Study on Technical Problems and Research Methods for Iterative Learning Neural Network Optimization Control for Robotic Arm

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Abstract: This paper conducts comprehensive scientific research on intelligent methods such as artificial neural networks, evolutionary computation and iterative learning, including the development of related algorithms with practical application significance and value. On the one hand, it strives to deal with the relevant massive data, and on the other hand, it develops and verifies relevant theories and algorithms for the optimization, control and other related problems in the movement of redundant manipulators. In solving the iterative learning neural network control system for manipulators, this paper analyzes the key technical problems to be solved and also describes related research methods.

1. Technical Issues

Robots are a class of highly nonlinear, strongly coupled and time-varying dynamic systems. Because of the tracking of a given spatial trajectory, the complex motions with high-order derivatives are often calculated when converted to the motion of each joint. Therefore, it is extremely difficult to implement a high-speed, high-precision, no overshoot and smooth robotic trajectory controller using conventional PID control. The neural network has the learning function and nonlinear mapping ability and the neural network control can solve the nonlinear control problem [1]. The feedback control and neural network learning control are combined. The feedback control makes the joint motion track the desired trajectory along the time axis direction. The neural network learning control makes the joint motion trajectory iterative axis direction approach the desired trajectory. The neural network BP algorithm is used to continuously adjust the weight of the neural network according to the joint expectation value and the error performance function, and realize the tracking iterative learning control of the desired trajectory. The robot is an active mechanical device. In general, each degree of freedom is driven by a single actuator. From a control point of view, the robot represents a multivariable nonlinear automatic control system. Each control task itself is a power system. To study robot dynamics is to further discuss control issues. For the robot operator, this study proposes a new method of iterative learning control. When the inertia of the drive device that is equivalent to the joint axis of the robot operator is large enough, the learning gain can be determined by the dynamic characteristics of the drive device, overcoming the traditional iteration. The learning control method has many attempts to select the learning gain, which enhances the practicality [2].

The robustness problem is to discuss the various disturbances in the system, such as uncertain input, state disturbance, measurement error, initial condition error, expected trajectory variation and learning interval offset. Under various learning laws, the controlled system controls the stability and convergence of the process. Theoretically analyzing and proving the obtained stable convergence characteristics of the iterative neural network solver, most of the current iterative learning control assumes that the initial state of the system is on the desired trajectory to obtain the convergence condition, when the initial condition of the system is not on the desired trajectory.

For the solution of nonlinear multi-angle time-varying problems, according to theoretical analysis and simulation experiments, it can be seen that choosing a suitable initial value can be a more efficient and faster convergence of the solution of the new iterative learning neural network control model to the time-varying problem of solving. The theoretical solution is up. Therefore, the

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selection of the initial value will also be one of the key issues in the research of this project.

When solving a multi-variable time-varying problem or application of a specific manipulator, it is necessary to derive an iterative learning neural network control model (continuous/or discrete) to solve the problem, and compare it with the traditional neural network model. It is necessary to reward the complete iterative learning neural network model design method to obtain various effective implicit/extended neural dynamic models for real-time problem solving [3].

Even if the iterative neural network control model for solving the problem is theoretically derived, it cannot be assumed that the obtained model must be able to converge its network solution to the real theoretical solution. It is also necessary to theoretically increase the environmental conditions and initial values according to the above solution. More and more detailed proof and analysis, combined with computer model/simulation methods and tools to verify the validity, accuracy, advantages and disadvantages of the neural network model.

2. Research Methods

The optimal control of iterative learning neural networks for robotic arms as a new technology involves different organizational activities and processes, and requires many disciplines from philosophy, graph theory, topology, control science, information technology, databases, biology and network science. Iterative learning neural network research method is based on literature analysis method, empirical research method, algorithm analysis, model research method and simulation experiment method. It has the characteristics of computational theory and technology and the basis of intelligent behavior. It is a combination of theory and practice.

The literature analysis method is searched and consulted through the network, journals and newspapers, and is mainly used to comprehensively understand the research and practice results of iterative learning control, neural network and feedback control at home and abroad, and then study, analyze and summarize the current complex nonlinearity in China. The literature analysis method mainly refers to collecting, identifying, and collating the literature, and through the research of the literature, forms a method of understanding the factual science. The content analysis rule realizes the scientific understanding of facts through quantitative analysis and statistical description of the literature. These two methods have common objects and are not directly related to the people and things recorded in the literature. Therefore, they are also called non-contact research methods. The difference between the two is different in the focus of analysis and the means of analysis.

Empirical research method: In-depth study of schools and enterprises, combined with the application of graph theory, topology and cybernetics, the in-depth study of the speciality and universality of complex robotic arms, and the statistical relationship and characteristics of statistical properties [4].

Empirical research methods include observation, conversation, test, case, and experimental methods.

Observation method: The researcher directly observes the behavior of others and systematically records the observation results in chronological order. This research method is called observation method. It is divided into natural observation and laboratory observation; participation in observation and non-participation observation.

Talk method: It is a method for researchers to understand the psychological state of a subject in the process of verbal communication through face-to-face conversation with the subject. It should be noted that: First, the goal is clear. The second is to pay attention to the way. The third is to pay attention to the use of "home advantage." The fourth is to try to be concise.

Test method: refers to the method of assessing and understanding the psychological characteristics of the subjects through various standardized psychological measurement scales. It mainly includes questionnaire tests, operation tests and projection tests.

Case law: A case study (case study) is conducted on a group of individuals, groups or organizations for a long time to investigate, understand and collect comprehensive data to study the whole process of psychological development.).

Experimental method: The researcher gives a certain stimulus to the subject under a tightly

controlled environmental condition to induce a certain psychological reaction, and the method of research is called experimental method, ie laboratory experiment and field experiment [5].

The algorithm is based on computational theory, computational techniques and computational tools. Generally, algorithms with computational functions should have the characteristics of numerical constructivity, iteration, convergence, stability and effectiveness, and comprehensively use intelligence, engineering, Knowledge in computer networks, genetics, informatics, and biology. This paper analyzes and studies the mechanism of iterative learning control by forming, simplifying, processing and controlling the mechanical arm, and discusses the construction idea of iterative learning neural network optimization control and its application feasibility, and uses its model for robots.

At present, the study of robotic learning control is mainly represented by iterative learning control and neural network-based learning control. However, iterative learning control can only be applied to those occasions where the robot performs repeated work, and it is also required to ensure that the initial conditions of its motion are the same. A defect seriously affects the application prospect of iterative learning control. While neural network has learning function and nonlinear mapping ability, neural network control can solve nonlinear control problems. The feedback control and neural network learning control are combined. The feedback control makes the joint motion track the desired trajectory along the time axis direction. The neural network learning control makes the joint motion trajectory iterative axis direction approach the desired trajectory. In this study, the iterative learning neural network control model is used to continuously adjust the weight of the neural network according to the joint expectation value and error performance function, and realize the tracking iterative learning control of the desired trajectory [6].

When discussing the problems of iterative learning based on neural network control, some algorithm models, mathematical models and given parameter characteristics created by neural networks, combined with relevant data, are simulated in Matlab and Labview by means of neural network toolbox. Experiment and analysis, compare and evaluate the conclusions with the actual network, and verify the correctness, reliability, validity and feasibility of the results [7].

Based on the above research, through the practical application of the field, the practical research on the performance and operation mechanism of the neural network is carried out. Mainly with mechanical arm and medical device as the application case, study the measures and methods of neural network optimization control, explore the practical experience of its existing problems and operation mechanism, summarize the topological characteristics and dynamic model of neural network through practical application, in order to form nerve The scientific research results of network and iterative learning optimization control have explored new methods for urban construction and economic construction in China. Promote the rapid development of China's modernization.

3. Conclusion

This paper aims to analyze and study the key technical problems and research methods in the research of iterative learning, neural network control and robotic arm at home and abroad. The traditional neural network algorithm has a large search space, a large amount of calculation, and a difficult robotic model. The problems of determination and time-varying are analyzed. The advantages of iterative learning algorithm are analyzed. The iterative learning neural network control algorithm is proposed and applied to the robotic arm to solve the multi-degree-of-freedom joint tracking problem of the manipulator.

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