

Research on Intelligent Planning and Construction of Virtual Laboratory Based on Multi-Agent System

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Abstract: Under the background of the continuous improvement of the development level of social modernization and the comprehensive deepening of scientific and technological capabilities, virtual reality technology, with its own diversified advantages, presents an unprecedented development trend. Therefore, through the full integration of various intelligent systems and the virtual laboratory, this paper makes intelligent control on each part of the virtual laboratory with the help of intelligent control measures to ensure the coordinated development of the whole experiment. On this basis, the learning mechanism is fully infiltrated into the multi-agent system, so that the control system has the ability of self-optimization.

1. Introduction

As one of the key technology types of the virtual laboratory, intelligent control can not only make the computer virtual laboratory have high reliability and improve the accuracy of the virtual experiment results, but also in the process of the comprehensive development of intelligent control technology, the virtual laboratory can carry out realistic simulation of the real experiment, which has the advantage that the real experiment can't reach. For example, the virtual laboratory can effectively control the speed of the experiment, ensure that the experimenters use the slow lens to carefully observe the experiments with fast speed, or use the fast lens to systematically observe the experiments with slow speed. Through the flexible application of the abstract model, the phenomena that are difficult to observe in the experimental process are simulated. By fully integrating many traditional intelligent control technologies such as fuzzy control system, expert control system and learning control system, it can help the experimenters to effectively control the experimental contents with high complexity.

2. Communication Mode of Multi-Agent Control System in Virtual Laboratory

2.1 Blackboard Mode

As for the blackboard, it mainly refers to a shared area that can publish information, process results and obtain the information needed by the agent. It has been widely used in the field of distributed-problem solving. Compared with the traditional information transmission mode, the communication mode provided by the blackboard is more flexible and efficient, which is more suitable for the virtual laboratory. The main reason is that the agents that provide communication functions have diversified characteristics, and different agents can accurately obtain the information they need by means of blackboard. The experimental rules in the database can provide support for the development of agent control activities, while the blackboard method can make the blackboard agent accessing the database unified and the time sequence effectively controlled, and ensure that the intelligent control efficiency is further improved.

2.2 Federation Mode

When a large number of agents are involved in the virtual experiment system, if the direct communication mode is still adopted, the amount of traffic and communication overhead will be

quite large. At present, the main way to deal with this problem is to organize a large number of agents in a unified way according to the Federation method, group the agents according to certain standards, and place a media sub-agent in each group of agents. The communication behavior of each group of agents is only effective for the media sub-agents in the group. Receiving or forwarding messages with the help of the media sub agents can effectively reduce the number of connection links between agents.

2.3 Broadcast Mode

By using broadcast mode, each message sent by each agent will be effectively received by other agents. In general, there are two types of broadcast modes, directional message and public message. A directional message mainly refers to sending the message to a specific agent. Although other agents can also obtain the message, there is a clear agent-designated receiving identifier in the specific message content. When the agent receives a directional message and finds that the receiving ID of the message is highly matched with its own, it should follow the corresponding process. Otherwise, it needs to ignore the message. Public messages mainly refer to messages sent to all agents.

2.4 Point-to-Point Mode

In the process of using point-to-point mode, TCP / IP protocol is usually used to directly establish a physical connection link between two agents that need to perform communication tasks. It is required that each agent must clearly grasp the location of other agents in the system. In the process of obtaining the location of other agents, the central object responsible for agent registration in the system can be targeted, that is, the current clues can be found from the broadcast information received by other agents.

3. Conflict Coordination of Multi-Agent Control System in Virtual Laboratory

3.1 Conflict Control Mode

3.1.1 Target Conflict

Some members of the system have achieved their goals, affecting other members to achieve their goals.

3.1.2 Resource Conflict

At the same time, the system members need to use the same resource, and the system can't meet the requirements at the same time, resulting in the conflict caused by the parallelism of the multi-agent system.

3.1.3 Cognitive Conflict

Because different agents have different skills and knowledge backgrounds, cognitive conflicts are inevitable.

3.1.4 Behavior Conflict

Because some members of the system take actions to complete tasks, other members' actions cannot be executed, resulting in conflicts.

3.1.5 Result Conflict

When performing tasks, system members may draw different conclusions on the same experimental problem, resulting in result conflict ^[1].

3.2 Conflict Resolution Strategy

3.2.1 Backtracking Method

As for the basic development idea of backtracking method, it mainly refers to finding the root of

the conflict with the help of backtracking technology when the conflict occurs, modifying the incompatible environment and corresponding structural model to effectively eliminate the conflict. Generally, backtracking technology is mainly divided into two types: sequential backtracking and correlation-guided backtracking. Among them, the sequential backtracking is based on the principle of the nearest node first, so the amount of retraction is large. The correlation-guided backtracking can accurately locate and backtrack the effective nodes that can eliminate conflicts through analysis, and effectively ignore the irrelevant nodes, having better performance^[2].

3.2.2 Constraint Relaxation Method

For the basic idea of the constraint relaxation method, it mainly refers to that in the multi-agent cooperation environment, with the help of various constraint rules, system members establish interdependent relationships, and under the action of various constraint mechanisms, restrict the behavior of members. When there is a conflict problem in the cooperation process, the objective of resolving the conflict can be effectively achieved by reasonably relaxing the constraint conditions and appropriately ignoring the secondary constraints. In this process, some individual members' solution objectives and solution methods often change, so the task will not fail. However, when individual members do not accept the constraint relaxation requirements, the conflict resolution goal will fail^[3].

3.2.3 Negotiation Method

For the basic idea of negotiation method, it is mainly aimed at the process of two agents communicating around a certain issue and finally reaching an agreement. In this process, the negotiation process between the two agents has obvious limited circulation characteristics. As for the negotiation strategy for resolving conflicts, it mainly refers to establishing communication relations between two conflicting system members, and constantly studying and modifying their plans in the process of joint efforts, so as to make the plans of both parties reach an agreement and ensure that the conflicts are effectively eliminated. Generally, the main negotiation strategies adopted include action filtering negotiation, multi-level negotiation, knowledge negotiation and debate negotiation^[4].

3.2.4 Arbitration Method

For the basic idea of arbitration method, in the negotiation environment, it establishes a coordination mode that covers the whole or a certain region, is trusted by all agents, has high authority, and is responsible for negotiating conflicts. In the event of a conflict, the corresponding solution is selected according to the criteria set in advance in the collaborative environment, and a decision is made to force all conflicting agents to fully accept the information provided by both parties to the conflict. It is also possible to select an agent that has no connection with both parties to the conflict, and make it act as an arbiter to make a fair and impartial judgment and ruling^[5].

4. Coordination Mechanism of Multi-Agent Control System in Virtual Laboratory

When the multi-agent control system of the virtual laboratory is coordinated, the complex control of the overall test system is mainly transformed to become a multi-agent coordinated control mode with the characteristics of autonomous agents. However, due to the opposition between subsystems in the system, there are often conflicts in local control. Therefore, scientific and reasonable coordination mechanism must be adopted to effectively control the overall situation^[6].

The coordination mechanism corresponding to the multi-agent control system is optimized and designed to make it an independent agent with the concept of global control, so that when a conflict problem occurs, arbitration and coordination can be conducted with the help of existing knowledge and known rules. The following aspects can be started. First, in the process of eliminating the conflict, arbitration method should be taken as the main strategy. Second, minimize the amount of communication between agents to ensure the effective improvement of control efficiency, simply and clearly realize global control objectives of the system^[7].

5. Conclusion

Through the detailed study of multi-agent system and agent technology, the various agent control problems in the laboratory are analyzed in depth, and the related problems are properly solved with the help of multi-agent technology, so that the role and value of the virtual laboratory can be fully played in the relevant work. The multi-agent system control mode is more targeted and has a wider range of functions. It can cope with the experimental content with high complexity and ensure that each sub-task can be controlled by corresponding agent technology. On this basis, through the comprehensive analysis of the communication mode, conflict coordination and coordination mechanism of the virtual laboratory multi-agent control system, a solid foundation is laid for further improving the effectiveness of the virtual laboratory construction.

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