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Modeling Intelligent C2 Using Technology Of Multi-Agent

C2 Modeling and Simulation

Qiang Liu, Ph.D [1]

Huifeng Xue, Prof[2]

Point of Contact: Qiang Liu

[1] Post Box 26

Department of Automatic Control

Northwestern Polytechnical University

Xi' an, 710072

Shaanxi Province

P.R. China

Telephone, (86) 29 8849 2272

E-mail Address, liuqiang@nwpu.edu.cn

[2] Department of Automatic Control

Northwestern Polytechnical University

Xi' an, Shaanxi Province, P.R. China

Telephone, (86) 29 8849 4500

E-mail Address, xue@nwpu.edu.cn

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Abstract

Intelligent command and control system model is constituted of four parts: foundation technique layer, situation perception layer, intention expectation layer and decision command layer. The model has five basic characters: systematic complexity, timely information, simultaneous manipulative, distributing of function and processing of collaboration. The system are composed of evaluate situation, belief format, rule confirm, reasoning judge, desire produce, commitment reach, mission execute in the proceeding.

Keywords

multi- agent, intelligent, command and control system, model

1. Preface

As the important of the information techniques, the computer techniques get the fast development from 1970s. Agent theories and techniques are applied in the distributed artificial intelligence research. It is played the important role that to study the complexity adaptation system of mold research field. It displays the certain advantage calculator science and provides more availably method application. This paper will make use of the agent theories and the techniques to analysis the command and control system molding of digital battlefield.

2. Agent theories and techniques

The agent research originates the distributed artificial intelligence. It was mentioned *The Social of The Thought* by Minsky, artificial intelligence scientist, in 1986 published early. He thought some individuals in societies that can be solved the problems via consulting with each other. Agent is a kind of the intelligence individual. Hewitt said: defined the agent of conception as the same difficulty as define intelligence of conception. It is hardly that has not the homologous comprehend about agent. This also revealed the agent theories still had been placing in the course development. So it needs more concerns and research.

Personally the agent definition is individual unit attaining for a certain particular target. It passed to cognition current environment system information, to cooperate with the common consultation of other agent. And it auto right solve the problem to process the exterior environment interaction. Figure 1 shows the basic construction of the general agent. Usually the agent has fundament three attributes that are the belief, desire and intention. Bratman studied the behavior intention and established the agent philosophy foundation. He thought that was keeping the belief, desire and intention reasonable equilibrium that could be realized multi-agents community targets. Based on these, many researchers studied to dynamic logic, mold logic into describe the logically agent. Cohen and Levesque established agent behavior theories related with intention. Rao and Georgeff mentioned the BDI model regard as the reasonableness agent. Singn, Jennings and Wooldridge discussed the problems solved that agents realized on alternative rule. All these researched to expand the field of the theoretical part of agent.

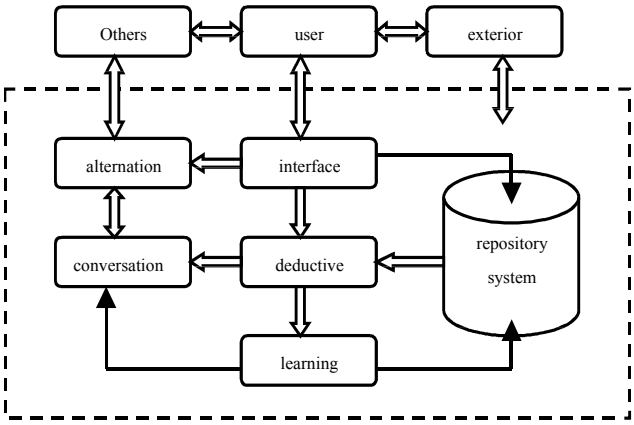

Figure 1 the basic construction of the general agent

Agent as an individual has the independence ability that it can combine reason logically with knowledge the other individual agent. With independence, agent effected the outside the environment. At the same time alone agent can obtain the knowledge from the environment, and increase oneself ability. As one of many agents can share the resources, negotiate each other, manage the commitment, form the cooperation and complete the mission. Jennings pointed out many agents to different and applied environment. Multi-agent system is a kind of continuously proceeds the information with the environment. The function has the certain reasonableness with alternant system. It has energy and resources with the intelligence. It can consider of certain problem and store information for subsequent use or retrieval. The core many agent problem is that agent moderate with the cooperation mutually. Wooldridge thought the agent had the more strong orientation ability with the more extensive and applied background from target, intention, program etc. Multi-agent go on proceed of the science research. It will make the agent improve ability each other and solve the problem of new indetermination..

3.The command and control system in the digital battlefield

It is not only changed weapon equipment construction, but also produced the important influence of the traditional battle when the information techniques application in the military realm. It makes command and control system gradually development the modern information system on the foundation of computer calculator. Figure 2 shows position and function of the IC2 in the digital battlefield.

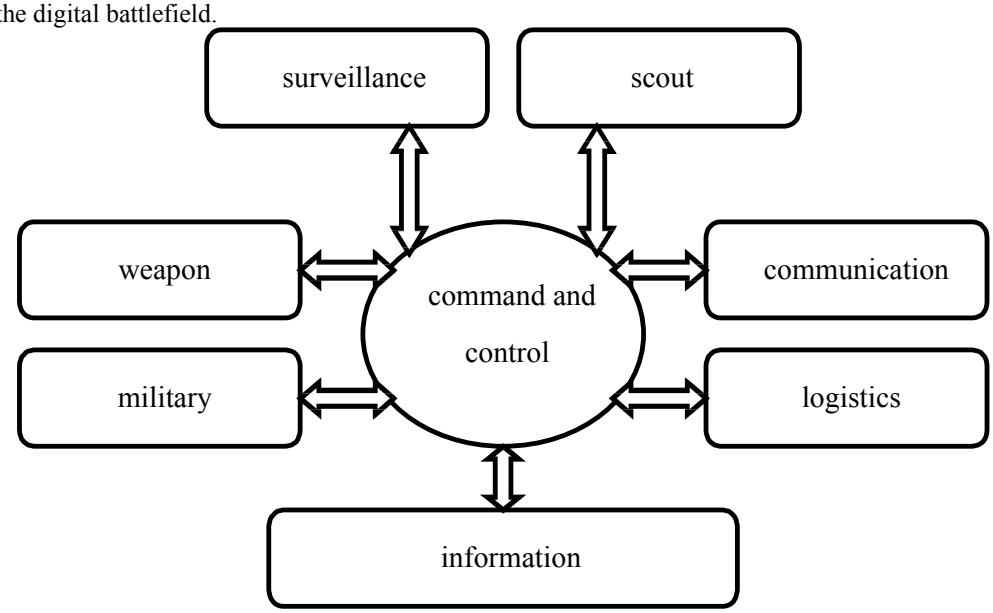

Figure 2 intelligence command and control system position and function in the digital battlefield

Following the high and new technique development that it makes weapon equipment change in the military realm. The command and control system have been promoted to higher level to match the modern weapon system. It is more and more required real time with a series of occurrence in the modern battle. Particularly many armies are needed more association with others, the scope of battlefield is extended, the precision of attack is increased under the high technique battlefield. Therefore it is realized that to valid the coordination control is the way of guarantee the war to victory. The command and control system has been become the important part of weapon equipment system. It has turned into the troops fighting competence transformer.

In 1995, as artificial intelligence expert, Guifoyle predicted: the mostly newly arisen technique development would be suffered influence by the agent technique research after decade. Many new products would be studied on the technique of agent. No doubt the intelligence command and control system research would get along with the biggest advancement. As a kind of validate method multi-agent technique would be used building the mold. It is more and more extensive application the aspect in building the system molding. According to the theories of multi-agents Holland established the CAS theories that resolve the general complexity problem from the orientation system. Following the distributing, dynamic, real time and

alternation techniques are required exaltation. Actually the multi-agent theories and techniques have more important value to make solution these problems. Gradually the agent techniques are used for the intelligence command and control system molding. It is realized that the command and control system are provided the best of solution method for distributing, complication, independence and intelligence of the system requirement.

4. Molding intelligence command and control system based on the Multi-Agent

The command and control system can make the troops to be known the battlefield situation in time through collecting data, analysis battle information. It strokes the enemy target precision to betake conjunct with the power quickly inside procession. The battlefield resources have been assembled to best in the scope of the whole battle. It can be realized the integral system from transducer spread to digital troops to weapon system.

4.1 The structure of intelligence command and control system

Everyone to know, command and control system main members are constituted to have coordinated attack background. Their intelligence behaviors are placed in the different grade, level, structure and position. Face to the intelligence molding in the dynamic environment, they have many characteristics such as distribution, conjunction, sharing and real-time. The traditional line mathematics mold method is not fit. It is difficult explained the inside relation between macro phenomenon and micro phenomenon within war because of lack describing the member of system. So it can't reach to mold of the intelligence command and control system request. Following the agent techniques development, it is possible that study to based on the multi-agent to set up mold of the intelligence command and control system.

It is useful to build mold of intelligence command and control system. Using the multi-agent method to solute building mold problems has the obvious advantages. The system characters performance at below four aspects:

(1) The technique of multi-agent can attain to command and control system requirement. It can offer the mold need the large quantity intelligence behavior.

(2) The technique of multi-agent can obtain to command and control system modeling. It has the integration and the independence characteristics.

(3)The technique of multi-agent can satisfy to request of command and control system molding. It was commuted inside very much sophisticate with each other work.

(4) The technique of multi-agent can adapt to changing request of command and control system model. It can be rectified continuously the environment of battlefield.

Therefore, such as figure 3 showing, the author brings up the intelligence command and control system modeling that it is base on the multi-agent technology. The multi-agent is organized mechanism command and control system. The primarily structure involved four layers.

(1) Foundation technique layer: it is satisfy the whole system normal work. It is constituted to service agent, correspondence agent and control agent. The layer belongs to the foundation module of the system.

(2) Situation perception layer: it is comprehended the variety battlefield situation. The data get to know the report from information agent, regulation agent, evaluation agent and repository agent. To judge the diversification battlefield situation according to collect the current information of battlefield environment, the certain battle rule and the expert's experience in the knowledge base. The layer is designed as the perception module of the system.

(3) Intention expectation layer: it is ascertained the battle target. The threaten grade judgment of battlefield is applied of manage agent, communion agent, moderate agent and integration agent. These agents can hand over with each other agent then realizing resources sharing, integrating information, producing association with conviction, conjunction requesting, reaching association with commitment. The layer is designed as the intention module of the system.

(4) Decision command layer: it is completed all missions what is the system produced in the battlefield. According to associate with intention output the result. It is format instruction by independence decision agent, cooperation decision agent and assistant decision agent. The layer is designed as the implement module of the system

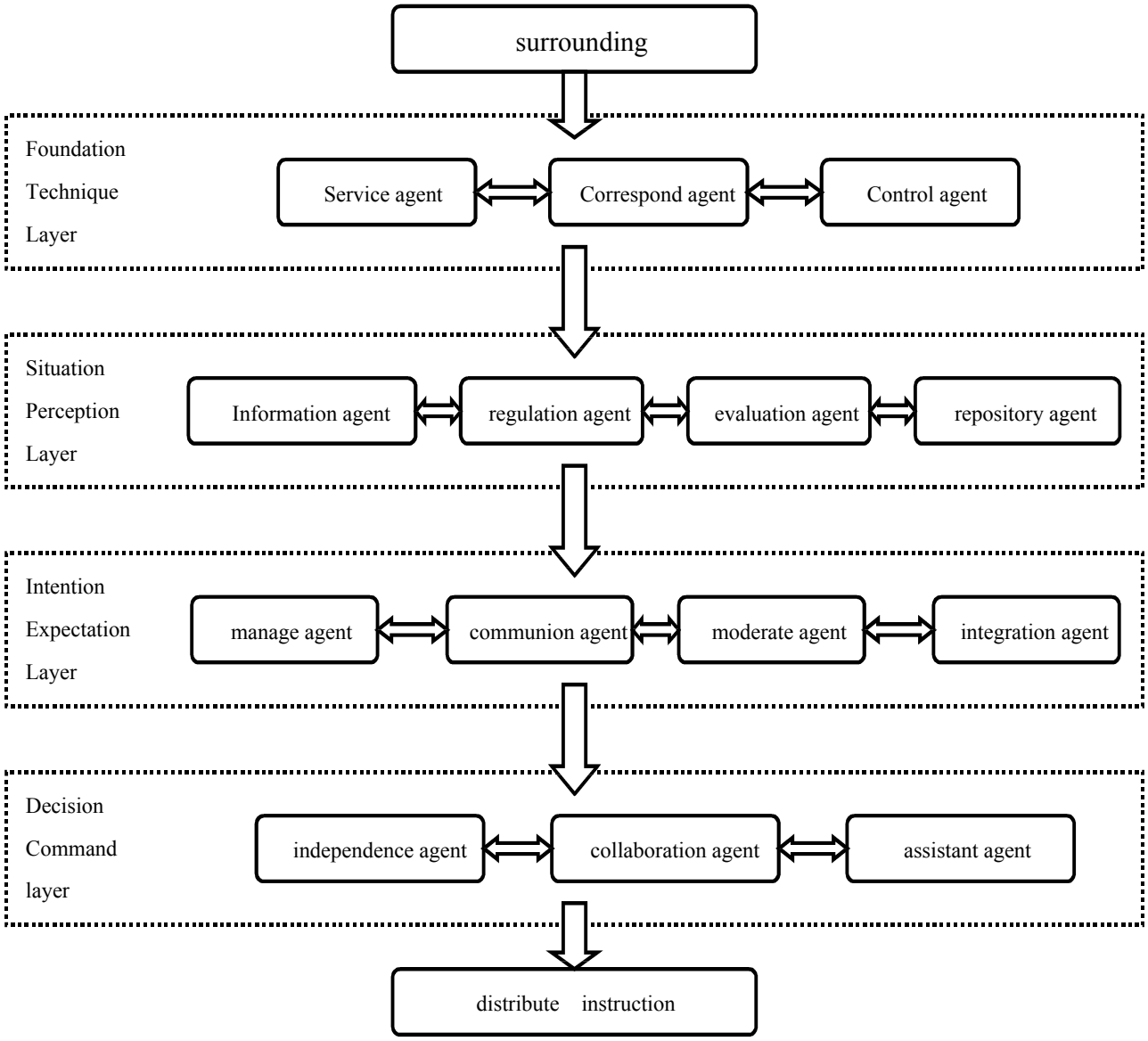

Figure 3 the construction of intelligence command and control system based on the multi-agent

At the same time, according to the multi-agent intelligence command and control system model, it is primarily involve in four cooperation relations.

(1) Person-person coordination: it is primarily dissolved the interpersonal clash, and realized interpersonal cooperation;

(2) Person-agent coordination: it is responsible provided to the science, validity, real-time of decision support;

(3) Agent-agent coordination: to work has reasonable distribute and implement mission, it is mainly established to the moderate mechanism.

(4) Agent-oneself coordination: according to oneself reason choice process on the logically knowledge, it is primarily make sure the inner part of coordination mechanism molding.

4.2 the basic character of intelligence command and control system

Look figure 3. The command and control the system has five traits in the battlefield.

(1) The system complexity: the command and control system is constituted of four layers. It is dominated many agents from the center. The process involved in collecting military information, analyzing battle position, formation battle project and taking military action. These made the system become very complicacy.

(2) The information real-time: the command and control system delivered information each unit on time. Every agent can share information resources and realized battlefield situation within system. Then it produced effective decision of the military tactics and practice promptly the precision stroke.

(3) The function distributing: the agent has the different function because of the environment diversity. The different mission need dissimilarity agent. Therefore the agent must have to program to oneself. Each of them undertake continuously change reasonable organize with ability dispenses. The agent can adapt to right choice of programming according to the battlefield environment.

(4) The command and control synchronization: the each unit is adopted by the simultaneity communication method. It is created the new battle instruction according to the battlefield environment change. Immediately the system carried out the new military tactics. At the same time it is realized that make use of the system can oppose synchronously all directions assault purpose in many soldiers, weapons, realms, and ways.

(5) Executive coordinated attack: each agent has oneself function. Generally speaking, many agents can be established good relation. According to the different battle mission, the information of background and the dissimilar campaign request, they can share on the information data, get to the overall situation, produce in the association with intention, reach in the association with commitment, execute to the battle project and complete to the mission of attack.

4.3 Describing the process of intelligence command and control system

In 1981, according to the process control Lawson brought up the command and control system model. The model was suffered the certain restrict in actual application because of lacking person function. At the same year, Wohl put forward the command and control system model on the known science. This model outstandingly explained the conductor process of perception activity but it was not reflected the characteristics of conductor process. In 1987 Boyd mentioned the model of OODA loops. The process was made up Observation, orientation, decision and action. This mode was more succeed in explaining aspect what the command and control relate to the interact enemy. The author established the intelligence command and control system model process in battle on the multi-agent. It can be described such as the figure 4 showing.

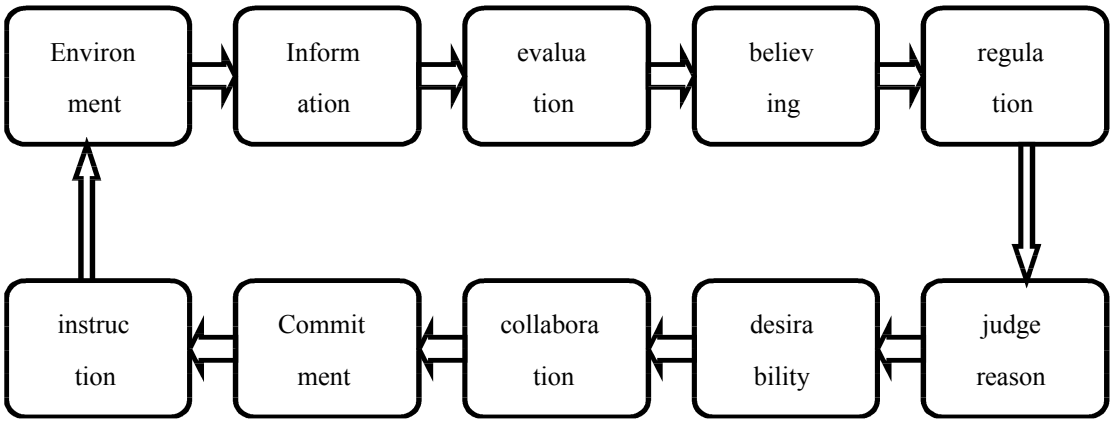

Figure 4 Describing the Process of intelligences command and control system in the battlefield

The command and control system begin to works: battlefield environment → receive information → disposal information → evaluate situation → produce warning → form believing → confirm certain military tactics rule → judge reason → produce desirability → send out request → reach in association with commitment → definite battle target → create battle instruction → execute battle mission → reflect battle result → renew ascertain goal → afresh new tactics rule → judge the threaten grade → send the result to the integration agent → understanding battlefield situation → if dissatisfied to create the new military tactics rule →directly new decision transit independence decision agent, collaboration agent and assistant agent →consequently send out the result from manag e agent and integration agent to alternation agent →form new battle instruction.

On the one hand agent can get to the ability what is the information of relate, proceed to reason rule, born in command, and form mission plan from conviction, consciousness and target inside whole system circulation. On the other hand it can revise current rule according to reflect the feedback information.

5. Conclusion

This paper was applied the technique of agent theories to set up the command and control system model. It has had multi-agent characteristic of alternation and collaboration. The single agent could be built model self-determination. This model would be shared every kind of information resources within battlefield. It could be felt to know the battlefield situation in time. The military tactics of the decision will be became more science and agility. And ability of collaboration to the stroke enemy is obviously exalted.

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