

Design of Virtual Simulation Experiment System for Maintenance Process of Emu Bogie

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Abstract: The development of economy and science and technology has promoted the great progress of China's high-speed car industry. With the advent of bullet train era, people pay more and more attention to the safety of bullet train. The safety of bullet trains is closely related to the maintenance of bullet trains. As an important structure of bullet trains, the bogie has a direct impact on the safety of bullet trains. Therefore, the research on the maintenance technology of emu bogie has gradually become the focus of people's attention. In this paper, the necessity of designing virtual simulation experiment system of emu bogie is briefly analyzed and the related system design experiment is carried out on the basis of Weibull distribution algorithm. Finally, based on the analysis of the experiment, the specific process of system design is discussed. Finally, the sensitivity test of the virtual simulation experiment system is carried out, which further proves that the simulation experiment system can be applied in the actual maintenance work of the bullet train. On the one hand, it promotes the development of the maintenance work of the emu, and guarantees the normal operation of the emu. On the other hand, it provides a theoretical basis for future related research.

1. Introduction

With the rapid development of China's science and technology and economic level, China's railway traffic has made great progress. In recent years, China has ushered in the era of high-speed bullet train, which has been widely applied in the whole country [1]. The rapid application of high-speed bullet train not only represents the rapid development of science and technology and economy in China, but also provides great convenience for people's life. At the same time of rapid application of bullet trains, the safety and stability of bullet trains should be guaranteed, so it is necessary to carry out regular maintenance [2-3]. However, the bogie is an important part of bullet train. If the bogie fails, the normal operation of bullet train will be affected, and safety problems of bullet train will also occur in serious cases [4]. In addition, due to the complexity of the structure of the emu bogie and the backward and single current maintenance mode, the maintenance effect of the bogie is lower and the maintenance cost is higher. In view of this situation, in order to improve the maintenance technology of emu bogie, it is particularly important to conduct relevant research on it [5-6].

At present, the maintenance technology of the assembly of motor vehicle bogie in China mainly includes the following three forms, including the maintenance of the ground ring car, the air suspension circulation technology line and the ground board transmission type. At present, the three kinds of inspection techniques for emu bogie have their own advantages and disadvantages [7-8]. Some maintenance efficiency is low, some need to spend high cost of time and money. With the current fierce technical competition, improving the maintenance technology of emu bogie and improving the maintenance effect are the current problems that urgently need to be solved in the maintenance of bogie [9]. In order to improve the maintenance efficiency, a large number of maintenance experiments must be carried out. Therefore, it is particularly important to establish a virtual simulation experiment system for the maintenance process of emu bogie. The establishment

of virtual simulation experiment system can make up for various deficiencies in the physical experiment to a large extent, and provide sufficient data and theoretical support for the improvement of emu maintenance technology [10-11]. However, at present, the establishment of this virtual simulation experiment system has not been paid enough attention in China, so there are still many deficiencies in the research on relevant aspects [12].

In order to make up for the deficiency of this research, this paper firstly analyzes the necessity of designing virtual simulation experimental system of emu bogie, and carries out relevant system design experiments on the basis of Weibull distribution algorithm. Finally, the specific process of system design is discussed based on the analysis of the experiment [13-14]. Promote the completion of simulation experiment system design, promote the improvement of bogie maintenance technology. It is not only conducive to ensuring the operation safety of bullet trains, but also can provide a certain theoretical basis for future research on relevant aspects [15].

2. Method

2.1 Necessity of Designing Virtual Simulation Experiment System

As one of the most important core components of the bullet train, the bogie is of complex composition structure, and the bogie usually adopts relatively high and new technology. Its important component structure mainly includes the following aspects: braking device, suspension device, wheelset, frame, driving device and other components. The main function of bogie is to ensure the smooth running of the train along the track, which has an important impact on the safety and stability of the train. Therefore, whether daily study or practical operation must be the doctrine of bogie maintenance process training and upgrading. However, only through the teaching of bogie solid experiment or the study of relevant maintenance theory can not get a better effect. On the one hand, it needs a lot of experiment cost to carry out the physical experiment on the maintenance technology of the bogie. Due to the complex structure and large size of the bogie, it is not practical to establish a physical laboratory for maintenance technology. On the other hand. The solid experiment of the bogie maintenance process cannot simulate the working condition under abnormal conditions, but can only be carried out under the current bogie state, and the experimental results have great limitations. However, with the help of virtual simulation experiment, it is possible to simulate the maintenance of various conditions of the bogie and draw a comprehensive maintenance conclusion. In conclusion, virtual simulation experiment plays an important role in improving the maintenance technology of emu bogie.

2.2 Weibull Distribution Algorithm

Weibull distribution model is often used for fault inspection of equipment and parts. It can be used for fitting inspection of maintenance of emu bogie. Weibull is applicable to some faulty equipment and parts, so it is good for the accurate maintenance of the bogie. The specific function model is as follows:

$$F(t) = 1 - e^{-\left(\frac{t-\gamma}{\eta}\right)^m}, t > 0 \quad \text{or} \quad F(t) = 0, t \leq 0 \quad (1)$$

Where, m represents the shape parameter; The size parameters of the gamma said location parameters, eta said. Shape parameter m represents the shape characteristics of Weibull distribution curve. The characteristics of the curve shape are as follows: when $m < 1$, the probability of failure of emu bogie is gradually reduced, which corresponds to the early failure in the curve. When $m=1$, the probability of failure of the emu bogie is constant, presenting an exponential distribution. When $m>1$, the probability of failure is increasing. When $m=2$, the distribution curve of wilb becomes c-shaped. When $m > 2$, it means that the emu bogie is completely in the period of loss and failure. But in the actual maintenance process, we usually set $\gamma=0$ when the bogie has failed, need to carry out maintenance.

In order to estimate each parameter in Weibull distribution, the hospital linear regression

equation can be used, and the specific equation is as follows:

$$Y = A + BX \quad (2)$$

Where A and B represent the relevant constants of the device, and Y represents the estimated value of the device in the Weibull distribution. When using the linear equation to estimate the relevant parameters, it should be noted that when the Weibull distribution contains two parameters, the linear transformation of the equation is required.

3. Experiment

Step 1: collect and sort the bogie fault data; Refer to the relevant information to sort out and analyze the fault data of the relevant high-speed train bogie in detail, including the relevant maintenance data of the bogie.

Step 2: data calculation and model establishment; Help Weibull algorithm was used to establish the maintenance model of the locomotive bogie of the bullet train. On the basis of this model, three-dimensional model was constructed. During the construction process, the model should be rendered repeatedly to ensure the authenticity of the model to the greatest extent.

Step 3: conduct detailed statistical analysis of fault data according to the results obtained in the above steps, obtain the final accurate evaluation results of the maintenance process of the bogie, and then provide sufficient data support for the determination of the specific maintenance mode of the bogie. On this basis, the virtual simulation experiment system is determined.

Step 4: system detection; After completing the system design, several groups of experimental data were selected for research and analysis, and the sensitivity of the system was tested and analyzed to test whether the design of the system was qualified and whether it could be applied to the actual maintenance process of the emu bogie.

4. Discuss

4.1 Steps of System Design

(1) Determination of maintenance process

In order to provide accurate and real-time technical data for the system design, the author, through consulting a large number of data and data, carries on a large number of data statistics and records for the operation of the bullet train and the relevant maintenance data of the bogie. This paper makes a thorough understanding of the maintenance theory and technological process of the emu bogie, and provides specific theoretical guidance and reference for the design of virtual simulation experiment system of the maintenance technology of the emu bogie.

(2) Establishment of 3d model

The difficulty and emphasis of the design of virtual simulation experiment system for maintenance process of emu bogie lies in the establishment of 3d model. The key of 3d model establishment is to ensure the complete consistency between the size of the model and the bogie size of the bullet train body. This requires detailed mapping of the components and related components of the bogie of each bullet train model before the establishment of the 3d model. On this basis, combined with the data consulted, the bogie 3d model was constructed with the help of Pro/Engineer software, then the model was rendered and optimized with 3DS MAX software, and finally the file with the extension*.wrl format was exported.

(3) Selection of design tools

In order to maximize the openness and sharing degree of the virtual simulation experiment system for the maintenance process of emu bogie, it is necessary to add interactive maintenance steps on the basis of the established 3D model with the help of Web 3D technology. The online access of virtual simulation system can be realized. At present, the technology development tools in this aspect mainly include the following several types. The specific comparison is shown in table 1. The relevant information in the table is the result of the author's collation.

Table 1. Comparison of Web 3D technology development tools

Design Tools	Establishment of 3D Model	Characteristic
Unity 3D	Third party software modeling import	Based on the Java, strong cross-platform and commonality, High efficiency of integrated compilation
Cortona 3D	Third party software modeling import	Data interface rich, strong interaction, support IETM Interactive electronic technical manual specification
Cult 3D	Third party software modeling import	Based on the Java, can achieve multi-platform development, expansion Good malleability and compatibility
Viewpoint	The software itself makes three-dimensional models	Based on the XML, high compression, convenient data transmission
*Data came from the collation results		

Through comparative analysis in table 1, Cortona 3D software can make Rapid production and design of IETM with the help of its Rapid Manual module. Therefore, it is proposed to use Cortona 3D software as the design tool for virtual simulation experiment system of emu bogie maintenance process.

4.2 Overview of System Design Process

With the help of Cortona 3D software to complete the assembly and disassembly, the virtual experimental system model can be generated. Import and save the optimized rendering bogie solid model with the help of 3D software, and conduct the following meticulous processing with the help of Cortona 3D software. Second, the established 3d model is repeatedly rendered and other parameters are changed to make the model more realistic. Thirdly, the tree list of steering machine and 3d model is established. Fourth, the interactive bogie maintenance process is added.

4.3 Design and Implementation of the System

This system takes Visual Studio 2012 as the design platform of the system. The background database of the system relies on SQL Server 2012 and connects the Server and database with the help of ASP.NET. In order to provide convenience for people to use the virtual simulation experiment system, the specific operation process of virtual simulation system for the maintenance process of emu bogie can be presented on the front page by referring to the technology of IETM, which provides a good way for students' interactive operation and actual system reference. After the system design is completed, the sensitivity of the system should be tested. Here, four groups of simulation experiments are selected to test the sensitivity of the system. The specific test results are shown in figure 1. The data in the figure is the result of experimental arrangement.

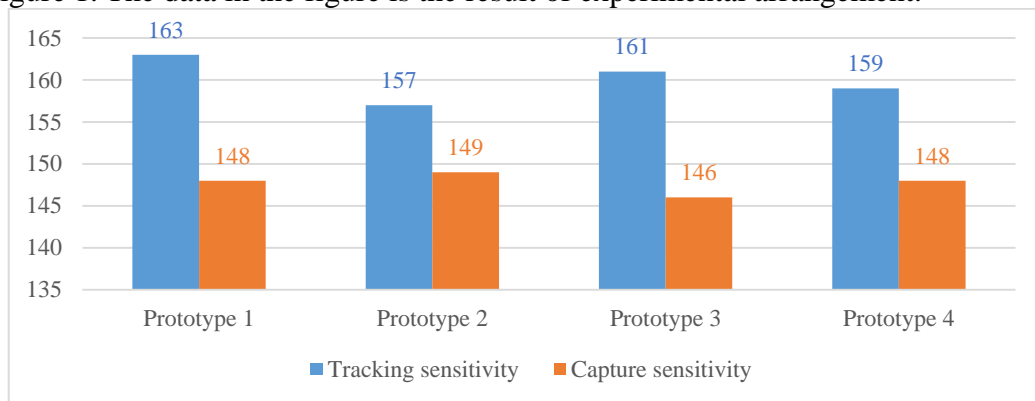


Figure 1. Sensitivity test data of the virtual experimental system

From the test results of four virtual system experiments in figure 1, it can be seen that the sensitivity of the research system has reached the systematic measurement standard, which can

ensure the accuracy of the experimental results. This shows that the design of the virtual experiment system is successful.

5. Conclusion

The design of virtual simulation experiment system for the maintenance process of emu bogie to a large extent makes up for the deficiencies of the physical experiment, not only reduces the cost of the experiment, but also ensures that The Times and quality of the experiment can promote the improvement of the maintenance process of emu bogie. To sum up, the virtual experiment system for maintenance technology of emu bogie is worthy of promotion and application in professional colleges and railway departments, which has a good role in promoting the development of emu in the future.

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