Design of Visual Simulation System for Carried-Aircraft Recovery Mode Based on AcoreOS

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Abstract. Based on the AcoreOS operating system, a visual simulation system for the recovery process of Carried-Aircraft is designed. The geometry model of aircraft is established, then the geometric model is driven by the AcoreOS operation system kernel task scheduling mechanism, using the development environment LambdaAE software to carry out software implementation of simulation. The simulation results show that the system can help the commander in command.

1. Introduction
At present, the visualization simulation can be used in the study of various techniques, such as OpenGL (Open Graphics Library, Open Graphics Library), CAD (Computer Aided Design and Computer Aided Design), etc.¹, this technology has been widely used in large engineering project construction²-⁴, kinematics object research⁵-⁶, and other fields. But in the field of aircraft recovery, research is relatively small, C/S (Client/Server) structure designed of the visual simulation system was introduced in literature⁷. The visual simulation system optimizes the 3d models of the carrier aircraft and aircraft carrier created by Creator by using the techniques of detail level, texture mapping and instantiation, but the whole visual interface only presents the landing part of the carrier aircraft. Literature⁸ used 3DMax software to draw the 3d model of aircraft and aircraft carrier, and used Visual C++ and OpenGL software for programming to complete the design of Carried-Aircraft automatic landing simulation software, and realized the Visual simulation of Carried-Aircraft automatic landing. However, this simulation system did not present the whole process of Carried-Aircraft formation recovery. In order to solve the above problem, this article first proposed to the aircraft fleet recycling process visualization, the visual interface including waiting for ships, aircraft into the fall line, the ships, escape overshoot, again the ships, etc, using LambdaAE software programming, making as much as possible to aircraft recovery trajectory real description, provide intuitive simulation interface for the LSO, auxiliary LSO command decisions.

At present, the visualization simulation technology mostly USES the overseas operating system, considering the aircraft recovery highly classified, based on domestic AcoreOS operating system design aircraft recovery process visualization simulation system, the operating system has the characteristics such as strong real-time performance, high reliability, strong confidentiality, and transplant emWIN GUI components, can be used for visualization simulation.

This paper based on the typical aircraft recovery model is established for the simulation of aircraft trajectory geometry model, then using the development environment visualization simulation system
software development projects, the application of each function module in detail, finally aircraft recovery process visualization simulation results, verify the superiority of this simulation system.

2. visual simulation
The design of the simulation system should rely on the development environment software LambdaAE supporting the AcroOS operating system to complete the project development. The development environment software has perfect software development ability, supports C, C++ and assembly language, and has a good human-computer interaction interface. The development flow chart of the visual simulation system project is shown in figure 1. The project includes the following modules: parameter calculation module, drawing module, graphics driver module and anti-flicker module.

![Figure 1 visual simulation system project development flow chart](image)

2.1 parameter calculation module
The parameter calculation module includes two parts: recovery strategy calculation and geometric model coordinate parameter calculation.

This module designs the recovery strategy calculation program based on the formula derivation process in literature[9], and obtains the recovery strategy by inputting the number of carrier aircraft and the landing probability of each carrier aircraft.

Considering that in the recovery process, the carrier-borne aircraft generally move in a straight line at a constant speed, and the horizontal distance of the carrier-borne aircraft is much greater than that of the vertical height, when the geometric model is driven in real time, the unit distance of the carrier-borne aircraft moving on the X axis in unit time can be guaranteed. In FIG. 2, the establishment of the coordinate system is based on the display resolution of the hardware platform, and the coordinate parameters of the position of the carrier aircraft at different moments are calculated according to the graphic parameter equation.

2.2 drawing module
The geometric model is composed of 2D graphs such as ellipses, arcs and line segments, etc. By combining the data obtained from the parameter calculation module, the relevant interface in the GUI is called to complete the drawing operation.
2.3 graphics driver module
Real-time drive geometry model by using AcoreOS operating system kernel task scheduling mechanism, in the development project, create two tasks, task 1 complete parameter calculation module function, task 2 task 1 is used to calculate the data to complete the drawing module function, by changing the task status to complete the task scheduling, implementation model driven, as shown in figure 2.

![Figure 2 dual task scheduling](image)

2.4 anti-flicker module
When the geometric model is driven in real time, the display screen needs to be updated regularly. If the drawing operation is performed directly on the LCD, a flashing phenomenon will occur when the LCD screen is rapidly updated. Therefore, in the project development of visual simulation system, automatic storage device\cite{10} is adopted to prevent the display from flashing. The implementation is shown in figure 3.

![Create automatic storage devices](image)

Figure 3 completes the drawing using a storage device

3. simulation results
Set the initial state: there are 8 Carried-Aircraft in the standby queue, and the landing probability is 0.9, 0.4, 0.9, 0.65, 0.9, 0.9, 0.6 and 1.0, respectively. The simulation results are shown in figure 4.
The calculated recovery strategy 0-0-1-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-1 is displayed in the simulation interface, which is strictly implemented by the carrier aircraft in recovery. Figure 4.1 shows that the carrier-based aircraft are in the standby queue at the initial moment. According to the recovery strategy, the first recovery point is class A recovery point, and the carrier-based aircraft no.1 is waiting for landing. Figure 4.2 shows that no. 1 carrier-based aircraft left the standby queue and entered the underline line. According to the recovery strategy, the second recovery point is still A class A recovery point, and no.2 carrier-based aircraft is waiting for landing. Figure 4.3 shows that no. 2 carrier-based aircraft left the standby queue and entered the underlined line. According to the recovery strategy, the third recovery point is class B recovery point, which is used to recover the carrier-based aircraft that may exist in the escape and escape queue. Figure 4.4 shows that the carrier-borne aircraft in the escape queue are ready to enter the underline line and start landing. When the ship is completed, the next recovery point will be executed.

Simulation results show that the visual simulation system designed in this paper has the following advantages:

1. The visual simulation system combines the visualization technology with the recycling strategy, and the data parameters presented to the LSO are more intuitive;
2. The visual simulation system includes the whole process of Carried-Aircraft recovery, including the process of Carried-Aircraft waiting for landing, such as the flight of aircraft, can effectively improve the LSO command decision-making;
3. Visual simulation system based on the actual application, reduce the LSO pressure, improve the command decision-making accuracy.

4. Conclusion

LSO, as an indispensable landing aid on the aircraft carrier, needs to consider a large number of factors and issue instructions quickly, which leads to high pressure on the decision-making of LSO command. Based on practical application, this paper designed a visualized simulation system for the recovery process of Carried-Aircraft to assist the decision-making of LSO command. Due to the limitation of display resolution of hardware devices, this simulation system does not take into account the interface design of the carrier-borne aircraft entering the standby queue. Therefore, it can be further applied to this simulation system to establish a more complete visual simulation system for the recovery process of carrier-borne aircraft.

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