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Controller Reset Slice Optimization Based On Virtual Prototype

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Abstract

The operating force required for the crane controller is large, and a large amount of wear is easily generated between the small roller and the rotating side reset piece. The virtual prototype technology is used to simulate and analyze the controller. The Bezier curve design is adopted for the contact piece of the reset piece and the small roller, and the platform for integrated modeling, simulation and optimization of the virtual prototype is established, and the optimization of the domestic controller is completed by using the platform. The results show that the integrated method of virtual prototype is effective and has guiding significance for practical work.

Keywords

Controller,virtual prototype, integration.

1. Introduction

Virtual prototyping technology, also known as mechanical system dynamic simulation technology, is a computer-aided engineering (CAE) technology that developed rapidly in the 1980s with the development of computer technology. In the development and design of new products, the rational use of virtual prototyping technology allows designers to simulate the possible motion states and stresses of the designed products in various possible virtual environments, and quickly analyze and evaluate the design. Rationality, optimization of design parameters, provide reasonable data for future design; at the same time, it can partially replace real prototypes for various experimental studies, and even some experiments that are difficult or impossible to perform can be carried out in a virtual environment. Virtual prototyping technology can be used to simulate a real prototype for verification design, which not only greatly shortens the equipment development cycle, but also greatly improves the design quality and design efficiency of the product.

2. Virtual Prototyping

The automatic analysis software for mechanical system dynamics ADAMS is a very famous virtual prototyping software developed by American companies. On the one hand, ADAMS is a virtual prototyping application software that allows users to easily perform static, kinematic and dynamic analysis of virtual prototypes. On the other hand, it is also an analysis and development tool for virtual prototypes. Its open program structure and multiple interfaces can be used as a secondary development tool platform for special industry users to perform special virtual prototype analysis. ADAMS uses interactive graphical environments and component libraries, constraint libraries, and force libraries to create fully parametric mechanical system geometry models, as well as static, kinematic, and dynamic analysis of virtual mechanical systems, output displacement, velocity, acceleration, and force curve.

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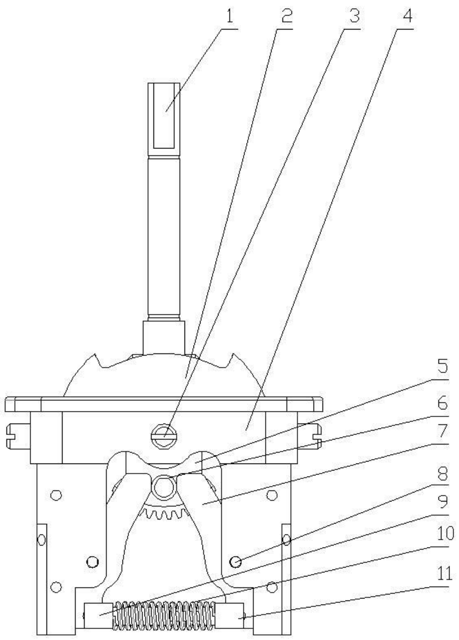
3. Controller Introduction

In cranes, the controller is often used as an input device for the crane to control the lifting, luffing, rotating, walking, etc. of the crane. In this paper, the domestic YGK3 handle is taken as an example to explain its components and working principle [1]. *Referenc*es, see Figure 1.



1. operating lever; 2. limit plate; 3. adjusting screw; 4. box; 5. bending axis; 6. small roller; 7. reset piece; 8. fulcrum rivet; 9. Reset guide sleeve; 10. Reset spring; 11. Reset guide rod

Figure 1. Controller body part

The working principle is as follows: when the worker pulls the operating rod, the operating rod contacts the bending shaft to drive the bending shaft to rotate, and the small roller on the bending shaft pushes the reset piece, so that the reset piece rotates around the fulcrum rivet, and simultaneously pushes the lower end of the reset plate. The guide sleeve or the reset guide rod is reset, so that the reset guide rod enters the hole of the reset guide sleeve, and the distance between the two faces of the fixed compression return spring is reduced, so that the compression return spring length is reduced and the compression amount is increased.When the worker releases the operating lever, the compression return spring pushes the reset guide sleeve (or the reset guide rod) under the action of the compression return spring force, the guide sleeve (or the guide rod) pushes the reset piece, and the reset piece pushes the small roller and the curved axis. The curved axis pushes the lever back to its original position.Thus the reset of the handle is achieved [1].

4. Controller Virtual Prototype

The controller 3D model is imported into ADAMS through the interface between ADAMS and SolidWorks, thus avoiding the cumbersome and difficult to implement modeling process in ADAMS. The controller body model imported into ADAMS has no quality, and it is necessary to add materials to each part according to the material properties of the part icon annotation. In ADAMS, you can quickly add material properties to individual parts using the Table Editor. References, see Figure 2.

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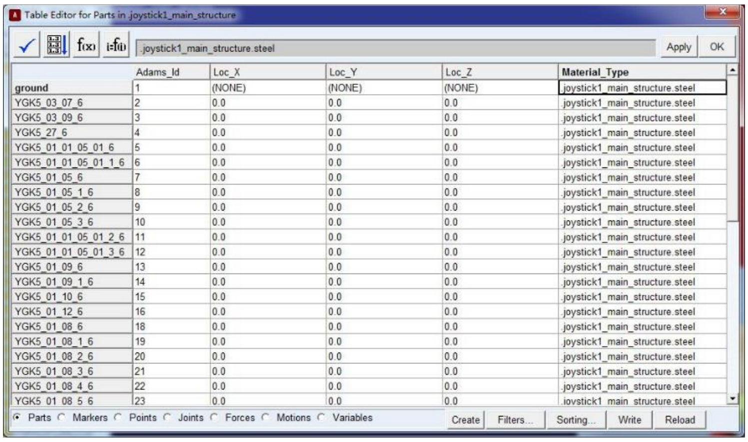

Figure 2. Add material with the table editor

Import the controller model into ADAMS, change some parameters, perform simulation analysis, and the engineering quantity is relatively large. So by writing a macro command, import it into the window where the macro command is written, and then select the name of the macro command to run the macro command. After the macro command runs successfully, the controller model will automatically add constraints and loads. This saves a lot of time and increases efficiency and saves a lot of manpower. References, see Figure 3.

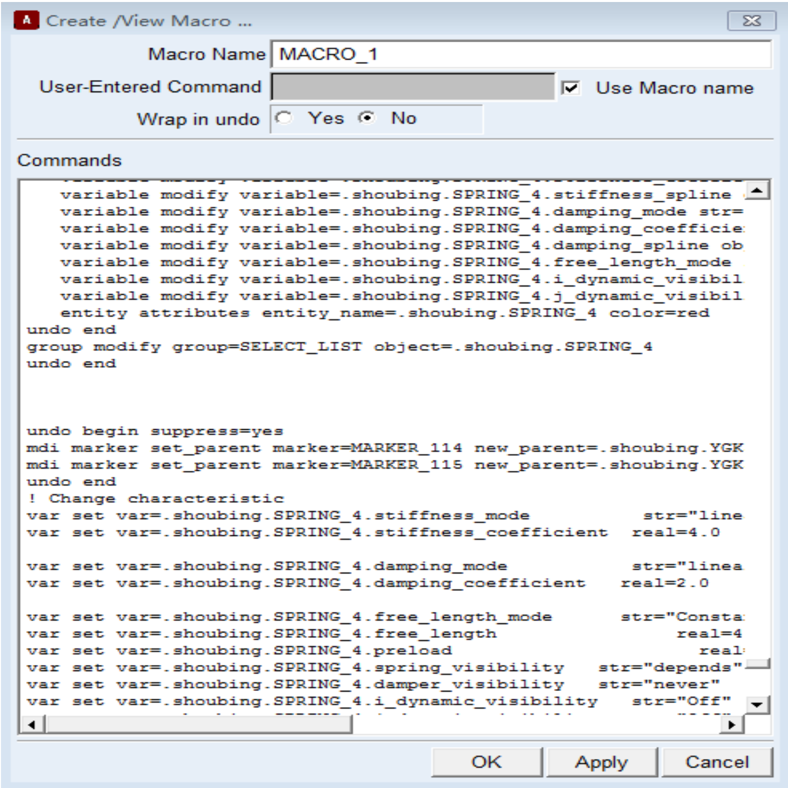

Figure 3. Write a macro command window

At this point, the virtual prototype of the controller has been set up, and this model can be used for kinematics and dynamics simulation.

5. Reset Slice Optimization

The shape of the reset piece is optimized by reducing the contact force between the small roller and the rotating side return piece. The contact surface of the original controller reset piece is a straight surface. Now consider designing the contact surface as a curved surface to ensure that the contact force between the small roller and the rotating side reset piece is minimized during the movement of the controller. Now in SolidWorks, the reset sheet contact surface design curve is designed as a cubic

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Bezier curve, and the Bezier curve shape is controlled by two of the points in the case of the known initial point and end point. References, see Figure 4.

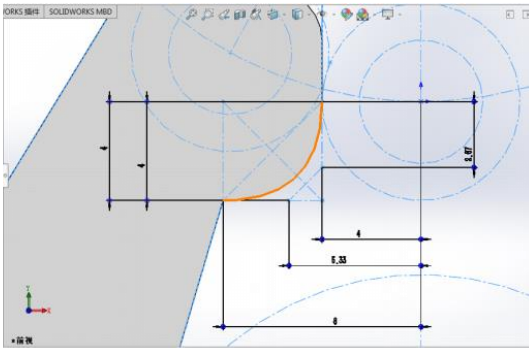

Figure 4. The Bezier curve design on the reset slice

For the reset piece, after optimizing its shape, the simulation is carried out directly in the ADAMS to optimize the contact force between the small roller and the rotating side return piece before and after optimization, and the optimization effect is determined. For the reset size that needs to be changed in real time and optimized to achieve the target, the integrated integration idea is fully utilized, and Isight software integration SolidWorks-ANSYS-ADAMS-MATLAB is used to complete the integrated parameter modeling, simulation, analysis, calculation, optimization of the platform. Using the platform to optimize the critical dimensions of the reset piece using the Latin hypercube test design method, the optimal value of the critical size of the reset piece when the contact force is minimum is obtained.

So far, the platform for integrated modeling and simulation optimization of the controller virtual prototype has been completed.

The Latin hypercube test design method was added to the integrated controller integrated modeling, simulation, and optimization platform, and D2 and D3 were used as factors, ranging from 0 to 4 mm and 4 mm to 8 mm, respectively, and 9 tests were performed. References, see Figure 5.

	D2@草图10fl_Part	D3@草图10fl_Part	jiechu
1	0.0	6.5	232.74
2	0.5	6.0	304.7
3	1.0	5.0	228.29
4	1.5	7.0	201.09
5	2.0	5.5	228.07
6	2.5	4.0	236.35
7	3.0	7.5	225.69
8	3.5	8.0	225.69
9	4.0	4.5	317.69

Figure 5. Test design result

It can be seen that the optimal design is D2 = 1.5 mm and D3 = 7.0 mm. After the optimization, the contact force between the small roller and the rotating side return piece is greatly reduced. References, see Table 1.

Table 1. Optimization result comparison

	D2	D3	Result
Before	0.0	6.5	232.74
After	1.5	7.0	201.09

6. Conclusion

This paper adopts virtual prototype technology to optimize domestic controllers. In order to realize the integrated modeling and simulation optimization of the virtual prototype, the integrated thinking is used to integrate SolidWorks, ANASYS, ADAMS, and MATLAB software to realize the

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interaction of software data and files in the optimization process, which greatly simplifies the operation steps of the designer and saves optimization time.

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