INTERNATIONAL JOURNAL FOR INNOVATION EDUCATION AND RESEARCH
ISSN: 2411-2933

Journal URL: https://scholarsjournal.net/index.php/ijier

DOI: https://doi.org/10.31686/ijier.vol11.iss5.4120

Research and Design of VR Based Unmanned Aerial Vehicle Model and Database

Ma Wenlei, Li Siyu, Ren Hao, Liu Shiyu, Chen Mengting, Wang Ying, Jing Pu

(School of Electrical and Electronic Engineering, Shanghai University of Technology, Shanghai 201620)

Abstract:

In response to the application of drones in real life, drones are more susceptible to interference and influence from various external factors such as weather, site, airspace, etc. during flight operations or related tasks. Not only can they not guarantee the completion of expected goals or tasks, but they are also prone to problems such as falling, collision, or accidental injury caused by the unstable state of drones. The drone flight simulation, virtual training, and drone database system developed based on VR technology has improved the safety, diversity, and instability of drones in practical applications, and reduced the interference of external adverse factors on drone flight. A comprehensive drone model database system has been established. This provides effective guarantees for the application and implementation of drones in various fields.

Keywords: VR technology, drone model, database system, simulation training

1 Introduction

Unmanned aerial vehicles (UAVs) have the characteristics of high flexibility, short work cycle, high production efficiency, wide application range, and convenient use. They are widely used in various fields such as military, agriculture, construction, traffic emergency, especially in panoramic photography, traffic monitoring, environmental protection testing, disaster rescue, power inspection, and military task execution. Due to their wide visualization range, saving human resources, and strong concealment, UAVs are widely used, the advantages of high flexibility have been highly valued and developed.

Drones are widely used in various technical fields and commercial markets. However, due to the high cost, vulnerability to damage, and susceptibility to external environmental factors, the user experience of drones is often greatly compromised. Moreover, the cost of drone experiments is high, and the technology of drones in their flight control systems, navigation systems, power systems, data link systems, and other aspects is not mature. There are many problems with drones in safe flight, laws and regulations, technical bottlenecks, industrial support, civilized use, and other aspects, and the development chaos cannot be ignored. The emergence of virtual simulation models and database systems for unmanned aerial vehicles provides a good solution to this problem.

2 VR technology

2.1 VR Technology Concept

The concept of VR technology (Virtual Reality, also known as VR) is a practical technology developed in the 20th century. The earliest person to propose this concept was Jaron Lanier, the founder of VPL in the United States. VR is also known as "virtual reality" or "spiritual realm technology". The specific implementation is to use computer graphics systems and various display control interface devices to generate an interactive 3D environment on the computer, thereby creating a virtual world. Virtual reality has the characteristics of interactivity, imagination, and immersion, covering multiple disciplines such as computer software and hardware technology, robotics technology, sensing technology, artificial intelligence, and behavioral psychology. It is the ultimate manifestation and application form of multimedia. Virtual reality technology provides participants with simulated contact with visual, auditory, tactile, and other senses, allowing users to observe and experience things in 3D space in real-time without limitations.

2.2 Advantages of VR technology in the field of unmanned aerial vehicle applications

2.2.1 Innovative scenarios for drone applications

Virtual reality technology can apply computers, software, and interactive peripherals to build virtual drone models and application scenarios, enabling people to complete drone control and execute various tasks as in real life. The virtual reality technology based on the Internet provides a low-cost and convenient online drone learning and exploration environment for drone enthusiasts, providing innovative and reliable new ways for the research and application of drones in various fields. It can effectively promote the innovation and application development of drones in the field of virtual reality.

2.2.2 Has a wide range of applications

In traditional drone operations, it is difficult for different regions, departments, and projects to quickly fit together in a short period of time. The collaboration between different drones is poor, and the flexibility of the fit is low. It is extremely easy to encounter issues such as asynchronous data transmission, delayed reception, and ineffective cooperation among departments. By combining virtual reality technology with drone big data, the precise display of city level panoramic operation status and cooperation ability can break space and time constraints, achieve centralized management and resource optimization of regional drones, unified scheduling and remote control.

2.2.3 Has high flexibility

Traditional industrial drones have many limitations. In the military and industrial fields, they are often limited by issues such as size, affordability, and concealment. However, in daily use, they are also limited by environmental conditions, human interference, self-recovery ability, and other factors. When performing refined tasks, there are extremely high requirements for the technological level and accuracy of drones. By using virtual reality technology, in the system simulation of interactive 3D dynamic scenes

and physical behavior, it is possible to better simulate the real environment and possible situations, while flexibly utilizing various technologies to create diverse conditions and overcome various limitations.

2.2.4 Safe and efficient application practice process

Unmanned aerial vehicles are prone to accidents caused by uncontrollable personal use, and unexpected events may occur during industrial operations, resulting in property damage or personal injury, and may lead to secondary injuries. Using virtual reality technology, anticipate various possible emergencies in advance and conduct simulation exercises without considering aircraft explosions, casualties, and property losses. At the same time, the combination of virtual reality and drones can greatly improve the personal safety of participants in many dangerous and prone to casualties areas such as traffic patrols, urban patrols, counter-terrorism and riot prevention, urban and forest firefighting, reconnaissance and pursuit.

2.2.5 Effective cost savings

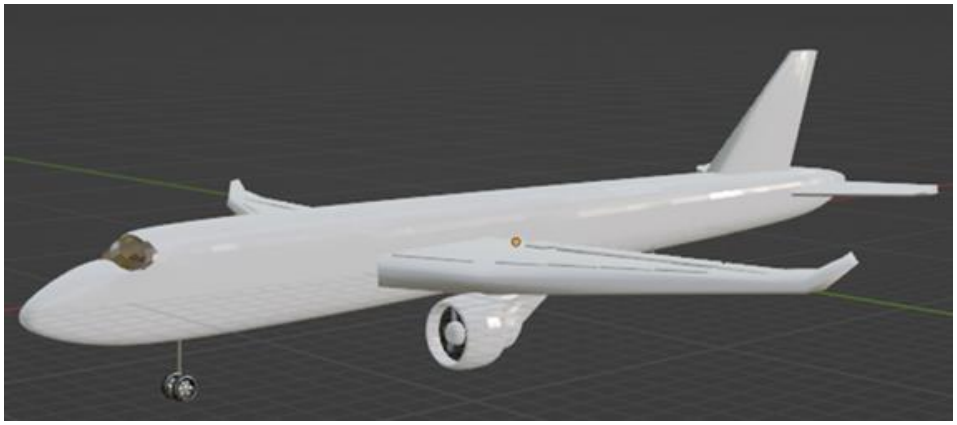
Drones themselves have high costs, and when used by individuals or teams, not only should their high cost be considered, but also their application scenarios, safety, and other issues. There are often problems such as high cost, single scenario, low reusability, and the vulnerability of unmanned aerial vehicles to damage. Using virtual reality technology to conduct homework exercises only requires consideration of initial investment, with almost zero cost in the later stages and no limitation on the number of training sessions. And there is no need to consider the cost of drones, as well as various component damage or updates and unexpected situations during the use of drones. Greatly reduces the potential losses and costs that may occur during the practical process.

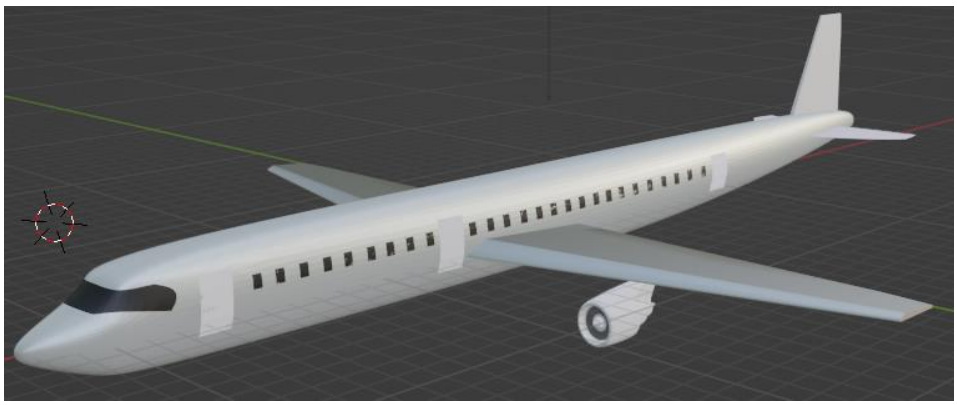
3 UAV Model Database System and Virtual Training System

Combining virtual simulation technology with modeling technology, data analysis technology, etc., based on research and development methods such as Python and Java language, and on the basis of mechanics and engineering, data such as drone flight conditions and flight data are added to the system. Blender 3D modeling technology is used to establish the internal and external architecture of the drone and airport facilities. The flight process of the virtual drone is achieved, achieving various functions of the drone from landing to takeoff. Combining theory with practice, utilizing professional techniques to deeply simulate and restore the drone architecture and its flight modes and postures during various tasks, simulating the execution process of drones in various task environments, identifying problems and deficiencies, and improving them to better complete various tasks in practice. And it is not limited by factors such as space and time, and can repeatedly practice the operational steps in drone flight missions to obtain better results.

The simulation model of the drone is shown in the following figure. This simulation model is part of the drone model database system, which has established a large number of drone

simulation models and drone flight mission data. And according to the actual training situation, corresponding data can be continuously added for enrichment.





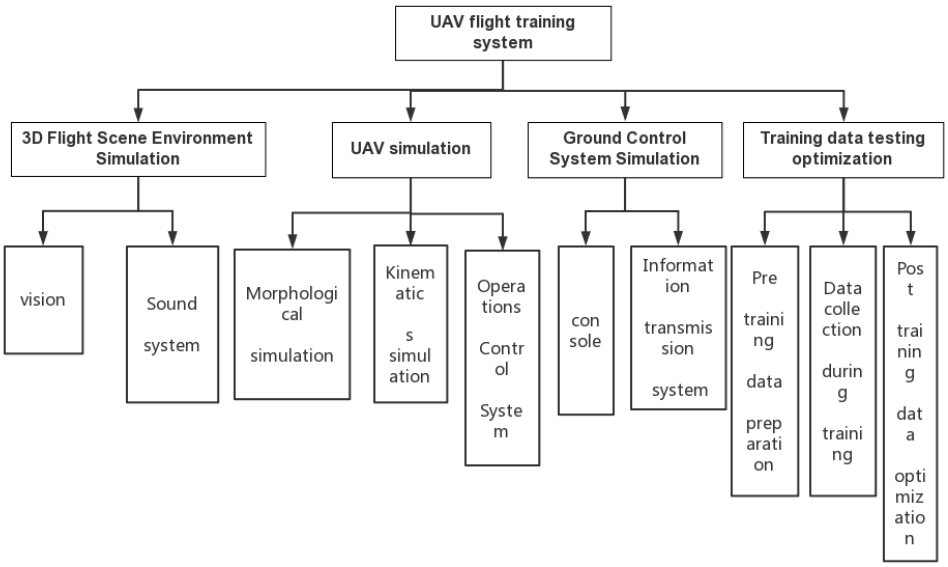


Figure 1 Training System Structure

As shown in Figure 1, the virtual UAV flight training system mainly includes four modules: 3D flight scene simulation, UAV model simulation, ground control system simulation, and training data test optimization. The 3D flight scene environment simulation module mainly includes visual system and sound system. The visual system displays the external environment of drones during takeoff, flight, and landing, while the sound system simulates the sound generated by drones throughout the entire flight process, including the sound of engines, propeller rotation, and various internal or external factors, making it more realistic. UAV simulation module mainly includes morphology simulation, kinematics simulation and operation control system. Morphological simulation mainly simulates and models the external and internal morphology of drones, refining the morphology of each part of the drone; Kinematics simulation analyzes and simulates the position, speed and attitude of UAV during takeoff and landing; The operation control system mainly simulates various actions and postures of unmanned aerial vehicles during flight, such as takeoff and landing, hovering and turning, etc. The ground control system simulation module mainly simulates the communication connection between unmanned aerial vehicles (UAVs) in the air and the ground. By using simulated wireless communication devices, a communication link between the ground and the air is established. The ground system can detect and receive telemetry information from the UAVs, thereby sending information commands to the UAVs. The UAVs then take actions based on the received commands. The training data testing and optimization system mainly collects, stores, analyzes and evaluates various data and problems that need to be generated during the execution of flight missions by drones, and continuously optimizes them to find the optimal solution for drone execution of various tasks and effectively avoid various problems that may arise in practice. It mainly includes three aspects: pre training data preparation, data collection during training, and post training data analysis optimization.

(1) Pre training data preparation

Analyze and prepare the required data before each training session, and adjust various parameters to the best. Input the data parameters of this task into the entire system.

(2) Data collection during training

Collect and store the data generated during the drone's task execution, adjust various data in real-time, and provide feedback to the drone to better complete the task.

(3) Post training data analysis optimization

Conduct data analysis on the issues arising from this flight mission, optimize the process and results, and upgrade the system.

4 Conclusion

With the increasing development of science and technology, the application of unmanned aerial vehicles has become an important content in various fields. However, due to the vulnerability of drones to damage, high costs, and significant environmental factors, there are certain difficulties in the actual task training of drones. At the same time, there are also some bottlenecks in the development of drone technology. And VR technology provides a virtual environment, and 3D drone models have good interactivity, experimentation, testability, openness, and so on. Unmanned aerial vehicles are completely free from external factors such as location and time, effectively solving various problems in actual drone training.

The virtual experimental environment, experimental objects, and highly simulated drone models deeply restore the conditions and requirements for drones to perform various tasks in practice, avoiding various safety issues, and facilitating rich immersive experiences and research for scholars and drone enthusiasts, greatly expanding the traditional industrial drone application field.

In the subsequent research process, VR technology can be used to carry out virtual drone simulation flight and technology research and development in more fields and tasks, achieving full field coverage and development of VR drone technology.

Reference

[1] Xu Jianmin, Liu Shuangtong, Jiang Chunhua, Xu Jianguo, Wang Tianwei. Application research of unmanned aerial vehicle flight simulation system based on VR technology in teaching [J]. Computer Knowledge and Technology, 2021,17 (15): 155-157

[2] Wang Feng Exploring the Technology of Unmanned Aerial Vehicles and VR Technology Assisted Large Scale and Whole Area Landscape Design - Construction and Verification of Yixing City Observation System Based on Arcgis [C]//. 2017 Urban Development and Planning Paper Collection. 2017:1605-1611

[3] Jia Pengwan, Feng Shoupeng, Zhang Aihui. Virtual teaching system for unmanned aerial vehicle relay communication based on VR Platform [J]. Military Automation, 2012,31 (06): 93-96

[4] Wu Chunyuan The Application and Research of Modern Information Technology in the Teaching of

Practical Courses in Universities [J] Computer Products and Circulation, 2020 (10): 22

[5] Zhang Deqin, Li Fei, Liu Xiaowei. VR Technology in UAV Control Simulation Training [J]. Communication World, 2020,27 (04): 146-147

[6] Bai Jin, Ji Jun, Li Xueqin, etc Research on the Application of Virtual Simulation Technology in Practical Training Teaching [J] Computer Knowledge and Technology, 2020, 16 (23): 141-142+148

[7] Gao Ying, Lian Ming, Su Wei, Ma Xin. VR Technology in UAV Control Simulation Training [J]. Microprocessor, 2005 (05): 57-61

[8] Zhang Xiong et al. A Virtual Reality Based Unmanned Aircraft Simulation Training System [J] Journal of System Simulation, 2002, 14 (8): 1022-1025