Chapter 25
X3D-Based Virtual Prototype Robot Mechanism Simulation

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ABSTRACT

This paper mainly studies the goal when using standard X3D robot virtual prototype technology research, design, and kinematics simulation of the body. In the study, the virtual prototype model should be able to satisfy the basic research and design of industrial robot kinematics. Validation X3D technology in the design of virtual prototype of robots can have good effective action. The design of industrial robot virtualization is positive. This work includes X3D technology based on the model, the robot kinematics mathematic model of virtual prototype, and the use of this robot kinematics model using the model analysis of the performance parameters of the robot virtual prototype. This paper solves X3D using the virtual prototype technology robot run to learn some key problems of the simulation of the virtual prototype of robot X3D expression methods (robot virtual body expression, organization, the assembly, and the constraint X3D research). Based on the virtual prototype, X3D is inverse kinematics calculation model.

INTRODUCTION

The traditional development process of robot system is usually divided into four phases: system design, performance test, prototype design, and production stages. In the system design stage, the main work includes the scheme design, structure design, parts design, assembly, sensor, software design and so on; in the performance test stage performance, the main work is to explore the debugging and modification research on software part, according to the characteristics of the key components of the product; the prototype design stage in the prototype, the main work is to make a physical prototype based on the design scheme, in order to examine the rationality of the design, it is time to use some special physical means, the prototype in some part or structure made adjustable, when necessary, also need to do multiple parts to replace; in the production stage, the main work is to design, test and manufacture by successful

DOI: 10.4018/978-1-5225-8060-7.ch025

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prototype implementation of products to the market(Koren,1985). Thus it can be seen, the robot system development cycle very long and the consumption is very high. There are obvious limitations of traditional development of robot system. The traditional development process is difficult to adapt to the modern manufacturing industry product development requirements of flexible, agile and efficient, high quality.

Virtual prototyping technology is an advanced manufacturing technology of mechanical mechanism, kinematics, dynamics, graphics, artificial intelligence, concurrent engineering, the engineering and simulation based on network technology, which based on computer simulation and graphics support (Yi, 2007). Using the virtual product model can forecast behavior, performance in many aspects before the product actual processing on the product structure, so as to evaluate and optimize the design scheme to achieve optimal target.

The design and assembly of components is one of the important work of the robot system design. It is unrealistic to product a robots of disposable all constraints and full size. It is important to establish some constraints, rules, equation, in order to reflect some of the most important engineering data. The component in the design criterion can be replaced, and modify. The use of virtual prototype technology can control and modify and update. Member the final shape, size and assembly, can factor and multi aspects of consideration and binding, such as force, processing, operating environment, software constraints etc.

The introduction of virtual prototype technology, kinematics simulation of the robot system is also important for implementing (Min & De, 2004). Using a perfect virtual prototype can predict the performance of products in a real environment, it contains mechanical analysis, kinematics modeling, applied loads and constraints, to predict the response in real working environment. So the performance of the system and optimize the system structure can be evaluated, and the design can be improved.

At present, the application of virtual prototype technology is mainly the following situations in robot industrial design:

1. The use of design software of industrial robot manufacturer dedicated machine design software, such as the world famous robot manufacturer ABB, KUKA production, the main problem using this kind of design software, hardware platform vendor optional proprietary, software programming interface for all manufacturers, general source code is not open, extended the development platform is very difficult. Plus the cost of training is very expensive, the actual development cycle, cost, production cost is high.

Another method is combination of the development of the use of industrial design software common, such as ADMAS, PRO/E American Company MDI, UG-II and so on, this kind of software industrialization application is mature. Some of the major manufacturers and the robot laboratory also use this kind of software combination for development. But the main problems are the special development platform copyrighted the cost of software development, caused by high distribution costs. In addition, this kind of software is not the robot development is special, so this kind of software in general need to use a combination of, for example, use 3DMAX to do 3D modeling modeling, and then the model into ADMAS simulation, and program development and the need for third party programming platform. This caused the use of difficulties and troubles (Zhen & XianWen, 1995).

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