Research and design of key technology and system architecture on simulation confrontation training

Fang Yuan[1], Junqiang Yang[1], Qinghui Zhang[1], Jun Wang[2,a]

[1]Test Center National University of Defense Technology, Xi'an, China;

[2]Unit 95795 of PLA, Guilin, China.

[a]wangjun09@gfkd.edu.cn

Abstract. Aiming at the problems of unreal training scenes, unintelligent training agents and difficult data interaction in the process of simulation confrontation training, this paper combines image processing, neural network, GBB(general blackboard) technologies with system simulation technology, research around realistic complex environment modeling technology, confrontation agents modeling technology, and multi-model data interaction technology, then puts forward practical solutions. On this basis, a simulation confrontation training system integrating training management, scene development and resource management is designed, which provides a feasible idea and reference for the construction of an immersive, high-intensity and agile interactive confrontation training environment.

Keywords: Simulation confrontation training; system architecture; complex environment modeling; agents modeling; data interaction.

1. Introduction

With the rapid development of virtual simulation, image processing, artificial intelligence and other technologies, simulation confrontation training has gradually become a more common training mode in the process of military training, because it is not restricted by factors such as site, time, personnel, equipment and so on. However, how to ensure the scene fidelity, agents intelligence, data agile interaction have been widely concerned and studied by scholars.

In view of the above problems, this paper focuses on the technologies of realistic complex environment modeling, agents modeling and multi-model data interaction, and proposes solutions. On this basis, a simulation confrontation training system integrating training management, scene development and resource management is designed, focusing on the research and design of key technologies, system architecture design, and core function content structure.

2. Concepts of simulation confrontation training

In the mid-1980s, the means of simulation training gradually changed from sand table and hand-made wargame to computer simulation[1]. Local wars under information conditions such as the Gulf War gave birth to the concept of LVC (live virtual constructive) virtual real integration joint training. Simulation confrontation training has become an important means of military training organization mode[2]. Simulation confrontation training is conducted by simulating various complex environments in the virtual world, modeling various models such as equipment and personnel, defining interaction rules and algorithm rules, and organizing confrontation training. According to the differences in training needs, the U.S. military has successively developed a number of simulation training systems, which are divided into individual soldier level (platform level) training simulation system, collaborative level training simulation system and comprehensive simulation training environment from the perspective of training objectives, training objects and riding and training capabilities[3]. The individual soldier level training simulation system is represented by the virtual reality combat training system which mainly carries out multi-person confrontation training in a virtual scene the size of a basketball court through head mounted VR equipment, simulation weapons, etc. The collaborative training simulation system is represented by

VBS (virtual battlefield space). Based on the military game "armed assault", a large number of military level entity models are used, which can support task planning and deduction, virtual environment construction and multi person collaborative training. The integrated simulation training environment is mainly to build a set of global general terrain driven by cloud, which is generated by modeling of real terrain, and can select virtual scenes for training as needed. Domestic simulation confrontation training is also undergoing continuous transformation and upgrading, but there is still a certain gap compared with foreign countries. The unreal training scenes, unintelligent training agents and difficult data interaction have become difficult problems hindering the development of digital transformation.

3. Research on key technology

In view of the above status and existing difficulties, this paper mainly focuses on three key technical points: realistic complex environment modeling, agents modeling and multi-model data interaction.

3.1 Research on realistic complex environment modeling technology

three-dimensional environment modeling is the basis of constructing virtual world, which can be divided into two parts: digital simulation modeling and visual simulation modeling. The digital simulation modeling is mainly based on the real world basic geography, meteorology and hydrology, electromagnetic and other information for modeling and simulation. However, the environment covers a wide range, and there are differences in the content, logic and storage methods of environmental data in different fields, which need to be described uniformly[4]. In this paper, the SEDRIS(synthetic environment data representation and interchange specification) standard is used to map the environment model data into the SEDRIS data representation model for accurate representation, generate unified standardized STF(SEDRIS Transmittal Formal) format environment data, form a synthetic environment database, and provide standard data for the system[5]. The visual simulation modeling uses remote sensing images, oblique photography and other technologies to collect image data of typical scenes, and constructs a realistic and vivid three-dimensional scene model through refined modeling methods such as monomer modeling and tile cutting processing to solve the problems of unreal and weak immersion simulation confrontation training scenes. The specific design idea is shown in figure 1.

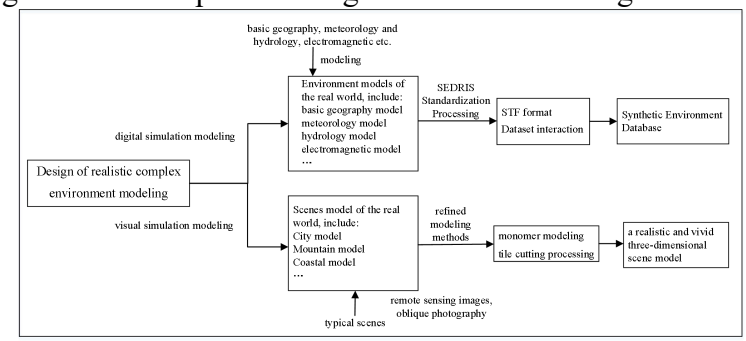

Fig. 1 Design idea diagram of realistic complex environment modeling

3.2 Research on agents modeling technology

In order to build a training system with high confrontation, the intelligence of agents is the key factor. With the rapid development of big data, artificial intelligence, machine vision and so on, the modeling technology of agent is also constantly breaking through. In 2019, OpenAi Five successfully defeated the world champion of dota2 game, and in 2020, the AlphaDogFight agent designed by DARPA company defeated human pilots in close air combat[6]. In this paper, a decision-making strategy driven by data and knowledge is designed. The "brain" of the agent is

constructed through the neural network, and the decision-making instructions are issued in combination with the knowledge rule base. The decision-making instructions are executed in the simulation confrontation training, and the execution results are fed back to the agent in real time. Through a large number of training, the effect of strengthening the agent model is achieved. The specific design idea is shown in Figure 2.

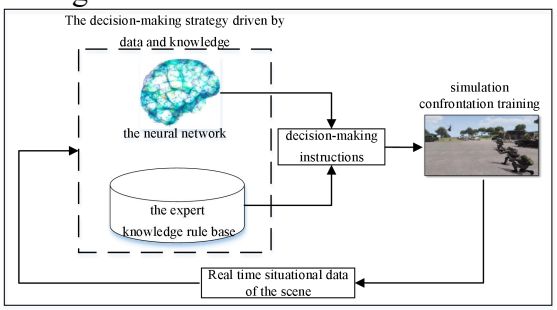

Fig. 2 Design idea diagram of agents modeling

3.3 Research on multi-model data interaction technology

For multi-model, its association complexity is high, the running logic is intertwined, the amount of interactive data is huge, and it is difficult to access and call between data, which restricts the type and scale, technical methods, integration strategies, and operation scheduling of the model, and seriously affects the system operation efficiency and simulation scale[7]. In view of the above problems, this paper adopts the GBB technology, with the modular design concept, supports the parallel computing between models and algorithms, carries out unified storage and classification management of simulation data[8], and realizes data interaction and model sharing. The specific design idea is shown in Figure 3.

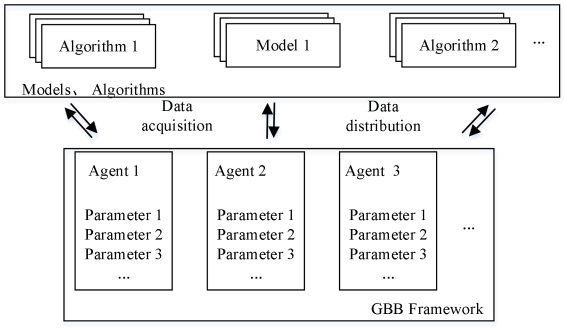

Figure 3 Design idea diagram of multi-model data interaction

4. Systems Design

4.1 Systems Architecture

The system architecture is divided into four layers: foundation layer, resource service layer, core function layer and specific application layer. The specific architecture design is shown in Figure 4.

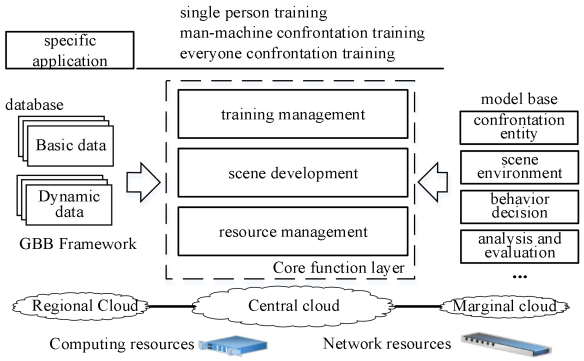

Fig. 4 the architecture design of simulation confrontation training system

The infrastructure layer consists of computing, storage, network, cloud and other infrastructure[9].

The resource service layer mainly includes database and model base. The database stores basic data (geographic information, meteorology and hydrology, electromagnetism, scene image, etc.), dynamic data in accordance with the general blackboard mode, and model inventory stores model data such as confrontation entity (data knowledge dual drive decision strategy training), scene environment, behavior decision, analysis and evaluation.

The core function layer is designed with three functional modules: resource management, scene development and training management. The resource management module is used to manage simulation confrontation training resources such as entity model, graphics and animation, scene environment, sound effects and algorithm services of simulation confrontation training system; The scenario development module is used to develop and edit simulation confrontation training scenarios and simulation confrontation training resources, provide the basic framework for confrontation scenario editing, and realize entity model editing, graphic animation editing, sound effect editing, algorithm service editing, scenario environment editing, training scenario editing and supporting resource editing; The training management module is used to organize and manage the simulation confrontation training, manage the basic information of participants, training tasks, control and monitor the training process, and collect and analyze training data.

The specific application layer mainly provides various typical simulation confrontation training scenarios, and supports simulation confrontation training in the modes of single person training, man-machine confrontation training and everyone confrontation training.

4.2 Core function module structure

The system realizes the development, management and operation of the whole process and all elements of simulation confrontation training through three functional modules: training management, scene development and resource management. The specific structure is shown in Figure 5.

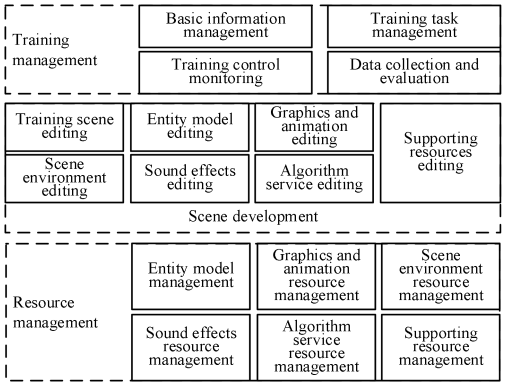

Fig. 5 The specific structure of core function module

The training management module is composed of four parts: basic information management, training task management, training control monitoring, and data collection and evaluation. It is mainly used to manage user account information, download and install training applications, classify and manage task scenarios, organize and carry out confrontation training, monitor the training process in the whole process, collect and analyze training data, and statistically analyze training results.

The scene development module is composed of seven parts: training scene editing, entity model editing, graphics and animation editing, scene environment editing, sound effects editing, algorithm service editing and supporting resources editing. It is mainly used to provide the combat scene editing engine, edit the virtual environment, combat entities, rules of engagement, animation effects and other contents in the combat training scene, and develop the combat training task scene.

The resource management module is composed of six parts: entity model management, graphics and animation resource management, scene environment resource management, sound effects resource management, algorithm service resource management and supporting resource management. It is mainly used to import and export, preview and test, query and retrieve the entity model, graphics and animation, scene environment, sound effects, algorithm services and other resources in the field of simulation confrontation training.

5. Summary

This paper summarizes the simulation confrontation training, and aiming at the problems of unreal training scenes, unintelligent training agents and difficult data interaction in the process of simulation confrontation training, it carries out in-depth research around realistic complex environment modeling technology, agent modeling technology and multi-model data interaction technology, puts forward the design idea of the solution, then it finally constructs the simulation confrontation training system, which include in training management, integrates scene development and resource management. This paper provides a feasible idea and reference for the construction of an immersive, high-intensity and agile interactive confrontation training environment, and has certain reference significance.

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