

Original article

Research on the application of 3D simulation technology in Maritime Regulatory

Hao Zhitao^a, Yang Zhuoyi^a, Jiang Shiyuan^a, Liang Hongguang^a, Zhou Fenglei^a^a Dept. For Ships and Port Engineering, Shandong Jiaotong University, China. 3341037904@qq.com

Abstract

The progress of science and technology has driven the development of the society, and the application of three-dimensional simulation technology in all walks of life has greatly improved people's life. Maritime affairs is an important part of comprehensive transportation. The improvement of maritime supervision and service level is conducive to the construction of domestic first-class economic law enforcement system and international leading maritime management institutions. Now the application of 3D simulation technology to maritime supervision is studied, aiming to improve the quality and efficiency of supervision, make maritime supervision more convenient and have further guarantee. Maritime supervision of ship environment is often more troublesome than personnel management. In the process of monitoring and control, many uncontrollable environmental factors greatly increase the difficulty of supervision, among which the port environment is more complex, which is a difficulty of monitoring and control in maritime supervision. This paper uses MapInfo Professional, Win Topo, Multigen Creator and other operating software to construct the Qingdao port visual simulation environment. The port topographic cloud map of Qingdao Port was captured, and the collected image information was converted into data through MapInfo Professional and Win Topo software, and then modeled by Multigen Creator software. After completing the general terrain outline, the established simulation scene was made more realistic and realistic through some detail processing and optimization means. By describing the establishment of 3D simulation terrain in Qingdao Port, the application status of the simulation technology in ship environment and port management is reflected, which provides a reference for the deeper application of 3D simulation technology in maritime supervision.

Keywords: 3D simulation technology, Maritime supervision, Visual simulation

☆(Do not DELETE)

1. Introduction

With the rapid development of the national economic construction, the port industry and the Marine transportation industry have developed rapidly, the navigation environment of the port waters is becoming increasingly complicated, and the port construction and maritime management are also facing great challenges. Virtual reality technology research and its application development is a research hotspot in the field of computer today, and it also provides an effective means to realize the port visual view simulation. The application of this technology to port construction and management can make the port environment more truly and accurately presented in front of supervisors, so as to achieve more efficient and intelligent use of ports, and also be more conducive to the supervision of port environment.

Virtual reality technology is a new computer technology that can create a virtual environment for users in a simulated way. The establishment of this virtual simulation environment can not only play a role in the survey and management of the ship environment, but also in the education and training of the crew. The establishment of a virtual simulation environment can not only promote a more scientific and reasonable organization of training, improve the training effect, but also stimulate the innovative thinking and inquiry ability of the trainers to a certain extent, so as to greatly make up for the traditional training methods problems and deficiencies, and the crew can also diagnose and investigate the faults in the virtual environment, greatly improving the learning effect.

2. The Application of 3D Simulation Technology in Maritime Regulatory

2.1. concept definition

(1) 3D simulation technology

Three-dimensional simulation technology is a kind of embodiment of virtual reality. Is a computer technology generated by a realistic, with visual, listening, touch, and other perception of the virtual environment, users through the use of various sensing devices with the virtual environment of the entity interaction technology. By simulating the action and position of an object, the user can simulate the environment to receive sensory

feedback, and through the three-dimensional scene roaming, it can effectively and quickly find the problems existing in the scene.

(2) Maritime Regulatory

Maritime supervision is mainly under ship and crew, forming a supervision chain covering human, ship, environment and management. It is a management system in which the maritime administration agency exercises the function of water traffic safety supervision entrusted by the state, conducts intelligent analysis of ship, crew, ship company and ship environment, and prevents and controls risks.

The application of 3D simulation technology to maritime supervision can make the supervision more efficient and convenient. Figures 1 and 2 below are the application schematic diagram of port environment actual shot pictures and visual view simulation in ship port environment control respectively. The convenience of control can be seen through the comparison of pictures.



Figure 1. Port actual drawing

Source:<https://zhuanlan.zhihu.com/>

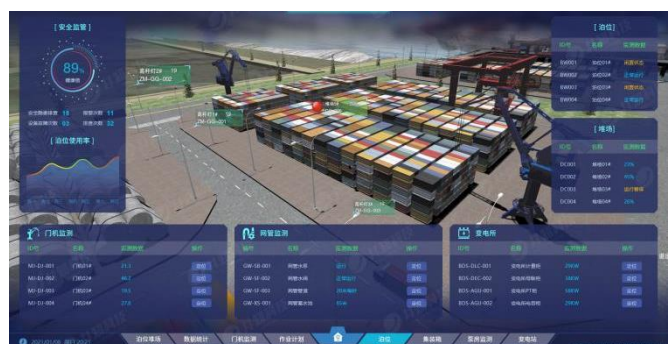


Figure 2. Schematic diagram of visual view simulation

Source:<https://www.openup3d.com/>

2.2. current situation and foreground

Three-dimensional simulation technology can survey the geographical environment of ship navigation in the maritime supervision field, and then provide solutions to the difficulties caused by the rapid development of port industry and Marine transportation industry; it can simulate the common faults during ship navigation and estimate the dangers during ship navigation, thus providing the crew with opportunities to learn and practice in the virtual environment. Jinping Liang pointed out that the port terminal business operation using the real simulation platform to build a virtual simulation environment, highly restore the development and change of the actual situation, can provide port according to need roaming and display, and the port equipment and its working principle are clearly visible, can practical demonstration teaching, can also submit homework, correcting homework, is perfect. Xiaoqiang Guo et al. said that in view of the complexity and security problems of port crane training, he proposed that combining virtual reality technology to carry out crane training activities, which can minimize economic costs and security risks, effectively overcome many limitations of training, enrich training methods, and stimulate the enthusiasm of students for independent learning. Guanzhong Zhou shows that VR technology is used to display the teaching content and explain the principle, so that students can more intuitively and vividly understand the content of the lecture. Xiaodong Shen et al. have found that the 3D display system can integrate GIS and virtual reality port. The 3D digital model created can not only visually show the 3D virtual scene of the port, but also make the audience have an immersive feeling when browsing.

Nowadays, the application of three-dimensional simulation technology in maritime supervision is more and more broad. From three-dimensional simulation technology in shipping route design and planning, to virtual reality technology simulation and simulation, all reveal that this technology is playing an increasingly important role in maritime supervision. Creating a virtual environment through 3D simulation can not only improve the supervision and management rate of maritime supervisors, but also promote the development of the navigation field to a certain extent. The 3D simulation technology will have broad application prospects in the field of maritime supervision.

2.3. Technical difficulties

Since the 3d simulation technology was initially proposed in the early 1970s, the technology has been greatly developed in more than 50 years, and its application level has been continuously improved. However, there are still some difficulties to realize the visual simulation of the ship environment:

- (1) In a large range of operation, how to seamlessly, and smooth switch page or to be studied and improved;
- (2) When constructing the terrain drawings in 3D simulation, most of them pursue the authenticity of the terrain, and often ignore the directionality of the starting point and the end point of the sketch, so as to construct some models that violate the law of geoscience.

3. Realization of Simulated terrain of Qingdao Port

This paper uses the 3D simulation technology and MultiGen Creator and other software to study the relevant technology and methods of 3D terrain establishment, and has visualized the 3D terrain of Qingdao port to achieve the expected effect.

3.1. Establishment of 3D Simulation terrain of Qingdao Port

The application of topographic visualization simulation in Qingdao port mainly includes the following steps:

- (1) Acquisition of the topographic data. For the acquisition of topographic data of Qingdao port, Google Earth was used to locate the location of Qingdao port, select the proportion to intercept, and record the latitude values and altitude values of the relevant location. Transfer the collected information to Win Topo software and convert the data to obtain the intercepted graphic files of Qingdao Port. The initial data information is obtained by converting the Win Topo software to the graphic files. In Figure 3 and Figure 4 below are the schematic diagram of the geographic information intercepted by Google Earth software and the graphic files converted by Win Topo software, respectively.

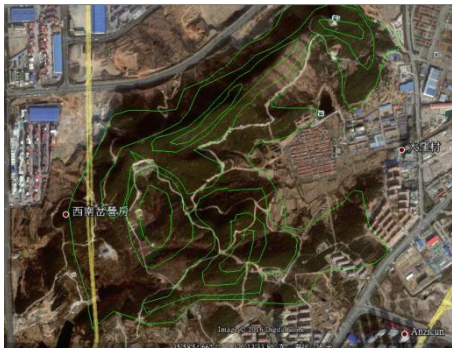


Figure 3 Google earth screenshot

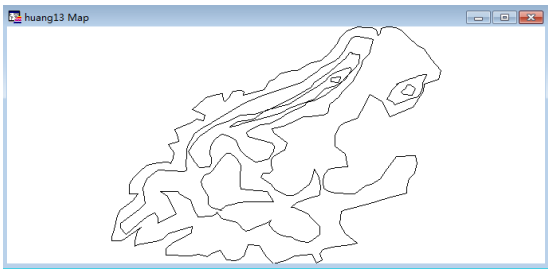


Figure 4. Win Topo Processing Fig

(2) Data processing. The vectorization processing of terrain data in Qingdao port requires MapInfo Professional, which is a powerful mapping information solution based on Windows platform. Using MapInfo Professional, the relationship between data and geographic information. Using this software, the data obtained by the Win Topo software is converted into the digitized grid files, and then the processed digital grid files by the FME software are converted into the DEM data format to complete the preliminary processing of the topographic data. Figure 5 below is the data model diagram after the raster treatment of Qingdao Port.

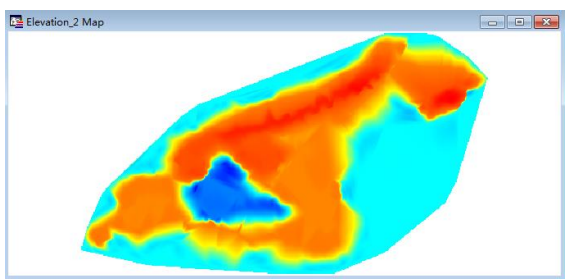


Figure 5 Digital grid model diagram

(3) Application of the Multigen Creator based on the DEM format data. The raster ized data was converted to the DEM format in the FME software, and the post-processing was performed in the Multigen Creator software to start the terrain generation.

(4) Parametric processing. The resulting topographic map is parameterized and adjusted to get the overall topographic profile.

(5) Optimize the processing. After the original terrain is generated, the texture stitching of the terrain is required. Textures need to be set by elevation so that the generated images are closer to the original terrain.

Figure 6 below is the completed initialized terrain modeling map. Different brightness in the model drawings indicates different terrain and height, which can be intuitively expressed through the subsequent simulation.

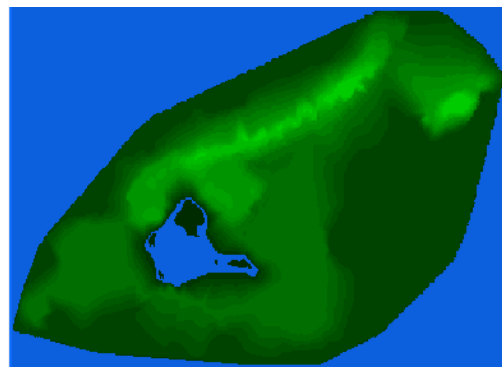


Figure 6 3D simulation modeling drawing

Figure 7 below shows the flow chart of the terrain modeling of Qingdao Port and port, which clearly shows the basic process of 3D simulation modeling.

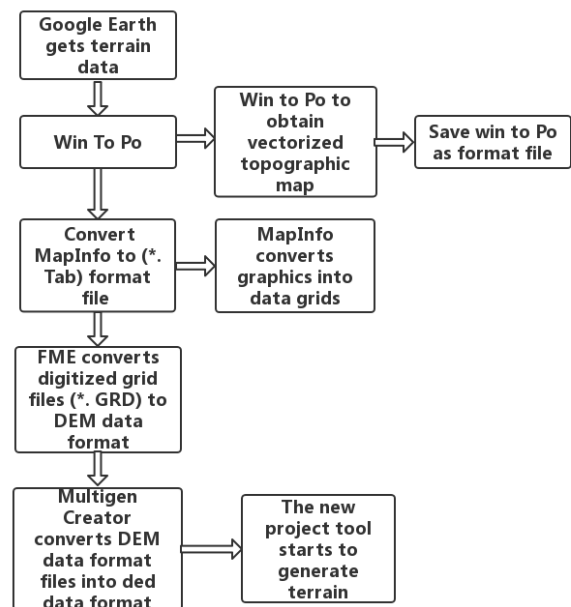


Figure 7 3D modeling flow chart

3.2. Establishment of 3D Model Library in Qingdao Port Area

According to the requirements of Qingdao port landscape simulation, the 3D model database of landscape simulation mainly includes port scenery and surrounding buildings, ship model, port geomorphic

model and port navigation aid sign model, etc.

(1) The establishment of the port area scenery and the surrounding buildings

Various kinds of port buildings are built by Multigen creator. In real scenarios, these data are measured according to the proportional parameters of the actual model, and the models are built by creator surface tool, geometry tool and color attribute tool. Taking the model of tower crane as an example, the modeling process of port buildings in the 3D model library is introduced through Figure 8 tower crane modeling flow chart.

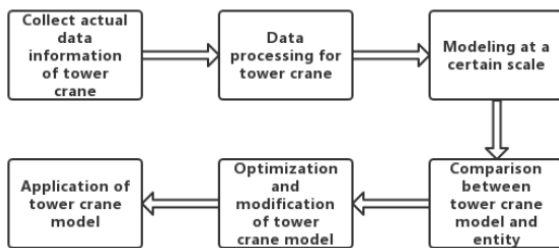


Figure 8 Flow chart of tower crane modeling

The modeled tower crane model is shown in Figure 9 below. The ship model is used for the port area scenery and the surrounding buildings.

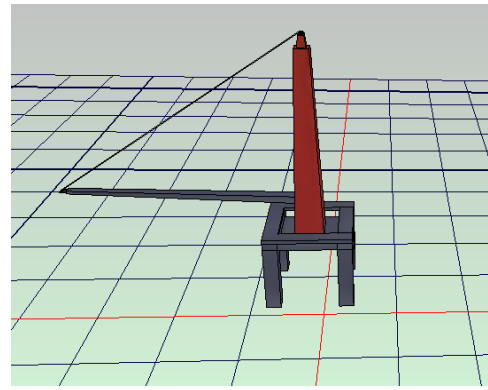


Figure 9 Tower crane model drawing

(2) Establishment of aids to navigation and other buildings

The building of AIDS and other buildings can be rough squares and other graphics. Use texture processing to transform these rough modeling with vision.

After establishing the required model, the established model data is imported into the 3D model database of Qingdao Port area. The required model is called in the model library to update the 3D simulation terrain of Qingdao port area. Update to the terrain model diagram shown in Figure 10 below.

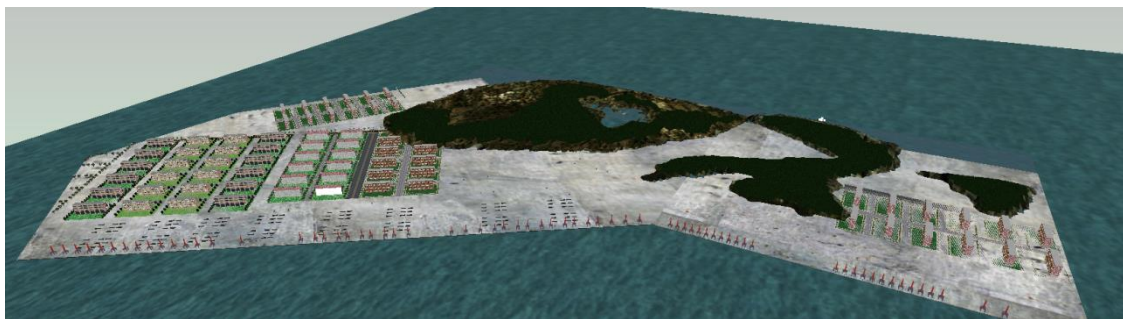


Figure 10 Terrain model diagram

3.3. Processing of Virtual Scene in Qingdao Port Area

For the virtual scene design of Qingdao Port area, Vega software is used to operate. As a virtual scene implementation software, Vega contains many tools and concepts. The following two steps are mainly used to complete the 3D simulation, so as to achieve the purpose of establishing the virtual scene.

(1) Add elements to the scene. For the established Qingdao port model, in order to restore the Qingdao port environment more realistic, it is also necessary to add some element cables to the Vega. For example, ocean,

observer perspective, climate environment and surface environment, etc.

(2) Software operation and detail processing. During the operation, the left mouse key controls the forward speed, and the right key controls the backward speed, and the operation key should pay attention to the established terrain model. If the terrain fails, it is necessary to readjust the model drawing and complete the details by changing the data information.

After modeling, simulation and virtual scene processing, the simulation picture of Qingdao Port area is included in Fig. 11 below.



Figure 11 View simulation picture of Qingdao Port and Port Area

The impact of simulated terrain realization in Qingdao Port on the Marine industry

3.4. The impact of simulated terrain realization in Qingdao Port on the Marine industry

The establishment of the simulated terrain environment in Qingdao port is of great significance, First, the success of this case shows that the 3D simulation technology is implemented in environmental simulation, Fishermen and some Marine workers can make risk estimates and resume some navigation environments through virtual environments, Don't have to "

4. Conclusions

This paper with the application of 3D simulation technology in maritime regulation for the research purpose, the simulation of emerging technology in maritime regulation and the development of related fields, and then introduce 3D simulation and maritime regulation, after analyzing the application of 3D simulation technology in maritime regulation, finally through the terrain modeling analysis of Qingdao port finally draw the following conclusion:

(1) The success of the visual experiment of Qingdao Port shows that the accuracy of the established terrain model and real-time terrain drawing are constantly possible through 3D simulation technology;

(2) The success of the visualization research in Qingdao Port area further shows that 3D simulation technology is reliable in the simulation and construction of virtual environment, and it also means that 3D simulation technology can play a greater role in the field of maritime supervision;

(3) The 3D simulation technology used for the shipping industry can make the shipping industry more convenient, whether in the risk assessment or education and training, can achieve excellent results;

depend on the weather" as before; Secondly, the implementation of simulated terrain in Qingdao port shows that the application of 3 D simulation technology is very effective, We combine the technology with navigation professional training and education, Simulation drawing complex shipping routes with special sailing sea conditions, Make the maritime workers more simulation and practical training, Can increase the integrated capacity of the maritime staff, Escort them to work at sea.

(4) The application of three-dimensional simulation technology to maritime supervision is the inevitable development of future ship development. Through virtual reality technology, it will make safer navigation, cleaner waters and more convenient navigation environment.

References

- Chi Xun.Application of virtual visualization in Yangpu Port Management[J].Port & Waterway Engineering,2015(12):133-137.
- Jia Rui.The Development and Challenge of Distance Education: Virtual Reality Technology[J].TV University of Science and Technology,2022(01):63-68.
- Jin-feng Yang,YaJun Jiao.Discussion on the Application of Virtual Simulation Technology in Building Construction[J].Intelligent City, 2018, 4(24):157-158.
- PANG Chao, NIU Hong-xia, BAO Yu-wei.Application of virtual reality technology in simulation of ship failure[J].SHIP SCIENCE AND TECHNOLOGY,2017,39(24):143-145.
- ZHANG Li.Research on ship 3D modeling design based on virtual reality technology[J].SHIP SCIENCE AND TECHNOLOGY,2022,44(09):40-43+56.
- Haotian Tang. Supervision and development of smart

maritime in Yangzhou section of the Changjiang River[D]. Yangzhou University,2022.

Liang Jinping.Teaching reform and exploration based on the combination of port and wharf business operation and virtual imitation and real training[J].Research on Transmission Competence,2020,4(02):170-171.

Guo Xiaoqiang, Liu Xingyu, Huang Dazhi, Feng Wen.The Application of Virtual Reality Technology in Port Crane Training[J].Mechanical and Electrical Information,2020(33):80-81.

Zhou Guanzhong, Gao Juan.Development and Practice of Virtual Training Platform for Port Machinery[J].Vocational Education (Journal),2019,18(12):62-64.

SHEN Xiao-dong, WU Yuan-hong.Design and Implementation of Three Dimensional Display System of Zhoushan Port[J].Computer Knowledge and Technology,2016,12(31):56-58.

Li Ke. virtual terrain generation based on deep learning[D]. Nanjing Normal University,2019.

Yu Lan Zhuang. A Research of the Application of Visual Simulation Technology in College English Teaching[J]. Advanced Materials Research,2014,3530(1044-1045).

Yu Feng YANG,Ming Kui Feng. A Comprehensive Experimental Practice for Ship Bridge Resource Management Training Based on Ship Handling Simulator[J]. Advanced Materials Research,2014,3326(989-994).

Received 21 October 2022

Revised 12 November 2022

Accepted 23 December 2022