

Design and Application of the Missile Combat Training Simulation System

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Abstract—In order to meet the teaching needs of the missile combat training simulation, a combat training simulation system based on the analysis of typical combat situation and process, was proposed. The hardware platform and the system structure was constructed, and the system software was realized by the modeling simulation mechanism on integrated application of Multi Gen Creator, Vega Prime and Visual C++. Through teaching practice, the missile combat training simulation system was feasible, and could meet the teaching needs of the missile combat training.

Keywords—combat training; simulation system; missile; visual simulation

I. INTRODUCTION

With the continuous progress of system modeling and simulation technology, weapon system combat simulation has been widely studied and broad application prospects. To meet the training and research needs of information warfare, how to build a high-performance combat simulation system was an urgent problem to be solved in current equipment system demonstration and combat research, and also an important factor to determine the level of weapon equipment combat training. Aiming at the teaching requirement of the missile combat training, the hardware platform and system hierarchy of the missile combat training simulation system were constructed based on the analysis of typical combat situation and combat process. The system implementation task was completed based on the modeling simulation mechanism on integrated application of Multi Gen Creator, Vega Prime and Visual C++. It was proved by the teaching practice that the missile combat training simulation system could effectively simulate the combat training process of the missile, and show the combat training effects by visual simulation, which could meet the needs of teaching and training.

II. ANALYSIS OF TYPICAL COMBAT SITUATION AND PROCESS

Generally speaking, there were three kinds of attack trajectories mainly in anti-ship missile combat modes: sea-skimming flight attack, terminal jump-dive attack and horizontal maneuvering attack. Under the background of information warfare, the typical combat situation of anti-ship missile has changed profoundly. It was no longer a simple missile combat process, but also involved a series of complex situations, such as the impact of sea warfare environment (islands or sea conditions), enemy air defense firepower

allocation, third party force arrangement, commercial and civil vessels, etc. The typical combat process was no longer a simple process of targets discovering, firing data calculating, missile attacking, etc. It involved a series of processes such as battlefield situation awareness, target acquisition, threat judgment, target allocation, combat style selection, route planning and calculation, attack effects analysis and evaluation^[1].

During the design and practice of the missile combat training simulation system, the process and architecture of the missile combat training simulation system was constructed, which was from a typical combat process of the missile and to set the battlefield situation and perceived as starting. The digital chart was integrated into the simulation architecture. The process of target recognition, threat judgment, target assignment, attack style selection and route planning, attack effect analysis and evaluation, was also included, just shown in Fig.1.

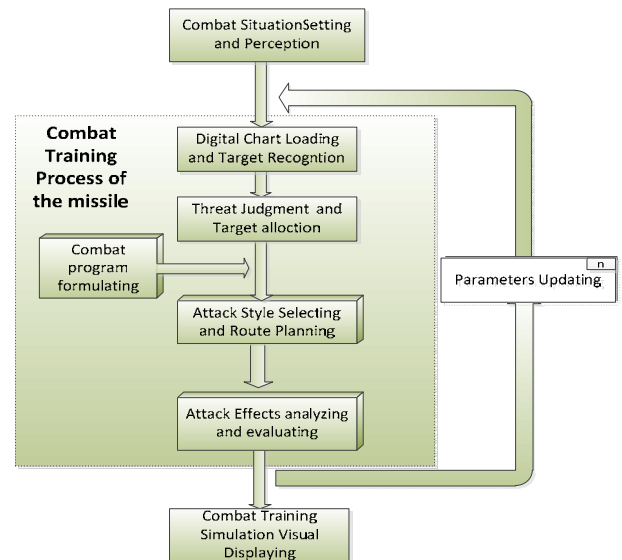


FIGURE I. TYPICAL COMBAT TRAINING SIMULATION PROCESS OF THE MISSILE

III. DESIGN AND APPLICATION OF THE MISSILE COMBAT TRAINING SIMULATION SYSTEM

A. Design of the Missile Combat Simulation Training System

Referring to the combat process of the missile weapon system, a missile combat simulation training system was

constructed based on high-speed Ethernet, which consisted of battlefield information processing simulator, command and control simulator, fire control simulator, combat simulation integrated console, visual simulation generation system and others [2]. The battlefield information simulator was mainly used for functional simulation of battlefield situation information processing, target information acquisition and others; the command and control simulator was mainly used for functional simulation of digital chart loading, threat judgment, target allocation, combat plan formulation and others; the fire control simulator was mainly used for functional simulation of attack

style selection, route planning, combat effect analysis and evaluation and others; the combat simulation integrated console was mainly used for battlefield situation and sea condition setting, battle training configuration and simulation data loading, etc. The visual simulation generation system was mainly used for the display of visual simulation effect in the combat training process, attack effect analysis and evaluation and other functions, which consisted of high-performance simulation computers, double-channel projection system, etc. The hardware composition diagram of combat training simulation system was shown in Fig. 2.

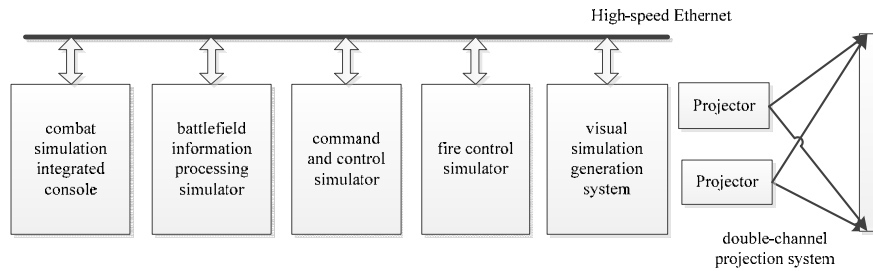


FIGURE II. HARDWARE COMPOSITION DIAGRAM OF COMBAT TRAINING SIMULATION SYSTEM

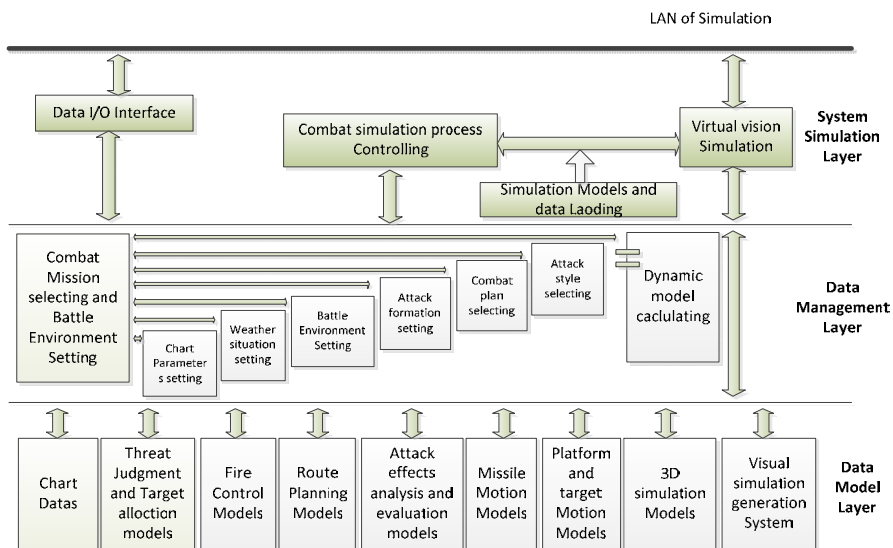


FIGURE III. HIERARCHY DIAGRAM OF COMBAT TRAINING SIMULATION SYSTEM

The function of combat command simulation, system integration and visual simulation was integrated in the training simulation system. A series of relatively perfect missile motion models, platform and target motion models, threat judgment and target allocation models, fire control models, route planning models, attack effects analysis and evaluation models, and 3D simulation models were constructed the simulation database, digital chart database management and integrated tools were also developed. Through the training simulation system, the real-time solution could be calculated and the combat simulation data generated according to the background scheme of combat training task, and the function of global viewing and virtual simulation 3D display was synchronously implemented. Also the function of simulation remote control and attack effect analysis and evaluation was realized based on simulation local

area network through data I/O interface. The hierarchical diagram of combat simulation training system was shown in Fig 3.

B. Modeling and Simulation Mechanism of Multi Gen Creator/Vega Prime Combining with Visual C++

In order to show the effectiveness of missile combat training process in real time, the virtual reality simulation mechanism combining Multi Gen Creator/Vega Prime and Visual C++ was adopted in the course of system design and development [3].

Multi Gen Creator software was used to build 3D simulation models with different details [4], such as missile models, typical ship models and typical island terrain models, based on the LOD (Level of Detail) technology. By setting the distance threshold to

realize LOD transition, rapid drawing of 3D simulation models in complex scenes was realized.

In the aspect of 3D real-time visual simulation, Vega Prime, a real-time scene driver software platform^[5], was selected for secondary development. A typical procedure was: (1) initializing Vega Prime environment, (2) creating vpApp instances, (3) loading scene ACF files, (4) controlling scene simulation through scene configuration and frame cycle, (5) closing vpApp instances before exit. The typical visual simulation system software structure was developed as shown in Fig. 4.

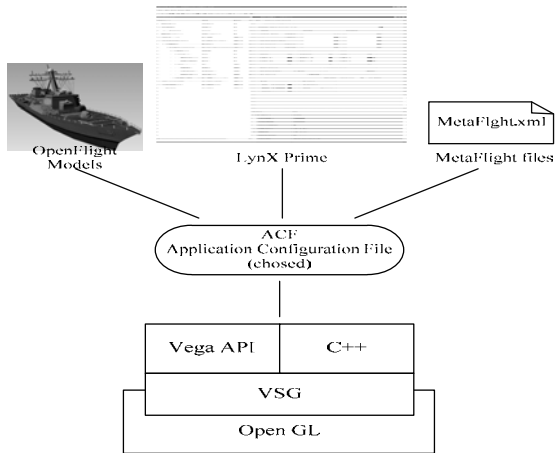
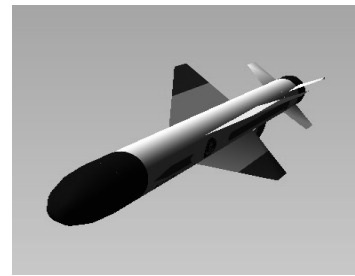


FIGURE IV. VISUAL SIMULATION SYSTEM ARCHITECTURE BASED ON VEGA PRIME

In the aspect of system integration, Visual C++ software platform was used to realize the function of combat command, data management and model control. process control of combat training and visual simulation was integrated^[6], which was mainly embodied in the design of control interface and the realization of combat application program, mathematical model program and control interface of 3D visual simulation in the core equipment such as battlefield information simulator, command and control simulator, fire control simulator, combat simulation integrated console and etc.

C. Effect Examples of the Missile Combat Training Simulation

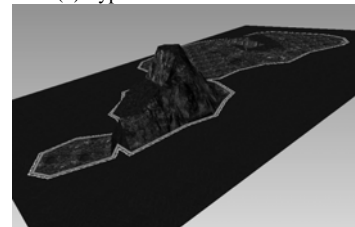
In order to show the effects of a combat training simulation system, an examples was carried out with the scenario of anti-ship missile evading Island and saturated attack surface ships. The 3D simulation models were shown in Fig. 5. The control interface and path result of saturated attack route planning was shown in Fig. 6, and the scenes of visual simulation effect in saturated attack combat process were shown in Fig. 7.



(a) Missile model



(b) Typical naval vessels model



(c) island model

FIGURE V. 3D SIMULATION MODELS

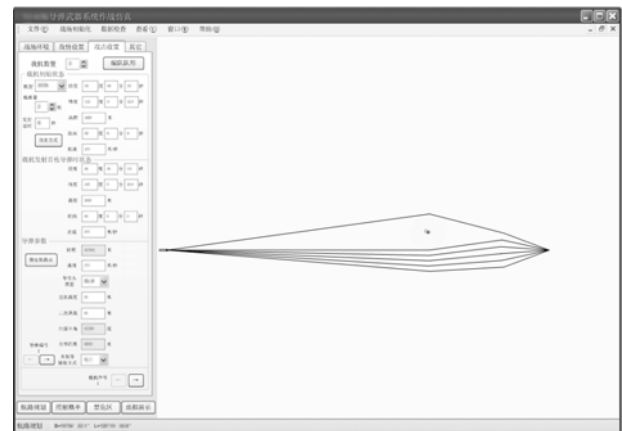
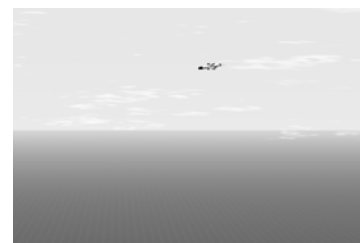


FIGURE VI. CONTROL INTERFACE AND PATH RESULT OF SATURATED ATTACK ROUTE PLANNING



(a) Scene of missile flying over sea

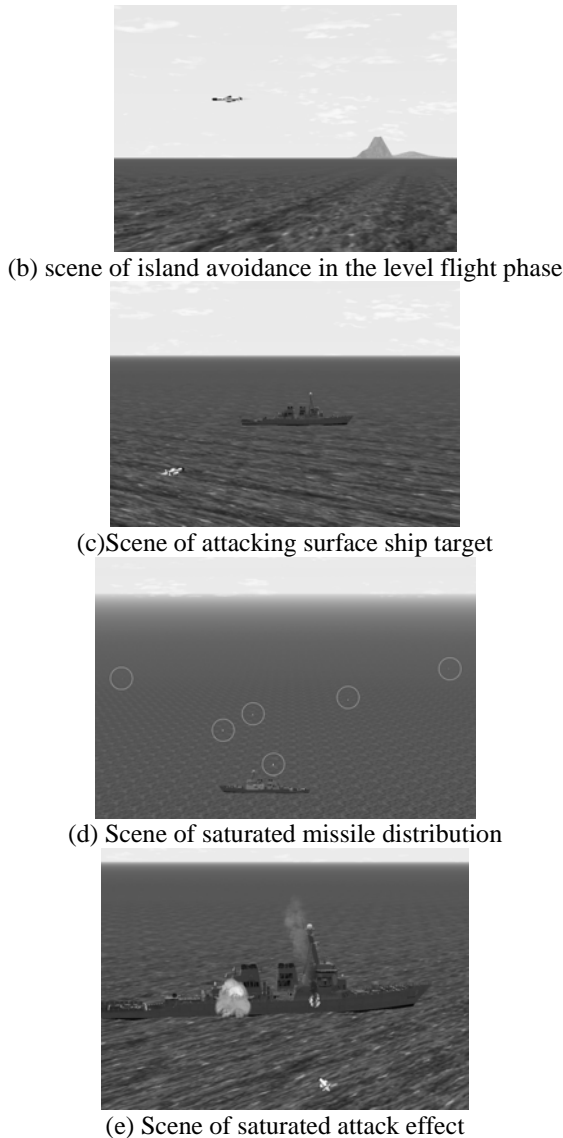


FIGURE VII. VISUAL SIMULATION PROCESS FOR SATURATED ATTACKING

IV. SUMMARY

Aiming at the teaching requirements of anti-ship missile combat training simulation, the design and implementation of an anti-ship missile combat training simulation system was completed by applying the modeling and simulation mechanism of Multi Gen Creator/Vega Prime and Visual C++, based on the analysis and study of typical combat situation and process of anti-ship missile. By building the general simulation hardware system and hierarchical architecture, a saturated attack simulation example of anti-ship missile was carried out. It was proved that modeling and simulation mechanism of Multi Gen Creator/Vega Prime and Visual C++ could be used feasibly, and important for practical system modeling and simulation.

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