Design and Realization of Shooting Virtual Training System for UAV-borne Missile

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Abstract. UAV-borne missile is effective weapon to attack enemy ground targets. It is expensive, costly and difficult to live-fire drill. Using virtual training instead of actual training can greatly improve the training efficiency and the combat effectiveness. The article regards the operation training of a certain type of UAV-borne missile shooting training as the research object, based on the development of a visual simulation system for UAV-borne missile, uses the object-oriented design method to design a virtual training system based on LabVIEW. The system can realize the shooting operation training of trainees in a virtual environment, and achieve the goals of reduce training costs; improve training efficiency and shorten training period.

Keywords: UAV-borne missile, shooting operation, virtual training.

1. Introduction
At present, virtual training has gradually become an important supplement to real training, and an effective way to improve training effectiveness under the informatization. UAV-borne missile is an important mission payload for UAV to perform fire strike missions, however the training cost is high, the training period is long, and the training effect is low. The research in this paper proposes a virtual training technology based on LabVIEW and gives the overall scheme and specific implementation process of shooting virtual training system for a certain type of UAV-borne missile. The system can be used in military training and teaching training of armies and academies to promote combat effectiveness.

2. Overall Technical Scheme
According to the objectives and requirements of the training subjects, formulate the simulation functions and technical indicators of the virtual training system. Based on the pre-designed visual simulation system for UAV-borne missile, an object-oriented design method is adopted to realize the interface design; program design; function realization and equipment model simulation of the system. It has achieved the training effect that the object models in the scene are basically the same as the actual equipment; the spatial position distribution is correct; the software operation steps are completely consistent with the actual operating procedures, and the feedback information received by the operator is the same as that of the equipment. The overall technical scheme of the virtual training system for UAV-borne missile shooting operation based on LabVIEW is shown in Figure 1.
The system is based on the virtual training visual simulation system, which designs simulation training module, interactive teaching module and operation assessment module according to functional requirements, and uses LabVIEW graphic programming to achieve. The system is designed and developed in LabVIEW environment and runs on windows system.

3. Program Design and Implementation

The program design adopts an object-oriented design method, replacing the switches, buttons, indicator lights, et al, on the actual equipment with virtual controls in LabVIEW, and clicking the switches and buttons on the virtual device with the mouse allows the trainees to receive the same feedback information from the actual equipment, and the action response of the 3D model of the missile system is also the same as that of the actual equipment. Through visual training, trainees can master the operational skills of training subjects such as missile launching and control.

This system mainly uses While Loop, Case Structure, Event Structure and other functional structures in LabVIEW. At the same time, it adopts a multi-layered While Loop nesting mode to realize complex logic structure programs. In order to avoid the repetitive operation of the internal loop, a combination of Boolean intermediate variables and flat sequence structure (Flat Sequence) is used to realize the function of running the internal loop only once, which ensures the continuous response of program operation and the single response of user control.

3.1. Virtual Operation Interface

The virtual control interface of the training system mainly includes the title, the selection of training subjects, the prompt of the missile shooting operation method, the virtual control panel, the virtual control system and the three-dimensional scene of the missile flight. The input controls mainly include various parts of the missile system and various switches and buttons, and the display controls mainly include various indicators and 3D scene displays.

3.2. The Program of Controlling Indicator Light

The program of controlling indicator light mainly controls the "on", "off", "flashing" and "delay coordination" of the 9 lights. The implementation method is given by taking the program of controlling flashing function of self-check indicator as an example. The program uses the Blinking Property Node to realize the blinking function of indicator light, uses the Boolean intermediate variable (a) and the local variable (self-check indicator) to control the execution of the Case structure, and uses the Flat sequence to control the flow of data. Part of the program chart is shown in Figure 2.
3.3. The Program of Controlling Firing Button
When the firing button is pressed, the missile-pylon indicator is off, and when the firing button is released, the missile-pylon indicator remains off. To achieve this function, the program uses the event of the firing button (SA1) being pressed as the trigger signal to trigger the Event Structure to run, and uses the Feedback Node to feed back the previous run values to the timeout branch. That is, when the firing button is pressed, the output of the event structure is always true. This result, together with the power switch, weapon selection and other buttons, determines the lighting of the missile-pylon indicator. Part of the program chart is shown in Figure 3.

3.4. The Program of Controlling Missile
The ground coordinate system is used when loading the 3D scene in LabVIEW. After the loading is done, the initial position of each model is set through the Set Translation function and the assembly is completed.
According to the Boolean intermediate variable (c) and the state of the firing switch, the program of controlling missile flight uses the And function to realize the two alternative branches of the case structure which is either true or false. Only when both variable (c) and the firing switch are True (pressing the firing button), the program executes the true branch to complete the missile launch, rotation stabilization and flight control. The program uses While Loops and Rotation Objects that they are parallel to control the missile to spin at the required frequency, and through the missile's measured ballistic data, changing the missile's space position (x, y, z) is to achieve the missile's flight control. When the missile flight ends (the missile hits the target), the program exits the While loop and assigns c to False; otherwise, the program executes a false branch and the program is in a launch waiting state, as shown in Figure 4.

Fig. 4 The design ideas of controlling missile
The part of program chart of controlling missile flight is shown in Figure 5.

Fig. 5 Part of program chart of controlling missile flight
4. Conclusion
This paper studies the technology of simulation modeling in SolidWorks and the virtual technology of instrument based on LabVIEW. On this basis, a virtual training system for a certain type of UAV-borne missile shooting operation is developed, which has the function of replacing the actual equipment training. The innovative research results obtained are as follows:

a) This paper created the action response model of missile firing operation and flight control. Using the functions of While loop, condition structure, event structure, and flat sequence structure in LabVIEW, the logical relationship between shooting operation and flight control is established, and the operation and control of missile flight are realized.

b) This paper developed a virtual training system for missile shooting operations. According to the training procedures of the actual equipment, except the missile flight control which adopts the virtual system to realize, the rest of the shooting operations are the same as the actual equipment, and the missile shooting operation training can be effectively implemented.

In general, the system can effectively solve the difficulties of troops and academies in missile shooting operation training and teaching, achieving the goals of reducing training costs, improving training efficiency, and shortening training cycles.

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