the facility for repairment, the fault cannot be quickly and accurately located, and historical data cannot be effectively utilized. Therefore, there is an urgent need to install "see-through eyes" for the pipe network to meet the needs of daily intelligent inspection.

Technological Innovation

1. This system is the first in China that applies AR visual sensing technology to underground pipeline management*. It superimposes the real environment and the 3D data of the underground pipelines onto the same screen in real time, making the relationship between underground pipelines and ground buildings clear at a glance. It can not only realize intelligent inspection of underground pipelines, but also view the properties of pipelines, manhole lids, valves and other facilities in real time, improving the accuracy of inspection, reducing the risk of accidents, and improving the efficiency of fault alarm and maintenance.

2. Through the multi-source data fusion technology, the data like BIM, Internet of Things, video and other traditional image, vector, terrain data are integrated. This has helped achieve seamless integration of multi-source heterogeneous data and supported the business collaboration and data sharing across different departments.

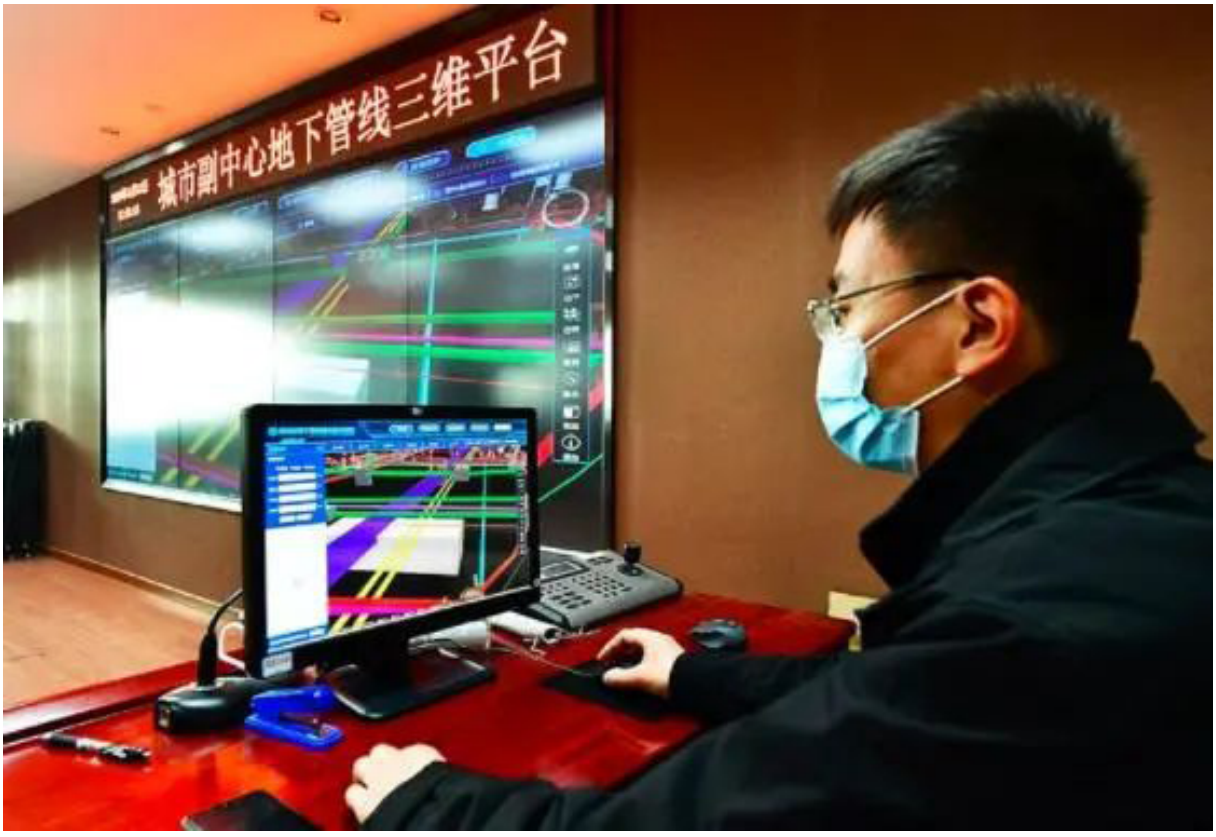
3. Innovative research and development of 3D pipe points, pipelines and adaptive pipe point symbol technology based on 2D and 3D integration provide technical support for the system in rapid construction of 3D pipelines, massive data carrying capability and application analysis of 3D pipelines.

4. Using BIM+GIS technology, it has constructed refined "virtual pipelines" and surrounding environments, achieving precise location matching between pipeline BIM and large-scale surrounding environments, and improved management efficiency.

In 2020, the system data has covered all underground pipelines within the scope of municipal roads in Tongzhou District, Beijing. The pipelines undertake transmission tasks in 8 major fields and 14 subcategories, including water supply, sewage, gas, electricity, telecommunications, and heat supply, with a total length of 9,900 kilometers.

During the actual application process, the platform provides functions such as road excavation analysis, pipeline aging early warning analysis, pipeline collision analysis, and historical data comparison

**Source: Beijing Tongzhou District People's Government http://www.bjtzh.gov.cn/bjtz/xxfb/202101/1333256.shtml*



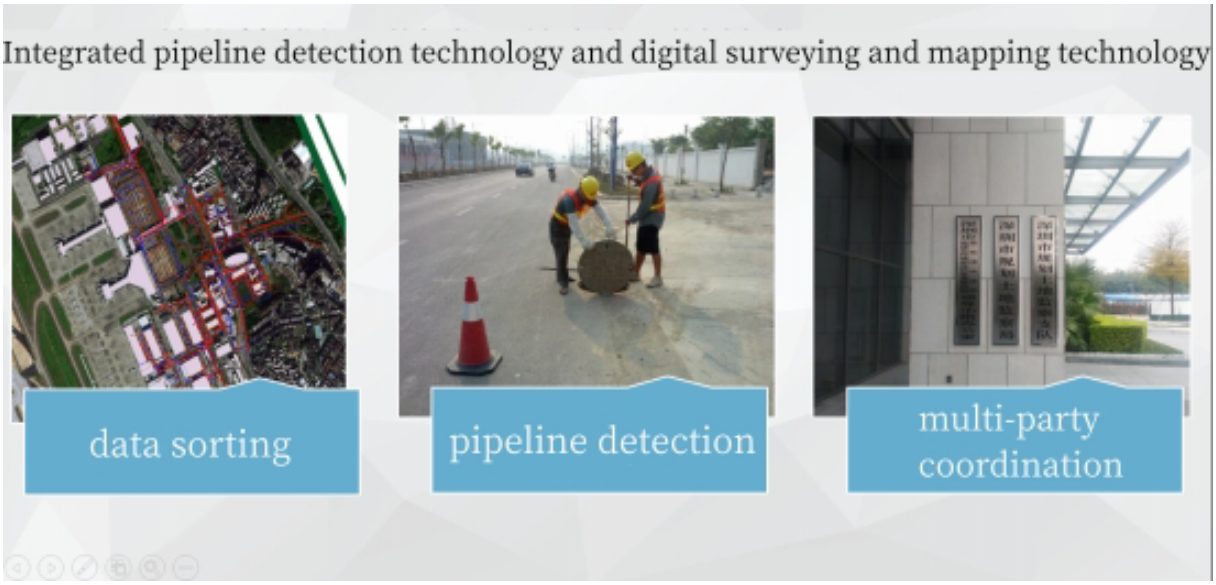
analysis through the underground pipeline information system. It has provided application support for multiple major projects during the construction of the sub-center. For example, it has provided the pipeline data analysis services for major projects such as sponge city planning and design, construction of public security project, landscape renovation of main roads, and simultaneous renovation of the sub-center and old city, which has ensured the safe operation of the city's lifeline.

In the future, the platform will continue to explore the application functions of above-ground urban 3D data, urban components, underground pipelines and auxiliary facilities, traffic signals and other data, and build a smart city data ecosystem to realize smart response to emergencies. Through the real-time collection and analysis of information about people, vehicles, objects, places, and events, the platform links and correlates data of pipeline safety risks, accidents, etc. to achieve immediate detection and control of complex scenarios. For emergencies that have occurred, the platform can combine big data analysis and algorithm analysis to automatically plan emergency repair routes, formulate optimal emergency repair plans, and dispatch surrounding mobilizable resources at any time.

How to “Smartly” Manage Numerous Pipelines at the Airport?

Shenzhen Bao'an International Airport was built in 1991. For more than three decades, the pace of construction has continued to accelerate. With more and more underground pipelines laid, the contradiction between the underground pipeline construction and aboveground management has become more and more prominent: the airport lacks complete and updated basic data of underground pipelines. The "zipper" phenomenon in road construction and underground pipeline accidents caused by blind design and construction occur from time to time, which not only cause huge economic losses, but also bring hidden dangers to the safe operation of airports.

In view of the problems existing in Shenzhen Airport's underground pipeline survey and detection and the integrated management of pipeline information, such as low operating technology, backward information management and imperfect management mechanisms, SuperMap took the lead and developed the “the Comprehensive Management System of Shenzhen Airport Underground Pipeline” and “Public Service Platform of Shenzhen Airport Geographic Information”. The platform and the system have been approved by the expert group and put into use at Shenzhen Bao'an International Airport. The project comprehensively applies advanced technologies such as surveying and mapping, geophysical prospecting, and GIS, integrates advanced management concepts, proposes a new model of pipeline census and information management, realizing comprehensive and dynamic management of pipeline information.



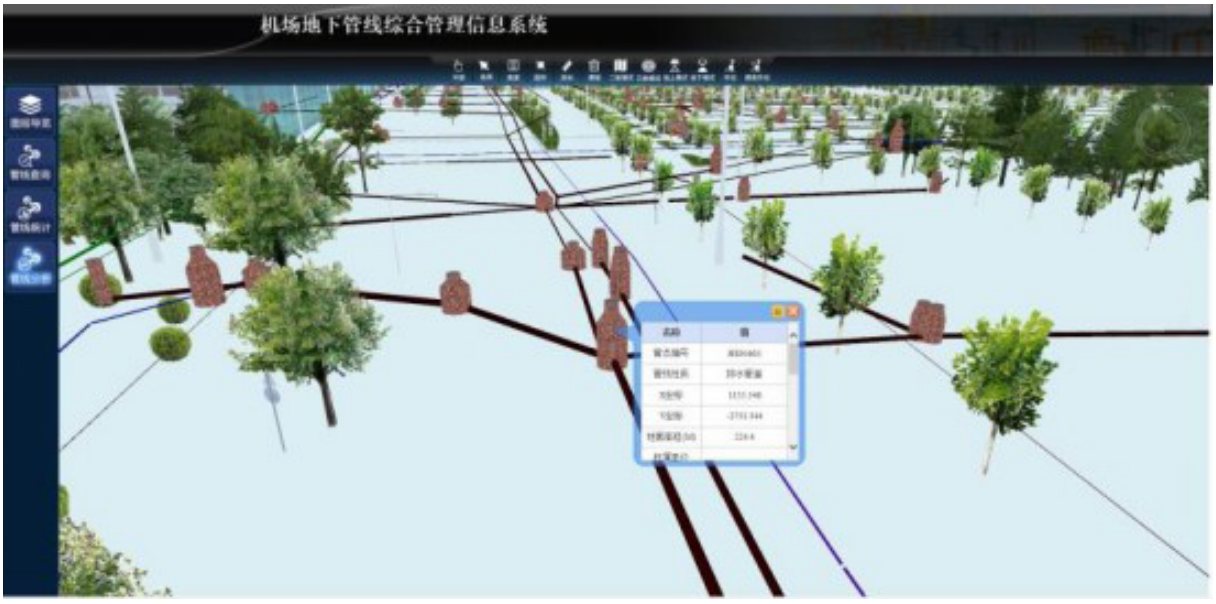
Multi-source data collection and fusion

The project takes the underground pipeline management system as the core. It uses GPS technology combined with data collection and data processing methods to establish a control network. It uses integrated pipeline detection technology and digital surveying and mapping technology to simultaneously collect the spatial coordinates, attribute data, surveying and mapping strip topographic maps of underground pipelines, and compile underground pipeline maps, laying a solid foundation for flexible management of the airport.

Using SuperMap SDX plus spatial database engine technology, the project integrates Shenzhen Airport topographic maps, high-resolution remote sensing images, above-ground 3D models and underground pipeline data to achieve multi-source heterogeneous data fusion and management.

“One map” of airport geographical information

The construction of the project integrates various thematic geographical information data such as airport topographic maps, above-ground 3D data, underground pipeline 3D data, remote sensing images, DEM, place names and addresses, etc., forming a "one map" of Shenzhen Airport's geographical information and realizing effective integration of the airport pipeline life cycle information resources.



2D and 3D integration to efficiently improve pipeline management

SuperMap 2D and 3D integrated GIS technology is used to quickly generate 3D scenes from pipeline census data through 3D automatic pipeline processing tools, and realize the integration of 2D and 3D pipeline data in data models, data storage solutions, data editing and management, visualization and analysis functions.

Shared, diverse and integrated applications

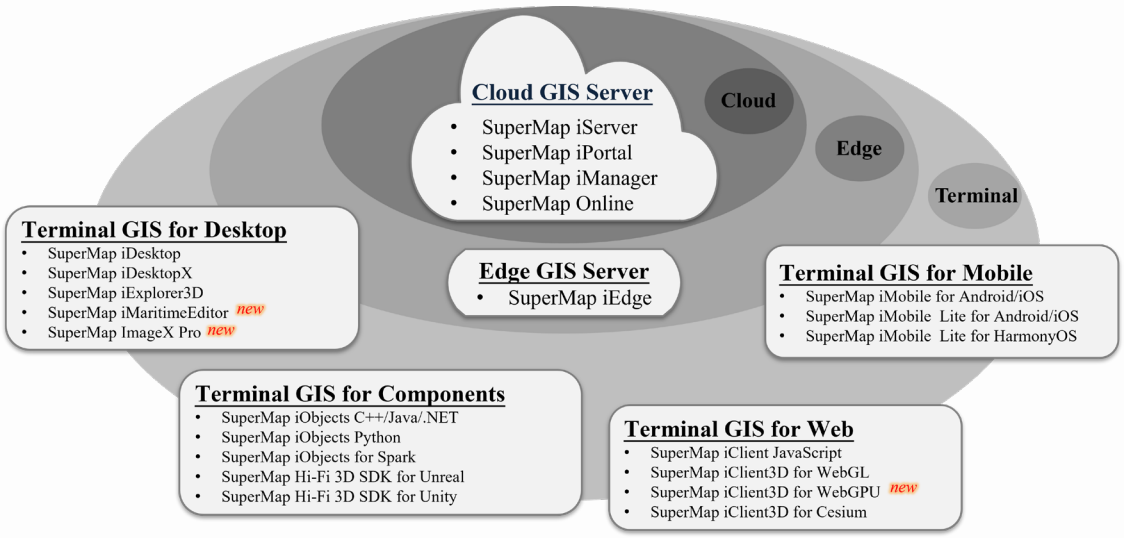
The project establishes an underground pipeline data management service center, pipeline database, data exchange platform and airport local area dedicated network, and then interconnects the pipeline data management center and professional pipeline ownership units by centralized management and information sharing of underground pipeline data. In this way, the modernized management and diverse application of pipeline information.

Based on the service-oriented architecture, an airport geographical information public service platform has been established. It connects to the Shenzhen Airport intranet system, realizing the sharing and exchanged of pipeline information and geographical information in an integrated way, and integrated application on the Web, PC and mobile terminals.

Products

What is SuperMap GIS

SuperMap is devoted to developing and providing the most innovative Geographic Information System (GIS) platforms and solutions for global customers. SuperMap product line includes a full range of GIS platforms, including Desktop GIS, Server/Web GIS, Mobile GIS, and Online GIS, which makes SuperMap GIS known as one of the most complete GIS software platforms.



SuperMap GIS 2023 Product Architecture

SuperMap iDesktop: Full-featured Customizable Desktop GIS

SuperMap iDesktopX: Full-featured Customizable Cross Platform Desktop GIS

SuperMap iExplorer3D: 3D Scene Browsing Software

SuperMap iObjects: Full-featured Components GIS SDKs

SuperMap iTablet: Native App for Mobile GIS

SuperMap ARSurvey: AR field surveying tools for Mobile GIS

SuperMap UAV Survey: UAV field survey and annotation software

SuperMap iMobile: Native SDKs for Mobile GIS

SuperMap iServer: Full-featured Application Server for Cloud GIS

SuperMap iPortal: Portal for Cloud GIS

SuperMap iClient: Web GIS APIs for Browsers

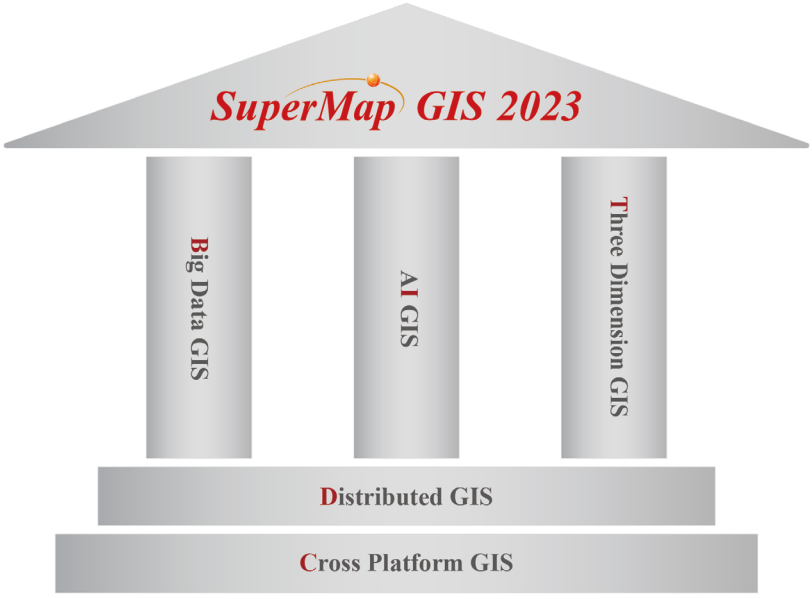
SuperMap iManager: Operation Manager for Cloud GIS

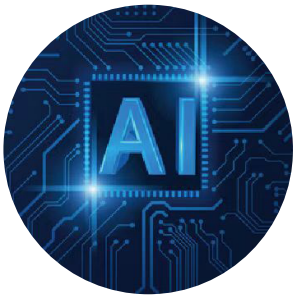
SuperMap iEdge: Server for Edge Computing GIS

Application Cases

Technologies

In SuperMap GIS 2023, SuperMap has further improved the five key technologies system (BitDC) of GIS platform software, they are big data GIS, AI (artificial intelligence) GIS, new 3D GIS, distributed GIS and cross-platform GIS technology, which enriched and innovated GIS theory and technology, and empowered the informatization of various industries.





“One Map” Solution for Campus—3D Underground Pipeline System

SuperMap GIS, Beijing Bolue company, and Tsinghua Tongheng Planning and Design Institute have built a strategic partnership. Concerted efforts have been made in GIS solutions for underground pipelines informatization on the campus, and GIS education with the characteristic of integrating teaching and practice for students majoring in tourism, urban planning, architeacture, civil engineering, etc.

A 3D underground pipeline system is established after on-site investigation and data collation. The system manages data utilizing sensing technology and implements the visual management and dynamic monitoring of underground pipelines on the campus.

The 3D Underground Pipeline System, in conjunction with the APP system, can provide accurate and detailed data, and location information at the construction site to avoid construction accidents and repeated construction, thus saving resources and time, and greatly facilitating supervisors' work.

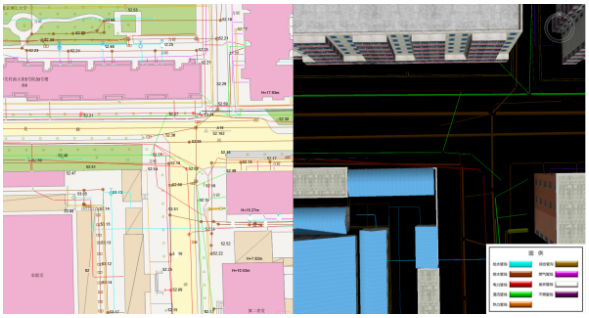
The system is attached with functions of digital campus exhibition and decision aids, which give play to school publicity, new students welcome, available classroom (exam room) inquiry, real estate management, greening & cleaning, fire drill, school field planning & construction, etc.

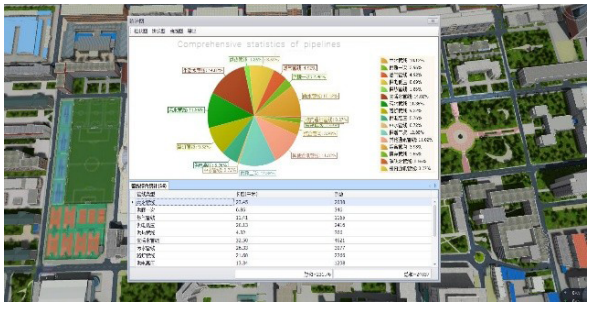
Browsing: The system supports hot spot navigation, above-ground (underground) browsing, road excavation browsing, 2D-3D integrated browsing, etc. (in layers).

Query & statistics: the system can query and locate the attributes of the pipeline, such as category, diameter, material, date of embedding, characteristics, and facilities, and performance statistics and export according to these attributes.

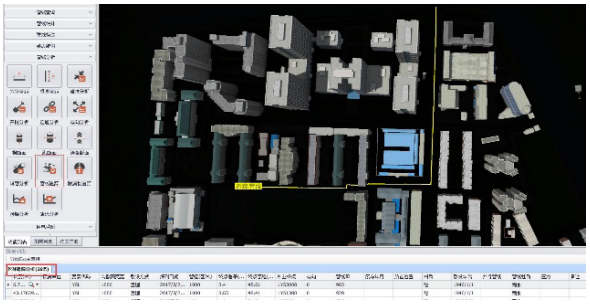
Platform connection: the system has an open interface, and can be connected with the existing energy platform or other relevant platforms.

Analysis: the system supports section analysis, soil analysis, pipeline burst analysis, flow analysis, collision analysis, net distance analysis, tracking analysis, etc., which can facilitate construction and maintenance of the campus.

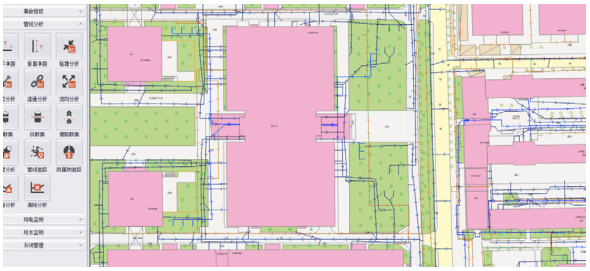




Pipeline tracking analysis:



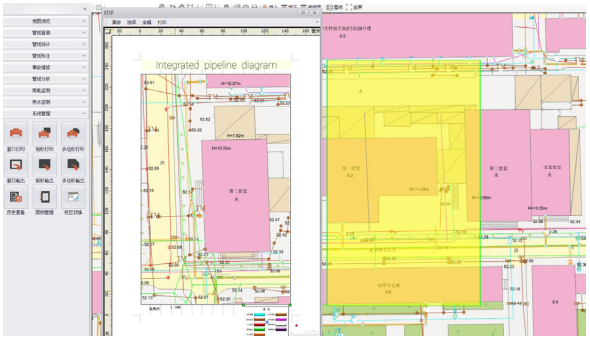
Pipeline flow analysis:



The analysis of building electricity consumption: data analysis of various dimensions is carried out based on smart electricity meter data, and big data analysis of the platform is conducted for visualization management.

Side leak check: according to the intelligent monitoring of the water supply network and the analysis of the data returned by the IoT equipment each day, the location of water leaks can be predicted.

Drawing management and updates: the system contains 2D CAD drawings which can be exported, and 3D pipelines can be directly altered in the system, which is easy to operate and update.

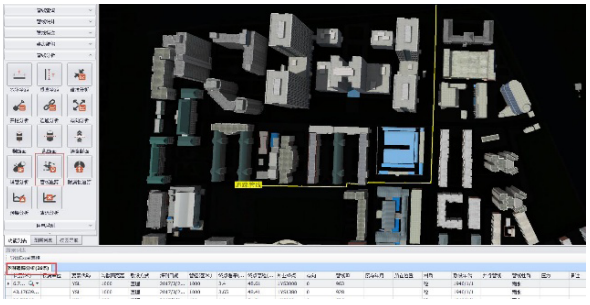


Repairs: the system can analyze the scope of pipeline accidents and record damages and repairs.

Measurement & labeling: the system can calculate the length, area, and elevation of 3D data; it can mark pipe diameter, buried depth, and elevation of pipelines.

Publicity: the real 3D scenes on the ground in the system can be linked to the school website.

Real estate management: combined with the 3D model, the real estate is integrated with complex attribute data, CAD drawings to implement queries, statistics, uncover the display of real estate resources.



Auxiliary planning: the system supports school building planning and design through buildings management, sunshine analysis, shadow analysis, dynamic visual range analysis, etc.

Welcome work for new students: freshmen can register by themselves after installing the welcome APP, which serves dormitory search, one-card handling, etc.

Greening management: collect the information of all trees and meadows in the school, and make inquiries and statistics through the system to combine information and graphics.

Indoor pipeline network analysis system: BIM modeling for building supports the integrated management of above-ground and underground pipelines and the integrated management of indoor and outdoor pipelines. It can also carry out the functions of viewing, checking, statistics, and analysis of indoor scenes.

Smarter 3D Utility Management in Germany with SuperMap GIS

1. Background: Urban underground utilities are a big part of urban infrastructure. Its stable operation is vital to the normal operation of a city. Germany is one of the countries with early urbanization development, whose urban pipelines are characterized by density and complexity of spatial locations and varieties, including water supply, drainage, gas, heat, electricity, communication, etc. The traditional 2D underground utility management mode is comparatively less intuitive and could not meet the current practical needs of 3D expression, spatial analysis and application of urban underground utility. Therefore, a 3D GIS system for integrated management of urban underground utility is now showing its necessity for a modern city.

2. Objectives of the system: The system integrates the data of various pipelines in the Döteberg region of Germany and conducted a unified information management, which digitalizes the underground utility network and achieves the 2D-3D integrated management.

The system is built based on the following objectives:

1) Improve the management ability and efficiency of relevant management departments for underground pipelines;

2) Provide information resources for urban planning, construction and management;

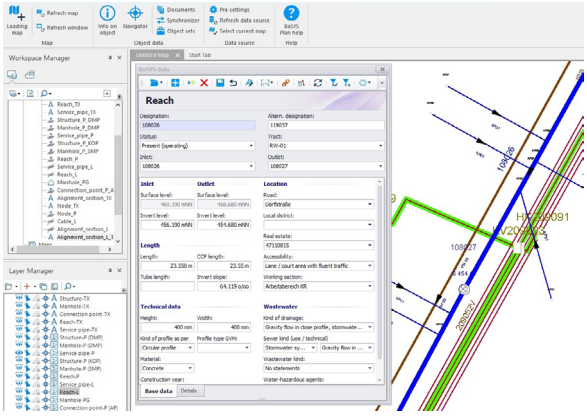
3) Provide data support for smart city construction;

4) Provide decision support for urban sustainable development and disaster prevention and reduction.

3. Key technologies

3.1 Rapid development of component products based on SuperMap iObjects .NET

The system adopts SuperMap iObjects .NET component development platform. As a service-oriented enterprise GIS platform product, it enables users to quickly build professional and powerful application software. SuperMap iObjects .Net is equipped with rich GIS functions, and the granularity of function modules is reasonable, so that users can obtain customized functions tailored for their own business through modular combination according to their actual needs.



3.2 Efficient pipeline data processing flow

Pipeline data usually comes from construction design drawings, geophysical prospecting data and underground

surveying. SuperMap GIS platform supports a variety of mainstream data formats and different data import modes, so as to meet the needs of data processing in actual business and improve data processing efficiency. SuperMap GIS also provides rich pipeline data inspection and processing tools, such as format conversion, topology checking, coordinate conversion, object editing, etc., which can quickly implement the preprocessing of pipeline data.

3.3 Comprehensive application of 2D and 3D integration technology

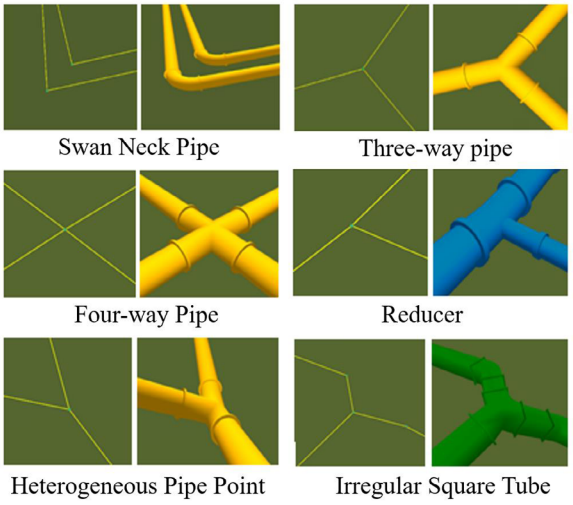
In terms of rapid construction and application analysis of 3D pipelines, SuperMap provides a fast, efficient, perfect and practical technical scheme. Thus, it can integrate data management, application development, 2D and 3D expression, symbol system and analysis and application functions. In particular, it is widely used in urban planning, engineering facilities management, etc., providing decision support for multi-industry applications in smart cities.

3.4 Multi-source data integration technology

The 3D pipeline scene involves the organization and management of multi-source data. The multi-source 3D data integration technology based on SuperMap supports oblique photogrammetry model data, architectural design model data, point cloud, underground 3D pipeline, terrain and other data. This technology breaks through the technical bottleneck of loading and managing massive 3D data, and provides an open, standard and universal data foundation for 3D spatial data sharing and interoperability between different application systems. At the same time, it is also compatible with a variety of software and hardware environments, which greatly reduces the costs of construction, management and maintenance of the 3D GIS application system.

3.5 Customized 3D pipeline symbol library

SuperMap innovatively developed 3D pipe point, pipeline symbol and adaptive pipe point symbol technology based on 2D and 3D integration technology, and provided users with a rich default symbol library to help users quickly build 3D pipeline scenes.



3.6 3D special effect based on high-performance particle system

SuperMap GIS not only supports a variety of 3D special effects, but also provides a high-performance particle system, which can be great support for the construction of high realistic 3D scenes. It can be used to simulate natural phenomena such as flame, fountain, rain and snow. SuperMap particle special effect system has been widely used in emergency relief, meteorological simulation, etc.

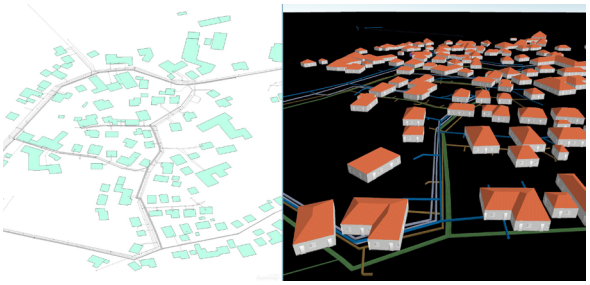
3.7 Ability to visualize massive data

SuperMap GIS provides a variety of technologies to improve rendering performance, including engine rendering technology, LOD technology, batch rendering technology, texture compression technology, large file storage and other technologies. LOD multi-level of detail technology also ensures the rendering effect and the stability of massive data loading, so as to successfully solve the technical problems such as the display and management of massive 3D pipeline data.

4. Functions of the system

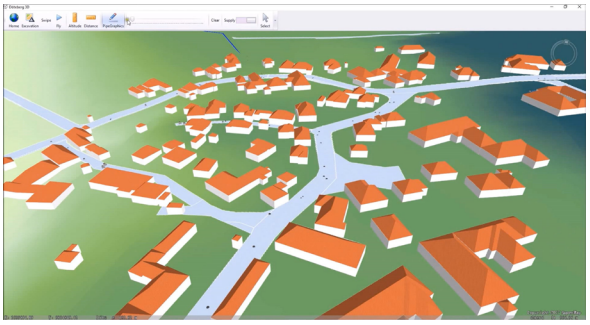
4.1 2D and 3D integrated display

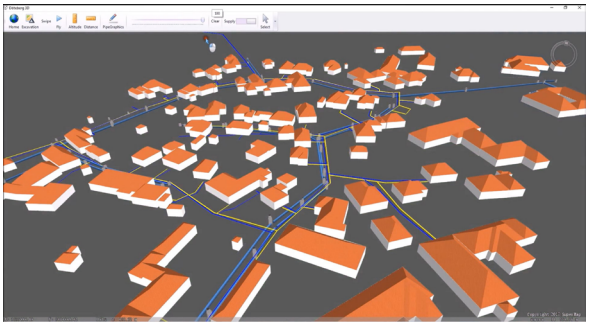
This function supports browsing different pipeline data and above-ground and underground space data. It can load and remove pipeline layers in maps and scenes by checking the tree menu node in the layer control, and provide users with intuitive 2D and 3D data browsing functions.



4.1.1 Transparency control of underground pipeline

This function can control the visible and hidden effects of underground pipelines by adjusting the transparency of the surface, so as to meet the needs of a variety of visual effects.

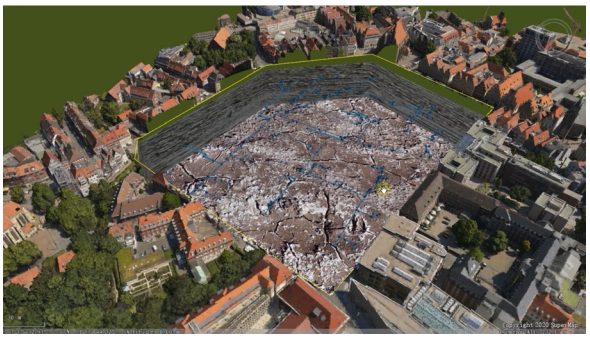


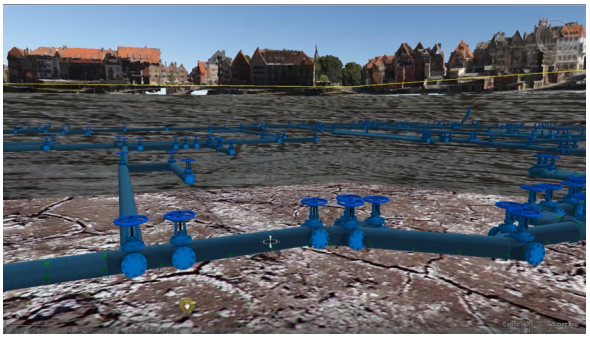


4.1.2 Overlay display with oblique photogrammetry data

When the pipeline is damaged and burst, this system can quickly locate the position and address of underground pipelines through the combination of oblique photogrammetry data. At the same time, it can also analyze the impact range and other information that may be brought to the surrounding

areas, so as to carry out rapid visual guidance and accurate data analysis, and provide data and technical support for the rapid formulation of emergency decision making.

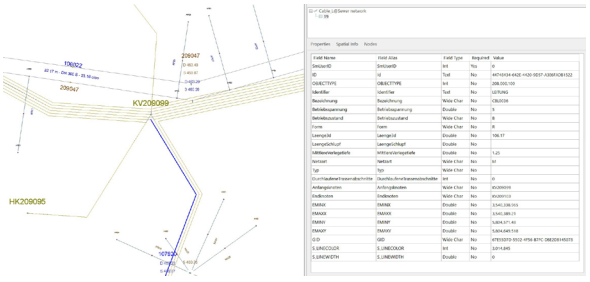




4.2 Pipeline information query

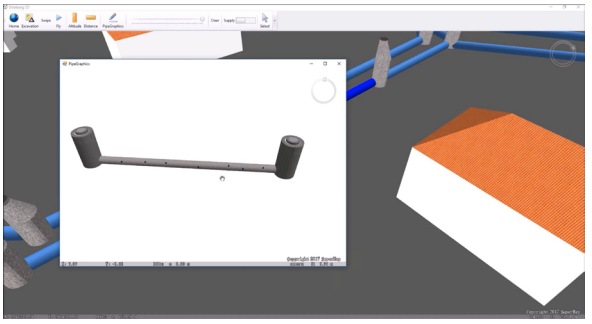
4.2.1 Attribute association query

By clicking and selecting pipeline facilities in a 2D map or 3D scene, the query of pipeline category, pipe diameter, material, embedding date, characteristics and other information can be implemented, and the attribute information can be modified. Meanwhile, the query results can also be exported into required forms or different types of statistical charts.



4.2.2 3D model or drawing association query

The associated query can be carried out by associating the original pipeline and facility drawings or 3D models, so as to facilitate users' view of the original status information of pipeline and facilities.



4.3 3D measurement of pipeline

The spatial measurement function enables users to quickly calculate the distance between pipelines or the area of the ground area to be excavated. This function includes distance measurement and area measurement. "Distance measurement" supports the measurement of pipeline space distance and pipeline distance according to the ground. "Area measurement" refers to area measurement based on land area and object area.

4.4 3D pipeline facilities analysis

SuperMap 3D pipeline technology provides facilities network analysis functions, including connectivity analysis, tube burst analysis, tracking analysis, etc. It can achieve the rapid positioning of pipeline facilities and emergency disposal, and analyze the information of surrounding affected areas and population, so as to provide a guarantee for urban emergency rescue and auxiliary decision-making.

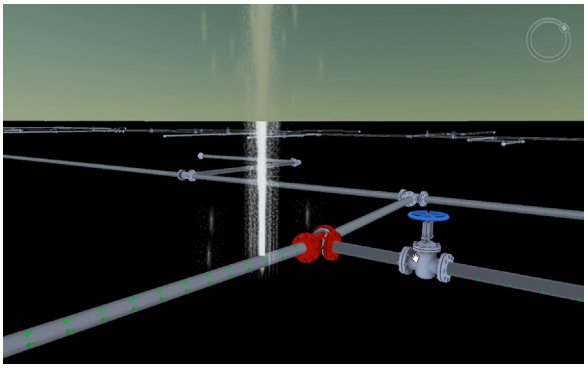
4.4.1 Connectivity analysis

Connectivity analysis can judge the connection relations between specified two points in the pipeline, and can

be analyzed based on parameters such as the location, connection quantity and flow direction of the pipeline. For example, it can be used to judge the connectivity between two specified valves in underground pipelines.

4.4.2 Tube burst analysis

According to the spatial topological relationship of the pipeline at the accident site, the tube burst analysis can quickly query the upstream valves to be closed and the affected downstream pipelines. Also, the valve to be closed and the user information affected by water cut-off can be output into a form.



4.5 Aided decision making based on 3D spatial analysis

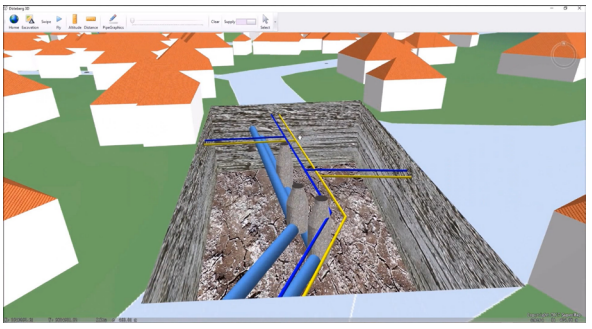
SuperMap GIS 3D spatial analysis supports buffer zone analysis, excavation analysis, pipeline cross-section analysis, etc., in 3D pipeline management.

4.5.1 Buffer analysis

Buffer analysis can be used to view the information of pipe points, pipelines and other facilities within the specified range of the object. For example, when reconstructing a designated area, information about the surrounding affected pipelines is required.

4.5.2 Excavation analysis

The terrain or oblique photogrammetry model can be excavated in the 3D scene, so as to view the distribution of the underground pipeline. This function helps users evaluate the effects and possible impacts of different excavation ranges and depths.



4.5.3 Cross section analysis

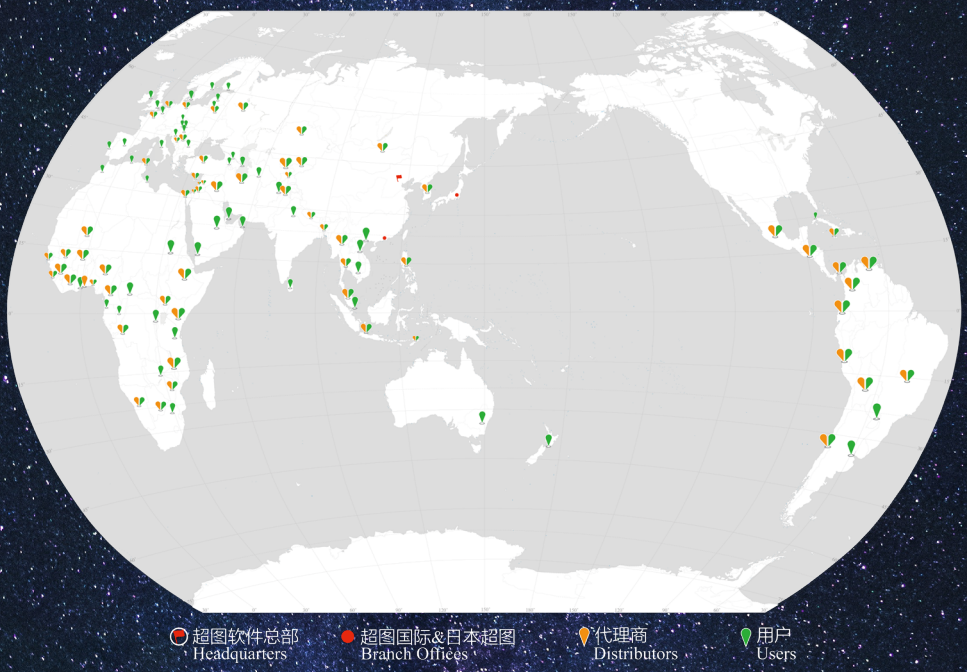
Cross section analysis can generate the section view of the pipeline at any position according to the pipeline data, so as to view the spatial position relations and attribute information between pipelines.

5. Summary

The 2D and 3D integrated pipeline management system based on SuperMap 3D GIS has been proved that it meets the evolving requirements of development of urban utilities. By integrating urban multi-source basic geographic information data and underground pipeline data, this system can implement all-round supervision of various underground pipeline facilities, standardizes pipeline management more and increase its safety, and also, reduces the cost of pipeline construction, maintenance and operation and maintenance management.

This system is regarded to have played a positive role in urban scientific decision-making, efficient service, low-carbon operation, etc. Building smart cities is really gaining momentum. There will be more such systems developed based on geographic information technologies such as SuperMap GIS being applied to different industries and drive the development of modern cities.

Global Distributors and Users



SuperMap has developed distributors and partners in more than 50 countries and SuperMap GIS end users in over 100 countries. We are looking for more partners from all over the world to build a global partner eco-system.