Research Article

Dynamic Posture Prediction Model in Informationized Combat Environment

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The several local wars that broke out at the turn of the century have shown to the world that the rapid development of high and new technology with information technology as the core is effectively promoting the pace of world military reform, and its most essential feature is information dominance. In local wars under modern high-tech conditions, rapid response and multiarms joint and coordinated operations have become the key factors to win, which requires multiarms, multiweapon platforms, and each combat unit software to work autonomously and dynamically. This research mainly discusses the dynamic posture prediction model in the informationized combat environment. It designs the organization of command elements, related data (products and tools), competency, personnel matching checklists, and activities in joint operational planning and relies on activities to model the binding of groups, capabilities, and related data. Finally, it forms process segments through the combined design of activities and then sets the final state and background knowledge constraints on the process segments to construct the process knowledge, turning each combat unit into an agent unit, so that the combat software unit has the performance characteristics of the agent’s autonomy, reactivity, and sociality. At the same time, it has good communication performance and autonomous negotiation ability, so it can realize the autonomous connection, communication, and cooperative work among multiagent systems. During the process execution or business processing, the seat staff can input the goal and background of the activity according to the current operating environment. It relies on the background constraints of the process knowledge to quickly match the corresponding process knowledge, insert the process fragments in the process knowledge into the original process, realize the rapid and efficient decomposition of the process redefinition, and effectively ensure the orderly development of the combat command. Techniques and methods for automating integration testing of combat systems are provided. These technologies are further applied to the process of combat system integration tests to improve the efficiency of combat system integration. In addition, through the research on the integration testing technology of combat systems, the problems of low generality of integration testing software and many structural repetitive codes can also be solved and the existing integration testing technology can be further improved. In the research, the time-consuming of the script interpretation module accounts for a relatively low proportion of about 5% of the simulation. The article embodies the platform to explore the realization of multiagent-based dynamic cooperative operations, to achieve the purpose of simulating the battlefield situation, rehearsing the combat plan, and evaluating the strike effect. This study will improve the efficiency of overall combat system integration.

1. Introduction

The practice of building a joint combat command system and the needs of contemporary military development show that a strong command system will play a pivotal role in future joint operations. In the context of the information age, relying on operational command flows can compress command decision-making and event planning, and complete multidomain, multilevel, distributed, and interwoven planning and execution, so that people can make the best use of their talents and materials, fully apply advanced combat concepts to future operations. Through the information network and collaborative system platform technology, the various elements of participation, command, and weapon functions are combined, so that it can negotiate and attack enemy units autonomously. That is to say, the
battlefield perception network, the battlefield command network, and the fire strike network are effectively connected to make it a whole combat system.

In recent years, the country has fully realized the importance of informatization construction, puts forward the goal of adapting to the military reform with Chinese characteristics, realized leapfrog development, strengthened the construction of military informatization, and made remarkable achievements. The composition of the combat command group is fixed. When the process execution subject needs to be modified, if the group itself is not modified, the process definition must be adjusted and the execution subject must be reselected. The introduction of capability can enhance the dynamic nature of the process. On the basis of not modifying the process definition file, the execution subject of the activity can be modified according to the situation in which the process is executed. That is, if the execution body is configured as a capability for activities that do not generate an instance, the members of the current capability will be read when an instance is generated. Capability itself is an essential feature of an atomic activity or task and the ability to land in an atomic activity or basic task. The members of relevant capabilities can be adjusted at any time with the change of external conditions; that is, different capabilities are allocated according to different types of activities during the execution of activities so that the execution body of the modified activities can be realized without modifying the process definition.

It is required that the mobile terminal of the individual soldier cannot only seamlessly link with the existing command system but also realize the interconnection and interoperability of various combat forces, battlefields, and combat operations. It is also necessary to pay attention to the use of battlefield network technology to enable individual soldiers to have flexible and effective networked combat capabilities. In addition to the message format and content definition described in the combat system data model, it is also necessary to add description operations, ports, and protocol binding information to the data model. To support the dynamism of the joint operations command process, two types of improvements are made to the workflow meta-model. The two types of improvement are the first type of improvement is concreted when the process is executed by adding pending activities; the second type of improvement is to increase the human capacity, form ad hoc groups, and dynamically assign activities at the time of the process instance. To realize the dynamism of the joint operation command, a hierarchical decomposition model is established through the analysis of the content and concept of the joint operation, the process of the joint operation command is processed, the modeling elements of the processing system are refined, and the dynamic requirements of the processing system are analyzed.

2. Related Work

In recent years, with the rapid development of computer science and technology, great changes have occurred in the application of information technology in the military field. War has become increasingly electronic, digital, and intelligent. Computer simulation technology and artificial intelligence technology have been widely used in the field of modern military exercises. In the combat system information model, the combat system data model only contains the message format and content definition, while the combat system process model describes the way of message flow and related information. Chen P measured PAH concentrations in total suspended particulate (TSP) samples collected at six sites along two north-south transects in the central Himalayas. Annual mean TSP and PAH (especially 5- and 6-ring compounds) concentrations were found to decrease significantly northward along both transects. In rural and urban areas, TSP and PAH concentrations showed significant seasonal variation, with lower concentrations in mid-monsoon and higher concentrations in winter. Meanwhile, in remote areas such as Nyalam and Zhongba, these pollutants remained largely unchanged throughout the year, but the levels were relatively high before the monsoon season. Atmospheric PAHs from urban and rural areas are mainly associated with emissions from biomass burning, coal burning, and oil burning [1]. Sharma et al. believe that cancer immunotherapy can induce durable responses in patients with metastatic cancers of various histologies. Expanding the clinical applicability of these treatments requires a better understanding of the mechanisms that limit cancer immunotherapy. The interaction between the immune system and cancer cells is continuous and dynamic and depends on immune evasion from the initial establishment of cancer cells to the development of metastatic disease. As the molecular mechanisms of immunotherapy resistance are elucidated, feasible strategies to prevent or treat them can be developed to improve clinical outcomes for patients [2]. Peng et al. presented a method for airport detection on optical satellite images using convolutional neural networks (CNN). To efficiently build deep CNNs using limited satellite image samples, a transfer learning approach is employed by sharing common image features of natural images. To reduce the computational cost, he proposes an efficient region proposal method based on prior knowledge of the distribution of airport line segments. He first evaluated the transfer learning ability of deep CNNs for airport detection in satellite images. His proposed method was tested on an image dataset including 170 different airports and 30 nonairports. In experiments with a computation time of seconds, the detection rate can reach 88.8%, which is a great improvement over other state-of-the-art methods [3]. Judson believes that the Baltic country Lithuania is emerging as a leader in charge of cybersecurity, and its development in cyberspace could benefit Europe and the United States. Lithuania has reason to be concerned about cyber threats: it is no secret that Russia targets cyber-attacks and disinformation campaigns. Although Lithuania saw a decrease in the total number of confirmed cyber incidents last year, the country reported a 41 percent increase in the number of sophisticated cyber-attacks. These malicious events include malware, system, intrusion, and compromised systems [4]. Wapstra et al. present the first of two articles (parts 1 and 2) presenting the results of the new
atomic mass assessment Ame2016. It includes complete information about the experimental input data (which also includes unused and rejected data), and details of the evaluation procedure are used to derive the table of recommended values given in Part II. He describes the evaluation concepts and procedures implemented in the selection of specific nuclear reactions, decays, and mass spectrometry results. These input values are entered in a least-squares adjustment to determine the optimal values for atomic masses and their uncertainties. The computational details and peculiarities of the same are then described. All accepted and rejected data, including weighted data, are presented in tabular form and compared with adjusted values obtained using least-squares fit analysis [5]. It adopts system modeling and simulation technology, service-oriented business process management technology, establishes a combat system information model with reference to the combat system interface protocol, applies model-driven thinking in combat system integration testing, drives the entire combat system integration testing process through the information model, and improves the integrated testing capability and technical level of the combat system. According to the traditional single-machine environment artillery combat simulation system, when a new situation appears in the simulated battlefield, the agent will continue to adopt a fixed combat plan to deal with it, which is limited in exploring a better combat plan. The combat simulation environment needs to shift from the stand-alone environment to the network environment.

3. Construction Method of the Dynamic Posture Prediction Model in Informationized Combat Environment

3.1. High-Rise Frame Design. Real-time decision-making needs to analyze and evaluate various action plans based on the real battlefield situation and predict the effects of various action plans on the enemy and the impact of these action effects on the enemy commander’s next decision. It allows the commander to conduct a quick action plan analysis before the decision is implemented, explore a variety of possibilities, and determine the most favorable action plan. The high-level framework of the dynamic data-driven simulation system for real-time operational decision support is shown in Figure 1. It mainly consists of seven parts: dynamic simulation engine, simulation system, scenario and plan generation tools, evaluation tools, data injection components, user interface and visualization components, command and control system, and its real-time database and real-time data feedback components.

3.2. Dynamic Simulation Engine. The dynamic simulation engine (DSE) is a scalable and flexible simulation engine that provides support for the execution of multiple simulations running across parallel and distributed platforms. It provides the basis for fast branch COA analysis for real-time decision-making and supports multiparallel COA simulation and single COA multibranch simulation. Through the data injection interface, the dynamic simulation engine provides the ability to inject reconnaissance, surveillance, and intelligence information in real time, and the commander can quickly “see” the future at any time.

Discuss load standards: For the load of each simulation instance, there are many factors that affect the running time of the simulation instance, and the historical running time and the last simulation running time can best reflect the load degree. Therefore, a linear function of load and historical running time and the running time of the previous simulation is established [6].

\[
y = \alpha \times t_n + \beta \times \sum_{i=1}^{n} t_i,
\]

where \(\alpha\) and \(\beta\) are controllable parameters, and \(\alpha\) represents the influence of the previous running time on the simulated load.

In modern warfare, the dynamic nature of the enemy’s behavior makes it difficult for us to accurately predict and analyze the enemy’s combat action plan. Analysts need to evaluate planning strategies against a wide range of possible adversary courses of action. After implementing the first step of the action plan, follow-up decisions must be made based on the new battlefield situation. To make action plan analysis tools more useful, adversary behavior models that accurately predict enemy actions must be incorporated into the system. Traditional combat simulation generally executes predefined enemy behavior scripts, and its plot cannot change dynamically with the development of combat. Our COA is also launched against the most likely enemy COA (eCOA) and the most dangerous eCOA. The system requires real-time prediction and evaluation of the results of our COA on the enemy’s behavior during combat, and these behavioral results in turn affect the decision-making of the wrestler and the way of future actions. Therefore, the ability to speculate on the influence of the previous hostile needs to be added to scenario generation [7].

3.3. Model Dynamic Composition. The plug-in function of model dynamic combination needs to start with design and develop low coupling model design. The core is layered design and interface oriented design.

3.3.1. The Principle of Layered Design. Model hierarchical division design refers to reducing the granularity of model division in the vertical direction and increasing the level. For a complete military simulation model, the depth and hierarchy of the model should be clear and follow the principle of multilevel design. For example, the combat action model includes the maneuvering model, reconnaissance model, firepower model, and communication model. In the reconnaissance model, there are the target models found, and the target model is divided into the field of view coverage model and the line of sight model; in the firepower model, the projectile matching model and the ranges model are divided. A multilevel model is a statistical technique that uses multiple levels of data to illustrate the relationship between different levels. Over the past few decades, the
statistical basis of multilevel models has been developed in various disciplines and given different names.

The layered design of the combat simulation model, first of all, has high accuracy in the model description, that is, the finer the granularity, the more accurate the description; secondly, the hierarchically designed model can take full advantage of parallel computing. Finally, the hierarchical division design is helpful for division of labor and module reuse. Through layered design, new models can be created by combining different basic models, reducing the amount of development.

Computational marginalization refers to handing over the model data as far as possible to itself for preprocessing and precomputing, reducing the communication cost, and reducing the calculation amount of the core central node. And it takes advantage of parallel computing to improve the overall computing efficiency. The hierarchical design pattern has the ability to utilize edge computing. Each submodel is responsible for receiving and processing the data it needs and then feeds back the processing results to the central model.

However, the excessive hierarchical design brings communication costs and possible model data inconsistencies. That is, the communication logic between too many submodels is complex, and more time and bandwidth are required in the case of multiple processes. At the same time, the direct data interaction of too many submodels may lead to data inconsistency. Taking the tank model as an example, the following advances discuss the benefits of a layered design strategy.

If the task of the tank is linearly centralized, the ideal total time is [8]

$$T_S = T_0 + T_A + T_B + T_C + T_1.$$  \hspace{1cm} (2)

If the task of the tank is to pass the edge computing mode, the ideal total time is [9]

$$T_M = \text{MAX}[T_0, \text{MAX}[T_A + D_A, T_B + D_B, T_C + D_C] + S] + T_1.$$  \hspace{1cm} (3)

In the case of a single machine, that is, the time-consuming of thread communication is 0, and the time-consuming due to multithread scheduling is very small [10].

$$T_0 \approx T_{A,B,C},$$

$$T_0 \leq T_1.$$  \hspace{1cm} (4)

In the case of load balancing, multilevel edge computing will obtain the greatest benefit, and its speedup ratio is as follows [11]:

$$Y = \frac{t/T_M}{t/T_S} = \frac{t/N}{t/N} = 4.$$  \hspace{1cm} (5)

### 3.3.2. Interface-Oriented Design

Combined with object-oriented polymorphism, through proper interface design and reservation, all operation objects are interfaces of this model. The developer sets an interface for each different model, and the user only operates on the interface and does not need to care about the specific implementation details. Model development and design process can learn from the programming idea of interface-oriented development, reduce the coupling between models, and combine the characteristics of object-oriented languages. For example, Java’s reflection technology can load specific models at runtime.

### 3.3.3. Human-Machine Interface

In the information-based dynamic combat system, the role of the commander is irreplaceable. The “man-in--in-the--the-loop” mentality needs to be leveraged, and the commander should not be excluded. Therefore, the system must provide powerful interactive functions that enable commanders to express opinions, propose plans, see into the future, make decisions, and issue orders. The decision support system is a computer-based human-computer interaction system, and the use of the system is oriented to decision-makers. Operational decision-making is a highly intelligent activity. Judging from...
the current development level of science and technology, none of the existing computer application systems can completely replace experienced commanders. For this, the following interfaces need to be provided:

1. Provide an interface for scenario and plan generation
2. Provide an interface to initiate quick prediction and COA assessment
3. Provide an exit for issuing command and control orders
4. Provide the visual interface of the system

3.4. Command and Control System and Its Real-Time Operational Database and Real-Time Data Feedback. The command and control system refers to the information system used to command the troops to perform combat tasks, which communicates the links between the troops and the command organization at all levels. In wartime, the command issued by the commander is communicated to the subordinate troops through the command and control system network, and the troops will carry out the combat mission according to the plan after receiving the command. The real-time combat database and real-time data feedback of the command and control system provide real-time information to the simulation system.

3.5. Campaign Tactical Combat Application Mode

3.5.1. Prewar Analysis Mode. The information-based dynamic combat system can be used for COA analysis and rapid mission drills. Using the predictive capabilities of the system, superreal-time simulation of COA and its backup plan provide support for COA analysis. Different scenarios are generated through the design, and a large number of experiments are carried out. According to the corresponding index system, comprehensively and accurately quantitatively analyze and evaluate the results and pros and cons of various schemes in various situations and conduct research on tactics under various pressures and extreme conditions and then use the research results as the basis for formulating combat plans. The three application modes of the information-based dynamic combat system are shown in Figure 3:

3.5.2. Prewar Training Mode. The use of the information-based dynamic combat system can not only carry out the usual decision-making ability and operation skills training but also carry out comprehensive training to simulate the real situation during the exercise and to enhance the decision-making ability, operation ability, and adaptability of the commander and staff. Utilizing the real-time simulation capability of the information-based dynamic combat system and man-in-the-loop simulation, it can support the training of commanders and staff. By adding real-time data calibration capability, this capability can be extended to a comprehensive training method during the exercise and experience the immersive real-time decision-making process. At this time, the operating mode of the system is the same as the real-time decision-making mode in wartime.

3.5.3. Real-Time Decision Support Mode. Real-time operational decision support is mainly manifested in the following two aspects:

1. Utilize the ultrareal-time simulation and prediction ability of the information-based dynamic combat system to quickly deduce the plan, provide the plan’s effectiveness to the plan generation tool, and make the plan generation process evolve into a more accurate plan optimization process
2. Leverage current real-time situational calibration simulations to predict the future effectiveness of plans and continually evaluate and improve plans as operational situations evolve.

3.6. Model Process Editable Design. The traditional simulation displays the system in four dimensions of space and time, while the simulation of the information-based dynamic combat system needs to display the system in five dimensions (5D): space, time, and branch. We can think of real-time simulation with dynamic data-driven updates as a continuous update of the 3D real-time situation. Since the real-time situation is constantly evolving with time, the simulation prediction based on the real-time situation is also continuously refined. The fourth dimension control of the simulation is realized by providing fast advancing time processing capability. Combining the four-dimensional situation with a variety of possible branching technologies provides the ability to manage and explore a variety of future five-dimensional situations. This idea expands the concept of four-dimensional space-time and displays the future world in parallel in five dimensions. The visualization tools compatible with the current parallel distributed simulation can be used as the five-dimensional visualization tools of the information-based dynamic combat system.

Visual programming technology mainly refers to the setting of model combination, model task flow, environmental information, and command information, by dragging and dropping the block diagram through the visual interface. It shows tactics and tasks through specific flowcharts, as well as links the communication and data flow of multiple modules. A complete simulation visualization tool should have the functions of model assembly, configuration, task configuration, and random event introduction and support function of runtime scripting language interpretation. The advantage of this design is that simulation developers can pause the simulation at any time and modify the simulation model, scenarios, tasks, and other information to achieve dynamic configurability, which improves the interactivity of military simulation to a certain extent. Simulation developers can quickly modify existing simulation tasks and scenarios to achieve multiple simulation verification tasks. First, the function of building model entities is introduced. The model construction method is shown in Figure 3:
3.7. Realization of the Agent Module for Force Deployment.
The force deployment agent module obtains the enemy’s highest threat level and battlefield combat unit information from the threat level agent module, obtains the next logical action to be executed from the situation judgment agent module, and then formulates the action instructions. The XML document is formed and submitted to the path planning agent. Logically, it is set to concentrate all firepower to attack the combat unit with the highest threat level of the enemy and then start other attack operations after it is eliminated. The command setting is mainly composed of the following elements: unit information, location, task type, and the target location of the task execution. The operational deployment agent module can be described by an expression, namely [12],

\[ D_I = (U, O, E_N). \] (6)

Here, \( U \) is the list of our participating troops, \( O \) is the list of instructions that the participating troops will execute, and the main elements in \( U \) and \( O \) are the same, and \( E_N \) is the environment description of the combat area.

In the code implementation, the main class of distribution agent is set up to generate the instance of the task distribution agent, and the real-time information-receiving behavior is added. It classifies the received threat level, battlefield combat unit information, and situation judgment agent’s instruction information by template matching. After receiving the message, it uses the behavior of distribution order behavior to assign the instruction and then forms the task instruction and stores it in the XML document and sends the document to the route planning agent.

The comment vector set for judging the human-computer interaction environment [13] is determined.

\[ V = (v_1, v_2, \ldots, v_m), \] (7)

where \( m \) is the number of comments in the vector comment set.

Factor set \( U \) can be described by the following expression:

\[ U = (u_1, u_2, \ldots, u_k, \ldots, u_s). \] (8)
Each \( u_k \) can be composed of several secondary indicator sets [14].

\[ u_k = \{u_{k1}, u_{k2}, u_{k3}, \ldots, u_{k9}\}. \]  

(9)

Similarly, \( u_k \) can be divided into several three-level indicators [15].

\[ u_{kj} = \{u_{kj1}, u_{kj2}, \ldots, u_{kjmn}, \ldots, u_{kjx}\}. \]  

(10)

The following fuzzy evaluation matrix can be obtained [16].

\[
R_{jk} = \begin{pmatrix}
R_{jk1} \\
R_{jk2} \\
\vdots \\
R_{jkm}
\end{pmatrix} = \begin{pmatrix}
r_{jk11} & r_{jk12} & \cdots & r_{jk1n} \\
r_{jk21} & r_{jk22} & \cdots & r_{jk2n} \\
\vdots & \vdots & \ddots & \vdots \\
r_{jkm1} & r_{jkm2} & \cdots & r_{jkmn}
\end{pmatrix}.
\]  

(11)

The fuzzy vector of each \( u_{kj} \) can be obtained correspondingly.

\[
B_{kj} = WoR_{kj} = W_{kj1} * r_{kj1} \oplus W_{kj2} * r_{kj2} \oplus \cdots \oplus W_{kjn} * r_{kjm}.
\]  

(12)

Thus, a fuzzy matrix for judging the secondary index set \( \{u_k\} \) of \( U_K \) is formed [17].

\[ B = (B_1, B_2, B_3, \ldots, B_N). \]  

(13)

The action-value function can be extended from the value function [18].

\[ Q(S, A) = R_t + \gamma(\text{MAX}(Q(S, A))). \]  

(14)

Its meaning is the state \( S_t \) at time \( t \) and the evaluation value of the \( t \)-th execution of action \( A_t \).

Its value update formula is expressed as [19]

\[ Q(S, A) = Q(S, A) + \beta(R + \lambda \text{MAX}(Q(S, A)) - Q(S, A)). \]  

(15)

Here, \( S_1 \) represents the state set; \( A \) represents the action set.

The value function of a certain state is defined as the expectation function of its reward value starting from a certain state in the process of Markov reward as follows [20]:

\[ V(S) = E[\sum_{t=1}^{T}R_t | S_T = S]. \]  

(16)

The basic form of the equation can be deduced from the value function as

\[ G_T = R_{T+1} + \lambda R_{T+2} + \lambda^2 R_{T+3} + \ldots + \lambda^N R_{T+2}. \]

\[ G_{T1} = R_{T+1} + \lambda \phi(R_{T+2} + \lambda R_{T+3} + \ldots + \lambda^{N-1} R_{T+2}). \]  

(17)

The triangular fuzzy number \( M \) can be defined by its membership function \( \mu \) as follows [21]:

\[ \mu_M = \frac{1}{m-u}x - \frac{u}{m+u}. \]  

(18)

From this, the comprehensive degree value of the \( i \)-th object with respect to \( m \) targets can be defined [22].

\[ S_i = \sum_{j=1}^{m} m_{ij} \oplus \left[ \sum_{j=1}^{m} M \right]^{-1}. \]  

(19)

The horizontal fuzzy judgment matrix is a generalization of the MIP judgment matrix, which is composed of triangular fuzzy numbers and is recorded as

\[ A = (a_{ij})_{m \times n}. \]  

(20)

where

\[ a_{ij} = \begin{pmatrix}
1 & 1 & 1 \\
0 & 1 & 0 \\
1 & 0 & 1
\end{pmatrix}. \]  

(21)

When there are \( T \) experts to judge, \( a_{ij} \) is the comprehensive triangular fuzzy number, which is the synthesis of the judgment of \( T \) experts.

For each fuzzy judgment matrix, calculate the probability that its \( t \)-th element \( A \) is more important than other elements [23].

\[ d(A) = \min V(S \geq S_i). \]  

(22)

The combat command ability is very strong \( e = 1 \), and its whitening weight function is \( F(X) \).

\[ F(X) = \begin{cases}
0, X \notin [7, 10], \\
X - 7, X \in [7, 9], \\
1, X \in [9, 10].
\end{cases} \]  

(23)

The operational command capability index \( R \) can be obtained, and the gray evaluation weight matrix for evaluating gray classes is

\[ R = (R_1, R_2, R_3, \ldots, R_i). \]  

(24)

### 4. Results of the Combat Dynamic Posture Prediction Model

This research designs a simple ant simulation application, each model communicates and interacts with each other, and each model runs with a matrix multiplication run of about 500 ms (simulating the actual computational load of the model). The number of models concurrently is 10, and the simulation end condition is 20 simulation runs. On the basis of the same simulation application, single-thread and multithread (in the thread pool, the number of threads is 3) are used for simulation operation, respectively, and the parallel running results of the simulation engine are tested by comparison. The performance comparison is shown in Figure 4.

As most simulations are run, the load (i.e., the amount of computation) is likely to be uneven. In this study, a load imbalance simulation application is designed to simulate the load imbalance during the simulation and to
verify the role of thread pools in load balancing. This study simulates the running time of each simulated design with different ratios of heavy loads. The test results are shown in Figure 5. The test results show that, under the condition of unbalanced load, the thread pool can effectively improve the running time of the overall simulation, reduce the waiting for synchronization, and improve the simulation efficiency.

The performance of the JS interpreter module is compared and tested, and the completion time of each key task in the simulation stage is recorded. The simulation test results of the script interpretation module are shown in Figure 6. The simulation analysis shows that the time-consuming of the JS script interpretation module accounts for a relatively low proportion of the simulation, about 5%. At the same time, due to the low computational complexity of the simulation experiment, if the computational volume per unit time of the model increases, the proportion of time consumed by the script interpreter will be lower.

In the simulation experiment, the model design is divided into red and blue tanks. The characteristics of the two tank models in each model are as follows, and the correctness of the function of modifying the configuration model at runtime is verified by experiments. In this paper, performance distinctions are made in the three submodels of the tank’s mobility model, reconnaissance model, and firepower model. The comparison of the three submodels is shown in Table 1.

During the simulation process, there is no need to modify the model or rerun the simulation task. After the red tank completes the task, after suspending the simulation, the model and its submodels are set as the blue tank through the hot-plug design of the model and then continue to execute. Under the condition that the task and model remain unchanged, the simulation is carried out, and the simulation time consumption results of both red and blue are shown in Figure 7.

The human-computer interaction environment for military command and decision-making constructed in this paper is shown in Table 2.

The results of the collaborative ability weight distribution are shown in Table 3.

The size of the obstacle avoidance test map is 20 * 20, the initial coordinates of the blue team are (0, 0), and the base coordinates of the red team are (18.18). After more than 300 rounds of training, the algorithm outputs the current optimal strategy. The agent can destroy the red base in only 22 steps under the premise of avoiding obstacles. The current optimal strategy is shown in Table 4.

After training, the blue combat unit planned its route with the current iterative optimal strategy and successfully completed the task of attacking the red base. The route of the agent in the test is shown in Figure 8.

The size of the test map to avoid the red team’s fire attack is 20 * 20, the initial coordinates of the blue team’s combat units are (0, 0), and the red team’s base coordinates are (18.18). After nearly 300 rounds of training, the current optimal strategy is output, and the agent only needs 23 steps to destroy the red team’s base under the premise of avoiding the red team’s fire. The training results are shown in Figure 9.

The size of the map in the multitroop cooperative combat test is 20 * 20. The initial coordinates of the blue team’s combat units are (0, 0), (19, 0), (0, 19), and (19, 19), and the red team’s base coordinates are (9, 9). After more than 600 rounds of training, the algorithm outputs the current optimal strategy. Based on this scenario, it only takes 8 steps to jointly destroy the red base in a coordinated operation of multiple soldiers. The training polyline is shown in Figure 10.

The test text file is test1.txt, and the file size is about 2 kB. Because there may be machine factors that affect the encryption speed, each test is used 5 times, and the average time is used to compare the operating efficiency of the model. The operating efficiency statistics are shown in Table 5.

5. Discussion

The first is to carry out the process modeling of the joint combat command, refine the elements, and analyze its dynamics; the second is to realize the rapid dynamic
planning of the process. Among them, fast dynamic programming contains two meanings, one is dynamic modification and the other is process reuse planning. The research content is as follows. Through the application of process management thought in combat command, the in-depth analysis of the content concept of joint combat command and the extraction of the elements and dynamic requirements of joint combat command are the basis of the research. Focusing on the study of the operational command and command process, it needs to be dynamic in response to changes in the external environment. This paper supports the dynamics of process definition by improving the workflow meta-model. The third is to study the reuse of command process knowledge to realize the automatic construction or generation of the process.

The business process model of the combat system takes business activities as the core and pays attention to the business logic between business activities. Compared with the message-centric approach in the information process, the business process model focuses on describing the business activities, describes the specific activities and events in the process in detail, and can display the entire process more intuitively. In SOA, the service provider itself does not care where the request comes from, and it just feeds back the response information to the requester after it has performed its own function after receiving a specific request. The consumer side is responsible for sending requests and

| Serial number | Model                | Red square | Blue square |
|---------------|----------------------|------------|-------------|
| 1             | Motorized model      | Powerful   | Weak        |
| 2             | Reconnaissance model | Weak       | Powerful    |
| 3             | Fire model           | Weak       | Powerful    |

Figure 5: Heavy load test results.

Figure 6: Script explaining module simulation test results.
receiving response messages from service providers. The consumption/service model can actually be applied to many scenarios. In the combat system, the consumer can be regarded as the terminal program that receives the external operation instructions; the service provider can be regarded as the system or equipment that completes the specific function module in the combat system. After analyzing the core consumption/service model in the service-oriented thought, the information model in the combat system can be understood more clearly. First of all, the existing combat system data model needs to be improved to a certain extent, and the specific function modules in the combat system are regarded as service providers. At the same time, the sub-services and subprocesses called in these modules are regarded as the service providers of these modules. Afterwards, the process composed of these modules and the

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**Figure 7:** Simulation time consumption results for both red and blue.

**Table 2:** Human-computer interaction environment for military command and decision-making.

| Index                  | Very good (%) | Better (%) | Generally (%) | Bad (%) |
|------------------------|---------------|------------|---------------|---------|
| Naturalness           | 26.5          | 22.6       | 16.8          | 7.3     |
| Efficiency            | 25.4          | 22.9       | 19.7          | 8.8     |
| Real-time             | 38.4          | 23.0       | 14.6          | 7.1     |
| Online tips help      | 39.0          | 29.5       | 11.3          | 9.6     |
| Status prompt feedback| 28.2          | 22.3       | 17.5          | 5.4     |

**Table 3:** Obtaining the results of the synergy weight distribution.

| First-level indicator | Secondary indicators | Three-level indicator | Weights |
|-----------------------|-----------------------|-----------------------|---------|
| F5                    | F51                   | F531                  | 0.1667  |
|                       |                       | F532                  | 0.3333  |
|                       |                       | F533                  | 0.5000  |
|                       |                       | F54                   | 0.5000  |

**Table 4:** Current optimal strategies.

| Serial number | Action | Agent coordinates | Serial number | Action | Agent coordinates |
|---------------|--------|-------------------|---------------|--------|-------------------|
| 1             | 7      | (1, 1)            | 9             | 7      | (4, 9)            |
| 2             | 7      | (2, 2)            | 10            | 7      | (5, 10)           |
| 3             | 7      | (2, 3)            | 11            | 7      | (6, 11)           |
| 4             | 1      | (2, 4)            | 12            | 7      | (7, 12)           |
| 5             | 1      | (2, 5)            | 13            | 7      | (8, 13)           |
| 6             | 1      | (2, 6)            | 14            | 7      | (9, 14)           |
| 7             | 6      | (3, 7)            | 15            | 7      | (10, 15)          |
| 8             | 7      | (3, 8)            | 16            | 7      | (11, 16)          |
Figure 8: The agent’s route testing.

Figure 9: Training results.

Figure 10: Training polyline.
subprocesses called by these modules are used to design the combat system process model with the help of the existing process design tools, to form a new combat system service. The driving method of the combat system process model is fundamentally different from the driving method of the combat system data model. The driving method of the data model is essentially a static driving, and its main work is done in the development. In this paper, the data model will not affect the specific functions of the software except to provide the displayed data to the software during the running of the software. The process model of the combat system is different, and the driving method of the process model is essentially dynamic driving. Although its main design work is done during development, like the data model, the driving of the process model actually affects the entire running process of the software.

Only in the conflict between top-level centralization and bottom-level decentralization can the commander quickly realize the dynamic adjustment of command power and complete the timely and on-demand distribution of command power based on the sharing of combat resources. Only in this way can the system effect of the command be better played, and the overall effectiveness of the operation can be expanded. However, the distribution of command power in wartime is not achieved arbitrarily by the decision-makers’ will but requires a certain objective basis to support. The issue of the freedom of decision-making in joint operations command is a new topic facing the current development of command decision-making theory. Exploring, researching, and solving a series of issues related to the degree of freedom of decision-making is of great value for enhancing the adaptability of decision-making, improving the overall efficiency of decision-making, controlling the dynamic balance of command, and promoting the in-depth improvement of theory.

At present, with the extensive use of precision combat methods, the command form is gradually showing a development trend of precision. Precise combat command not only requires the commander to possess the level of precise intelligence, precise decision-making, and precise assessment but also the basic ability of precise control. The operation of power also faces corresponding demands. Based on the information system, the system combat elements are synthesized, integrated as a whole, and the rhythm is fast. The joint operation under the condition of informatization is not only the confrontation between the combat force system and the system but also the contest between the combat command with the knowledge as the core, the information as the foundation, and the system as the support. The information-based military transformation has led to changes in the form of war, combat style, and combat methods. Joint operations are the main combat mode at this stage, and scientific and rational combat command process design is the fundamental guarantee for victory in war. To study the flow of joint operations command, first consider the research status of the joint operations command process, compare and analyze the differences in the current domestic and foreign command process modeling and expression methods and the ability to express the process, and sort out the system requirements to support the joint operations command process. Secondly, for the current business process, static management system, to deal with the insufficiency of the dynamic demand generated by the battlefield command activity demand, we discuss the status quo of the methods to realize the dynamics and analyze its advantages and disadvantages.

The information fusion mechanism is represented by synchronous perception. The mechanism of information fusion is to give full play to the cohesive effect of information technology to promote the seamless link and function improvement of various elements and units in the decision-making system. The first is to realize the real-time sharing of command information. The command information system has changed from a top-down "level difference" structure to a vertical and horizontal two-way "networked" structure. It not only accelerates the flow of information in the vertical direction but also achieves a breakthrough in the exchange of information on the horizontal nodes. In this way, the multisource sharing and synchronous perception of information on the enemy’s situation, feelings, friends and neighbors, environment, and coordination between different military services and different command agencies are realized. The second is to promote the cognitive approach among decision-makers. The basic idea of the joint operations command process is that the command process passes through the command organization, the command process drives the operation of the organization, and the command process evolves and optimizes the organization. That is, the process traversal organization is the horizontal end-to-end penetration, the process-driven organization is vertical function-driven, and the process evolution optimization organization is the closed-loop feedback of the process management life cycle and ultimately creates a target value through the process. The foremost question of the joint operations command process should revolve around what level of detail the model needs to be studied, and what method needs to be used to describe the process model and characterize the model. In the face of the same process, staff officers will have many different viewpoints. Participants stand in their corresponding positions, each person’s information is asymmetric, and there are differences in vision and strategic starting points, and the issues of command flow to consider are also vastly different. The joint operational command process model is a typical multilevel and multigranularity process model. Different command levels need to build command processes with corresponding granularity, and higher-level command processes design the overall planning and deployment of national strategy and force structure.

| Running time (s) | Encryption operation | Decryption operation |
|-----------------|---------------------|---------------------|
| The first time  | 11.518              | 11.193              |
| The second time | 11.604              | 12.298              |
| The third time  | 11.427              | 12.400              |
| The fourth time | 11.585              | 12.361              |
| The fifth time  | 11.462              | 12.252              |

Table 5: Operational efficiency statistics.
Lower levels may include actual weapon system implementation steps.

6. Conclusion

The joint operations planning process is designed to promote healthy interaction and role of the theater commanders, their staffs, and subordinate commands throughout the planning process. Assist the theater commander and his staff team to organize their planning activities, share common situational awareness, information, and the intentions of decision-making layers and theater decision-makers, and help the staff team to formulate operational plans and operational orders efficiently. The changes in the current situation must be fully considered when the plan is formulated, and the corresponding plan formulation process must be carried out in a timely manner. Through the construction of the joint operation plan formulation process, the seat personnel can input the objectives and background of the activity according to the current operating environment during process execution or business processing and quickly match the corresponding process knowledge by relying on the process knowledge background constraints and inserting the process fragments in the process knowledge into the original process to realize the rapid and efficient decomposition of the process redefinition.

Data Availability

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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