Computer Wargame System Based on HLA

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***Abstract*—This paper proposes a set of design of computer wargame system based on HLA. This system can process the time sequence and logic sequence of command better than existing wargame system. The system simplifies the calculation of the logical process which is used to calculate war results.**

Keywords-* *Wargame ; HLA; combat simulation; Command Training Simulation System

I. INTRODUCTION

Von Royce Horowitz, Prussian palace war consultant, invented strict wargame in 1811. After 200 years of development, strict wargame has become an important means of combat simulation. [1] When users use of computer combat simulation system based wargame, they need to deal with their own complex situation information. In such systems, the computer is only responsible for calculating the impact of the wargames by the decision-making of combat. Combat simulation systems based on strict wargame rules do not need the support of CGF system or semi-automatic computer troops. This approach can significantly reduce system development costs, while it avoids the problems which are made by artificial intelligence technology. [2][3]

The High-Level Architecture / Run-Time Infrastructure(HLA / RTI) is the framework of a distributed simulation system technology by the U.S. Department of Defense Modeling and Simulation Master Plan, released in 1995. The framework is used to solve the interoperability between heterogeneous simulation systems. HLA completed in August 1996 definition, subsequently adopted by NATO countries, and in September 2000 was The IEEE accepted as standard. In the relevant provisions of the United States Department of Defense, after 2001 all the defense sector simulation system must be compatible with HLA. [4][5]

The program improves the traditional strict wargame system using the HLA time management mechanism. The new computer wargame system can describe the complex situation changes on battle field better. This article will focus on describing the system with the difference between the traditional strict wargame. The system uses the traditional strict wargame modeling method described operational entities, entity acts and war activities. There is only a brief introduction of the contents of this section in this paper.

II. SYSTEM ARCHITECTURE

The system consists of the following three subsystems:

1. The director subsystem. It is responsible for the data ready before training and training process management.
2. The wargame subsystem. It is responsible for calculating the operational activity results in each round. It generates a new battlefield situation and sends new objects' state data to the command and control subsystem.
3. Command and control subsystem. It provides for the users graphical operator interface. The users issued various command orders with this subsystem.

The entire operation of the system also needs the support of the database system and Run-Time Infrastructure (RTI). The system is based on HLA / RTI. Each subsystem is run on the same federation as federate. The system uses the object class to describe situation state, and uses interactive class to describe the command orders. The subsystem as federate subscribes object class for the object class data. [6] The interaction between the various subsystems as shown below:

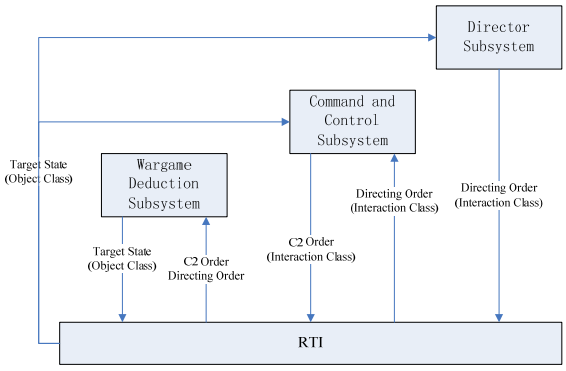

Figure 1. Subsystem Interaction.

III. SYSTEM DESIGN

The traditional strict wargame is turn-based. Against both move the pieces one after. It uses the "Round Table" to define system processes. Users operate the system according to the provisions of the round table. Users who preemptive hand, occupy a certain advantage in the decision process. In using traditional strict wargames, the command orders send by the users in a round is not sequential. This control method is difficult to reflect the internal logic of combined operational command. In strategic and operational level wargame system, the combat time of a round is long. This method of command order management will make more problems.

In traditional strict wargame systems, the entire combat process is divided into multiple rounds, each turn represents equal combat time. Each round is divided into a number of seasons in accordance with the provisions of the round table. The round table designing affect the game system. Various types of combat entities involved in combat operations in modern warfare. In modern high-tech warfare, battle command staff must be able to quickly and accurately respond to the ever-changing battlefield situation, flexible use of a variety of combat units to complete combat missions. Strict wargames round table is designed by professional military personnel. In the design process, the designer has to consider the actual principle of operational command and classic examples. But the commanding officers must combat training step by step in accordance with the pre-designed processes in such system which uses this operational process modeling method. Such training methods limit the play of the command staff. It also deviated from the true course of combat.

To overcome these problems, we have to transform wargame modeling method of the action of the combat units and warring activities. The rehabilitation program is based on the HLA \ RTI architecture and system design methodology of discrete event-driven simulation. Round is no longer divided into the season, and the sequence of operations is no longer provisions by the Round Table. [7]

In the Improved computer game system, the command has time property, which record the time to issue command and duration. In this system round on behalf of the combat time is short. The principle to set Round is “the time which the most common combat unit uses to move one step on the most common terrain in the wargame map”.

We put “the army field Battle with Air Force fire support” as a combat scenario. We introduce the method for the determination of the time of the Round deduction in the design process of the Battle of class wargames. In the application context, the most common ground combat unit is "Tank Battalion” and “Mechanized Infantry Battalion”, the most common terrain is the "flat open land ". A cell on the wargame map represents four kilometers. Assuming the tank battalion expands into evacuation formation march, its maximum speed is 16km / h in flat open. Well, it advances a grid took 15 minutes on average. In this system, each round represents the operational time of 15 minutes, referred to as "Round Time”. Basic combat unit in the time of a round is able to complete a step of combat deduction. And in this time, wargame deduction subsystem can generate meaningful trend calculation.

In this system, the director subsystem, wargames deduction subsystem and C2 subsystem are "time control and time limited" federates.[8]

A. *Director Subsystem*

The director subsystem's main function is to manage deduction. The director subsystem, the wargame deduction subsystems and C2 subsystem each call RTI time management interface to apply to promote the combat time. The software the cyclical automatically apply combat time advancing. The director subsystem unified control interval (physical time), which is between twice application of promoting the combat time. The system achieves acceleration and deceleration of deduction in this way. All federate are time control and time limited, so once the director subsystem pause time advancing, the entire wargame system deduction pause. The combat time of director system is “Round Time”.

The director system is able to release a variety of incidents, including the event of changes in the weather. The incidents have time attributes, including the duration of the events and the start time of events. These time attributes are combat time (simulation time). The system deals with the incidents according to their time properties.

B. *Wargame Deduction Subsystem*

In the training process, wargame deduction subsystem periodically generates new battlefield situation data. Before Round calculation subsystem need to call the RTI time management interface to apply combat time advancing. It completes application of advancing combat time first. Then, it calculates new battlefield situation data of the round. Subsystem uses the system "Round time". In the calculation process, it first finds all unprocessed command and control commands whose start time is in the round. Then, the subsystem deals with them. Round processing is the last step.

In the round processing, the wargame deduction subsystem detects collision events between combat entities first. Then it determines whether collisions cause war activities. If the collisions cause war activities, subsystem will transform collisions to discrete Events. Next, the subsystem fixes the entity ability according to battlefield environment and situation. At last, the subsystem calculates the warring results, and generates new battlefield situation.

C. *Command and Control(C2) Subsystem*

Of particular note is that the C2 subsystem dos not use the “Round Time” as the Cycle propulsion time. The subsystem combat time step is shorter than the “Round Time”. For example, it can be defined as one-tenth of the Round Time. Similarly, the physical time interval to apply combat time advancing is also one-tenth of the other subsystems. This implementation can guarantee allegations command with a more precise operational time stamp. [9][10]

The main function of the command and control subsystem provides a graphical, interactive interface for the trainees. The trainees will be able to use the subsystem to observe the virtual battle space combat entity, Research the battlefield situation, and command entities.

D. Process Workflow

In the traditional strict wargame system, the director subsystem sends control orders to drive the inference process. In such systems, the inference process is divided into rounds. The users move chess pieces in accordance with the provisions of the round table every round. After moving chess pieces, the system calculates new battlefield situation. Each subsystem serial work according to a certain time sequence, as shown below:

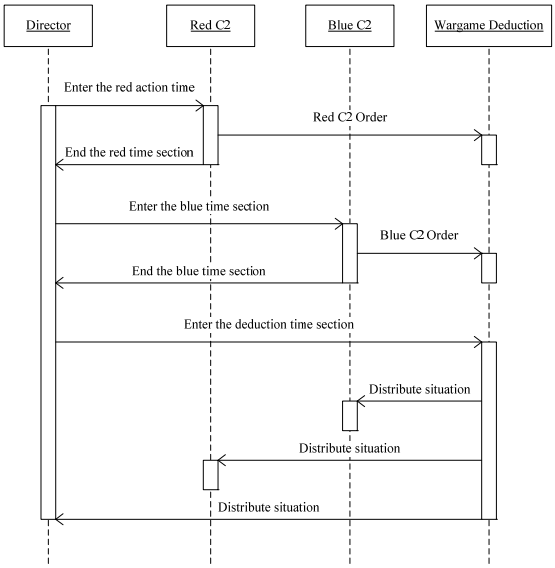

Figure 2. The sequence of classic wargame systems

This operation mode is different of the mode of existing C2 system. If the existing C2 systems are not reformed to fix the simulation system based on classic wargame system, it is not possible to make them work together.

In our scheme, every subsystem manages its own combat time advance. The time management method of HLA can make sure the time consistency of the whole system. In the deduction of the whole system, the wargame deduction subsystem and the C2 subsystem are the major players, as shown below:

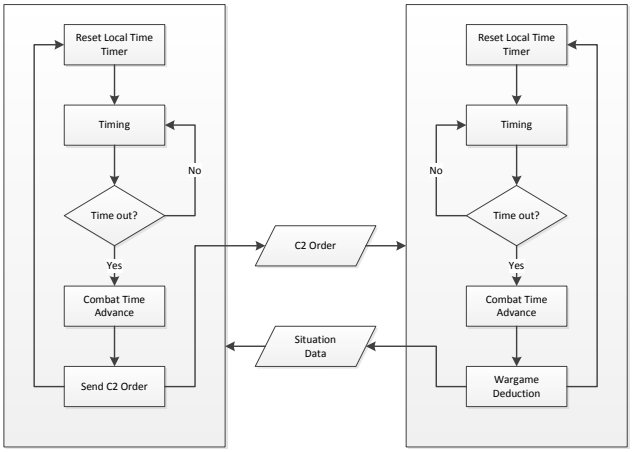

Figure 3. The workflow of the improved wargame system

The C2 subsystem and wargame deduction subsystem work independently. Their steps of combat time advance can be different, as shown below:

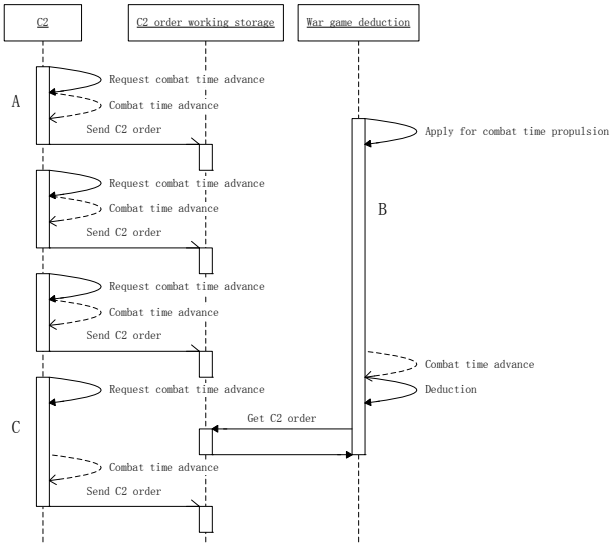

Figure 4. The sequence of the improved wargame system

In this system, the director subsystem and wargame deduction subsystem are "time control and time limited" federates. They can influence each other's combat time advance. The combat time step of C2 subsystem is shorter than the director subsystem. When it requests combat time advance, it does not wait in most cases, as shown in figure 8, the "A" Point. The combat time step of wargame deduction subsystem is longer. It often has to wait for the C2 subsystem, as shown in figure 8, the "B" Point. The combat time advance of the C2 subsystem can be influenced by the director subsystem, but it is unusual, as shown in figure 8, the "C" Point.

IV. CONCLUSION

During operation, the system no longer relies on the Round deduction command to drive system deduction, which is send by director subsystem. While it uses automatically advance of combat time, and the HLA time management mechanism, which can coordinate the combat time of federal members to ensure the consistency of the combat system time. From a user standpoint, the system is more close to real-time deduction combat simulation system. Using A elements deduction computer wargame system designed by this way, the command training can be organized manner closer to the actual operational command processes. And this system can be used with the existing C2 systems.

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