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Review Article

Parallel Battlefield Test based on ACP Method

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Abstract: Parallel battlefield Test Research Based on ACP method is an important means to test the operational effectiveness and operational applicability of equipment system. It is a new type of equipment test carried out by our army under the background of the new military revolution in the world. Parallel battlefield test based on ACP method is an effective means of test management and control through the combination of physical and computational tests and complementary of actual military system and artificial military system. Aiming at the problem that the equipment performance test and in-service assessment test cannot reflect the combat effectiveness in real battlefield environment, combined with the theory of parallel test method, the framework system of space parallel battlefield test system based on ACP method is proposed, and its artificial system modeling, computational experiment design and parallel execution mechanism are studied respectively.

Keywords: Parallel battlefield test, ACP method, Calculation experiment, Parallel execution

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1 Introduction

The concept of parallel system was first put forward by professor Wang Fei-yue of the Chinese Academy of Sciences, referred to a common system consisted of a natural reality system and the corresponding one or more virtual or the ideal artificial system[1], through the mutual connection between the actual system and the artificial system, the behavior between the two is compared and analyzed to complete the reference and prediction of their respective future conditions, and adjust their respective management and control methods accordingly to achieve the purpose of implementing effective solutions. Professor Qiu Xiaogang from national university of defense technology[2] proposed the concept of parallel military system in 2013, introducing the concept of parallel system into the military field. The essence of parallel military system is the integration of military knowledge, information and data, which is to generate new knowledge by means of computing experiments based on knowledge, and to realize the research, auxiliary management and control of the actual military system

The parallel battlefield test theory[3] is proposed on the basis of the parallel system method[1, 4] in the field of complex system control, which is a relatively effective theoretical method to carry out the effectiveness test and evaluation of weapon and equipment system. The basic idea of the parallel battlefield test theory is to realize the cyber expansion of the physical shooting range by constructing the artificial battlefield that is parallel to the real battlefield, from the three aspects of artificial battlefield environment construction, virtual combat system construction and computational experiment exploration, so as to provide solutions for weapon equipment performance test to system effectiveness evaluation.

2 Basic concept connotation of parallel battlefield test based on ACP method

The core idea of parallel battlefield test theory based on ACP methods is: On the basis of the parallel battlefield constituted by real battlefield and artificial battlefield, the parallel test is carried out synchronously by artificial system and real system to realize the effective supplement of artificial military system to real battlefield test system. By calculating test expand physical test, artificial object is used to analyses the

actual object abstraction and modeling, eventually in the condition of digital parallel to the physical environment, to construct a complete equipment system test environment, so as to realize the test and evaluation of weapon equipment system efficiency.

The parallel experiment theory is proposed on the basis of the parallel system method in the field of complex system control. In simple terms, it is: by building a work with the real battlefield and artificial field the development of parallel computing systems, through data collection, modeling and simulation, machine learning, with real battlefield, parallel mapping and effective development of combat system, on this basis, promotes computing test and physical test combination of parallel test, test of the equipment operational effectiveness. According to the theoretical basis of parallel test theory, the computational test method based on artificial system and the ultimate practical goal, the theory of parallel test can be defined in three levels:

(1) Parallel test level. By synchronously carrying out tests in real and artificial battlefields, the parallel sample tests in real and artificial battlefields are realized by means of manual test in loop, semi-physical test in loop, command and control in loop, etc., so as to expand the number of samples and improve the benefit of test evaluation.

(2) Combination of virtual and real. By constructing artificial systems and utilizing virtual objects and environments in the artificial system battlefield, it can supplement the operational background of the real battlefield, such as the composition of the combat system, the impact of the combat environment and the scale of operations, so as to solve the problem of operational effectiveness evaluation in the combat environment. Virtual reality technology and simulation technology, as an important combination of virtual and real technology, are the important support of parallel test theory, and also one of the basic technical means of artificial battlefield construction. Through agent-based simulation, hardware-in-loop/man-in-loop simulation, large-scale network communication simulation, virtual reality and artificial intelligence decision-making system, a system test environment based on information system network can be constructed to provide support for weapon equipment effectiveness evaluation.

(3) Parallel development level. By machine learning, artificial intelligence technology, by means of big disturbance analysis, data mining method, the real war, real weapons and equipment, realistic combat power and system simulation data, test data acquisition and learning, and make the artificial objects in artificial systems online growth and evolution development, with the real object form parallel development, the relationship between mapping each other and influence each other, so as to achieve the real reflection of artificial system to the real system, settlement system build, development and equipment effectiveness evaluation problem in the process of fighting. Parallel development is the highest requirement and the core of parallel test. Only the parallel artificial system can adapt to the system performance evaluation dynamic, growth as the "virtual solution" of the real system, and can interact with the "real solution" of the real world, so as to solve the "no solution" state of complex system control under the condition of "real solution".

3 Review of military parallel systems

Military parallel system is a set of parallel military systems[6]. The parallel military system consists of the real military system and the artificial military system running parallel to it, which is used for the research, management and control of the real military system. The technology of parallel military system is based on the construction of an artificial battlefield that can reflect the relationship of various elements in the battlefield and the operation of deduction. Parallel military systems allow commanders to "see" the future and quickly understand the unfolding of military operations by conducting hyper-real-time simulation analysis and evaluation of the latest situation, and continuously match, select, adjust and supplement future plans.

The application of parallel military systems can help speed up the transformation of information advantage into decision advantage, so as to gain execution advantage and cope with the rapidly changing battlefield. Foreign countries have long been similar to the parallel military system of the study. In order to adapt to the needs of the transformation of operations under the conditions of informatization, the military powers have actively explored new operational concepts and new thinking to adapt to the new situation and new requirements. U.S. military has carried out based on dynamic data-driven simulation embedded aided decision-making system, to form a kind of war and battle one, plan formulation and evaluation of combat decision support system, the United States armed forces

has formulated the embedding simulation system of C4ISR system plan, and carry out the corresponding work, its basic idea and the pattern is the parallel control.

In 2000, the office of defense modeling and Simulation developed the Embedded Simulation Infrastructure program. The overall goal is to create a Simulation friendly software environment, promote simulation-based mission application design in c4i systems, and enhance the tactical capabilities of c4i systems. Since 2005, the U.S. air force has conducted a series of studies focusing on "real-time operational scenario analysis", which aims to assist decision-makers in super-real-time evaluation of their effect-based operational scenarios in a combat-level confrontation environment. Based on the latest battlefield situation, the system can predict the future in super real time, dynamically formulate the action plan in a tightly coupled confrontation way, conduct super real time analysis and evaluation on the action plan, and provide real-time decision support for commanders at the operational and tactical levels. In 2007, deep green was proposed by the defense advanced research projects agency. It emphasizes the commander's leading role in the program making process, and it is a way for the commander to drive people in the loop. The system consists of "commander companion" man-machine interface system, "blitzkrieg" simulation system and "magic ball" control system. China held the 428th Xiangshan Scientific Conference in Beijing in June 2012, with the theme of "ACP method and parallel military system SoPMS".The conference focused on the discussion and exchange of parallel military system, parallel system technology, equipment system and parallel computing, and discussed the application prospect of multiple parallel military systems. Since then, the idea of parallel military systems has gained wide attention. The battlefield information and related operations inject artificial military system information in real time, form based on the calculation of the simulation experiment, "growth" variety of possible future reality, then based on the various possibilities, analysis and evaluation of action, through parallel execution, further realize plan under the condition of rapid dynamic formulation of action plans, so as to realize the dynamic control, which is the core of the parallel system technology.

4 Design technology of parallel battlefield test system

A parallel battlefield is generally a parallel system consisting of an actual battlefield and several artificial battlefields[6]. Generally, the design of parallel battlefield dynamic evolution experiment system needs to solve the following problems:

(1) Construction of parallel battlefields. From the perspective of research, parallel battlefields can also be composed of two artificial battlefields. In experimental study, a simulation platform can be used to a practical virtual battlefield, and then based on the previous research results to build an artificial field with knowledge acquisition ability, these two war battlefield experiment system, the dynamic evolution of parallel calculation and experiment design solutions, by looking at the evolution of the system, and dynamic adjustment model of artificial field.

(2) "Parallel" measurement problem of parallel dynamic battlefield. The "parallel" measurement of the dynamic evolution process of parallel systems is a core problem in the application of parallel systems technology. Therefore, it is necessary to define "parallel" indicators according to the research problem. In theory, the two battlefields cannot be exactly the same to achieve true "parallelism". However, as long as the key characteristics of the two "battlefields" are consistent and do not affect the analysis of the problem, they can be regarded as approximately "parallel".

(3) The use of parallel battlefields. Immediately after the war, artificial battlefield for wartime condition, based on the perception of different operational phase information in real time collecting, sorting, analysis, and get together in harmony, battlefield of artificial ongoing assimilation of information, realize the real battlefield and artificial the co-evolution of the battlefield, the time adjustment function of parallel simulation, using artificial society "perspective" in the future battlefield evolution for a period of time, in order to guide the decision makers for management and control of operations.

5 Conclusion

Parallel battlefield test theory is based on complex system theory and thought to solve the problem of effectiveness evaluation of weapon and equipment

system. The theory of parallel battlefield test is put forward on the basis of the development of computer technology, artificial intelligence and social science of computing. Although the current research and work are still in the preliminary agent-based simulation test and the simulation test of the shooting range in the loop, the idea and direction of constructing the parallel shooting range are correct and worthy of scientific and technological workers' efforts. The gradual development of parallel system theoretical research and practice will also promote the development of parallel experiment theory, which requires a lot of pioneering work[7].

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