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Design of virtual prototype of crank slider mechanism based on ADAMS

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Abstract: This paper expatiates on the concept, related technologies and applications of virtual prototyping technology. Based on ADAMS software, this paper establishes virtual prototype model for crank slide block mechanism, and carries out simulating analysis. Finally, it expounds the process of applying virtual prototyping technology to carry out designs.
Keywords: virtual prototyping technology; ADAMS; simulating analysis.

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1. INTRODUCTION

Virtual prototype technology (virtual prototyping technology) is to use the software provided by the physical and geometrical information of each parts directly on the computer modeling and virtual assembly of mechanical system, which based on computer digital product model, namely virtual The virtual protatype is simulated and analyzed.

This method enables designer to quick test a variety of design on the computer, until get optimal results, and was relieved from the traditional design method of the physical prototype trial-manufacture, thus greatly shortens the development cycle, reduce the cost of development, improve the product quality.

2. VIRTUAL PROTOTYPING TECHNOLOGY

Virtual prototype technology in product design and development process, the scattered parts design and analysis technology mix together and built the overall product model on the computer, and put into use in the product after the simulation analysis under various working conditions and to predict the overall performance of the product, and then improve the product design, improve product performance.[1]

Virtual prototype technology is a combination of many technologies, its core is a multiple system kinematics and dynamics modeling theory and its technology, its key technologies including engineering design, modeling and simulation technology and the technology of VR visual. Mature 3 d computer software effectively guarantee the large-scale popularization and application of virtual prototype technology. With the rapid development of network technology, designers can also through the Internet message design, different locations, different operating platform, the application of

different design software technicians can perform a coordination and cooperation, realize the design of parallel and integrated. The virtual prototype technology emphasizes the system's point of view, Its application can run through the whole life cycle of product design. This technology can be used from the initial conceptual design to the trial production, design improvement and design verification of virtual prototype, and even the fault diagnosis of physical prototype.[2]

Before due to the technology of mechanical system virtual prototyping software system development and commercialization of importance and urgency of understanding insufficiency, the application of virtual prototype technology research in China starts late. Beijing institute of control engineering to undertake the project of 863 "detecting robot research" on the surface of the moon's use virtual prototyping technology to construct the virtual simulation environment on the surface of the moon, on the surface of the moon a robot dynamic characteristics are analyzed and the simulation of mechanical structure, the optimization design of robot, the key technologies of the surface of the moon robot were studied, some results were obtained.

3. APPLICATION EXAMPLES OF VIRTUAL PROTOTYPE TECHNOLOGY

3.1 ADAMS software overview

ADAMS (Automatic Dynamic Analysis of Mechanical Systems) is the MDI (Mechanical Dynamics Inc) company in 1977, compiled by the commercial software of mechanical system dynamics Analysis, is an excellent representative of function of digital prototype technology products, in the field of mechanical dynamics Analysis in the international market share accounted for more than 50%. ADAM S is a modular software, specifically divided into core modules, interface modules, professional modules, functional extension modules and toolkit.[3]Core modules include user interface module (ADAMS/View), solver (ADAMS/Solver), special post-processing module (ADAMS/PostProcessor), has a good interactive graphic interface, powerful solver and high-performance post-processing function. The result of the various modules are core modules based on different professional in the field of modeling and simulation solution tool. Use IGES interface module, STEP, STL, DWG/DXF products such as data exchange standard format file,Can realize ADAM S with CATIA, Pro/E UG, outstanding CAE/CAD/CAM software such as ANSYS, two-way transmission of data to make it function be extended to a large extent, also can provide users with special virtual prototype analysis with secondary development platform![4]

3.2 The design steps

ADAM S geometric model provides a rich tool library, through a simple mouse operation, which can generate a simple geometry such as cuboid, cylinder. Based on the geometric entities of addition, subtraction, multiplication, division and Boolean operation, and can generate complex geometric entities. In addition, you can also to auxiliary operation of geometry, such as chamfer, dig a hole, etc. In the process of modeling, can be set in the dialog box to geometric and physical parameters of geometry, also can use the default value, and then according to the actual request a change in the characteristic changes dialog box.

ADAM S provide constraints, a total of three types: motion pair constraints (such as the deputy of rotation and movement) , basic constraints (such as surface and parallel constraints) and motion constraints (such as mobile and rotational constraints). The motion pair and basic constraints are used

to define the interaction between two or more geometries, which will be independent of the geometry FIG is formed a system. Constraints can be specified for kinematic pair and point movement way, according to the design requirements to decide whether to establish the system of the applied load and load types (such as force, torque, etc.).

Prototype model is built, it is necessary to the simulation analysis. The simulation can set the control parameters (e.g., time and step length), can also compared with empirical data or add the necessary auxiliary analysis tools, such as sensors, to test the model establish whether there is any problem.

Finally, according to the requirement to post processing of the simulation results, the simulation results of various curve drawing, intuitive and accurately compare the simulation results. In this process can be realized by parametric design, modification, and many times repeated analysis of virtual prototype, until satisfactory results are obtained.[5-7]

3.3 Examples of application

It is known that the crank is 100mm long, 10mm wide and 5mm thick. The connecting rod is 200 mm long, 25mm wide and 10 mm thick. The slider is 60 mm long, 240 mm wide and 40mm high, and the material is brass. All other materials are steel. The crank rotates counterclockwise at a speed of 60rad /s. A spring is connected at the end of the slider, with an elastic modulus of 800n /mm and a damping coefficient of 0.5.To solve the

(1) Draw the displacement, velocity, acceleration and force curve of the spring of the slider;

(2) When the crank and horizontal forward into β = 60 ° displacement, velocity and acceleration of slider, β = 180 ° when spring force;

(3) The mechanism parameter value of the spring with the minimum force.

Modeling, simulation analysis by using ADAMS/View, set the output parameters measured the curve shown in figure 3, after which the abscissa graph has been set to beta Angle, β Angle is 60 ° and 180 ° as the ordinate correspond to the solution. Study of institutions, found that the length of the crank and slide block of spring force influence the sensitivity of the biggest, change the numerical range of 85 ~ 115 mm and 185 a respectively 215 mm, then optimized design, the final result is: the crank length of 85.00 mm, 215.00 mm long connecting rod.

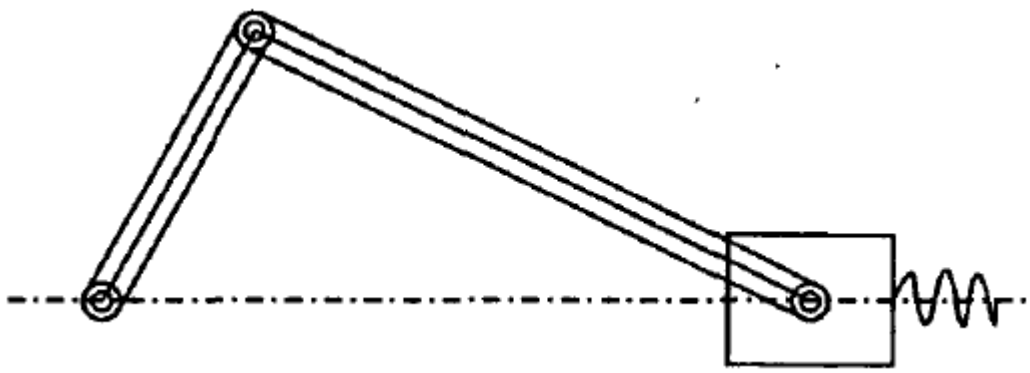

Figure 1

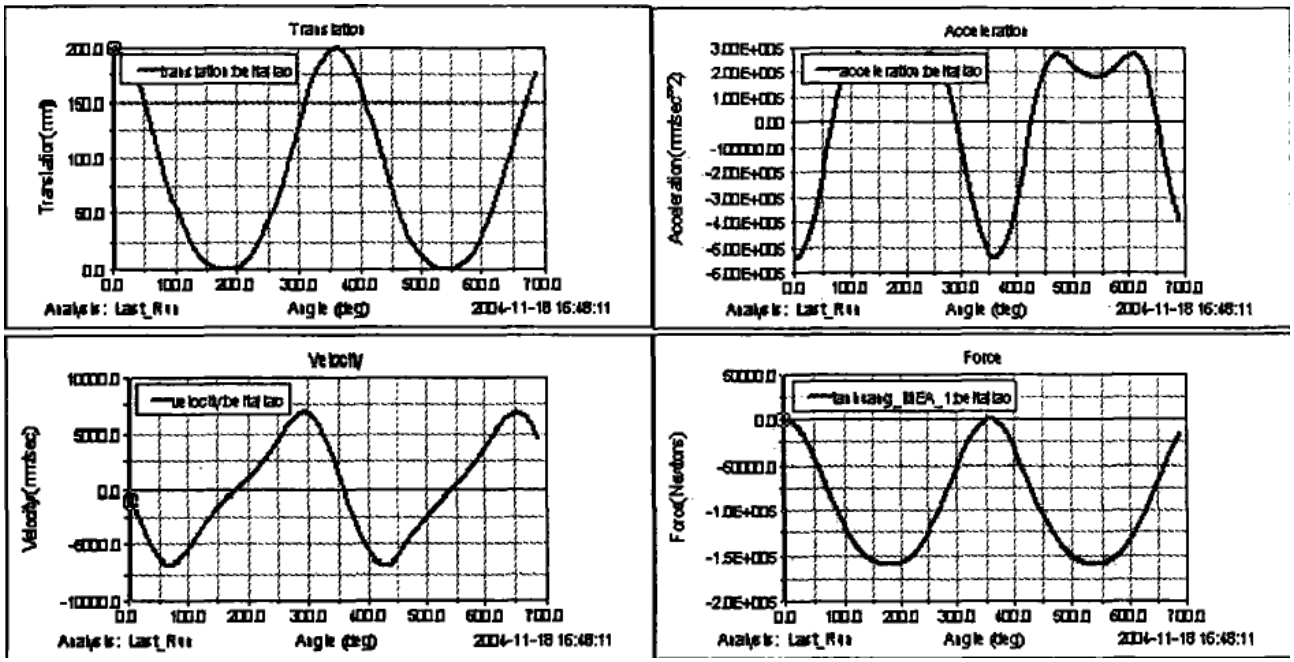

Figure 2

4. CONCLUSION

Through slider-crank mechanism the examples, this article introduces the use of ADAMS in the process of product design, hope to help people understanding of the virtual prototype technology and promote the further application of ADAMS software.

Of course, since ADAMS is mainly a powerful CAE software, it may be necessary to use Pro/E,UG and other CAD software to model complex products.

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