Fault Diagnosis of the CJ1 Flight Simulator Wheel

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Keywords: CJ1 Flight Simulator; Wheel; Auxiliary operator; Amplifier.

Abstract: In the warranty period, the reward simulator makes a loud noise (mechanical friction sound), the fault is serious, it cannot be balanced by electric power, and it can be balanced manually. The reset button cannot be reset, and the reloading model cannot troubleshoot. Turn on the cockpit power cabinet and find the auxiliary operator left amplifier error. The fault remains after the restart. After the amplifier is reset, the balance wheel will automatically hit the low limit card to die. Let the auxiliary amplifier not work. At the bottom of the simulator, the motor was found to be in the farthest position and could not be adjusted. Check the mechanical structure drawing remove the wheel balancing observation found that main shaft screw loose, tighten the screw, found that fastening balancing wheel can be normal, regardless of position or to be obtained power balancing, without noise, troubleshooting.

1 INTRODUCTION

China's aviation maintenance market has great potential, and the maintenance industry should belong to the new industry, and the development prospect is very promising[1-5]. Among them, the maintenance prospect of the simulator is also very promising [1-5]. Now flight simulator is mostly mechanical, electronic, computer and automation, and other more advanced technology in the integration of high-tech products, its structure and components are associated with complex, thus caused by the failure type and failure causes are complex and changeable. Many perspective from the simulator fault detection, fault type, fault phenomenon is various, and the same causes of the failure phenomenon and may be varied, so the analog fault diagnosis and maintenance process is very complex [6-8].

The CJ1FFS simulator is in the warranty period with a loud noise (mechanical friction sound), which seriously affects the flight. It is normal to work when the balancing wheel is rotated, but mechanical noise can occur when it is rotating at high speed or using electric power. It may occur because of damage to the buckles (broken gear).The fault occurs because the output force of the motor exceeds the range that the gearbox can handle when the fault is blocked. This could cause the gearbox to fail. And that's why the chain is getting longer and longer, because there's torque in it. MSI, a simulator manufacturer, suggests that the chain should be replaced, and the use of PD1 lubricating oil to lubricate it quarterly will increase its service life.

On top of that, the clutch on the motor's link shaft needs to be tightened. However, if the balancing wheel is too tight, it may be difficult for the balancing wheel to be manually operated, so some tests and attempts are needed to obtain the correct tension on the balance wheel. This means you need to open the central console. The gear has no gear box. The chain cannot be tightened through the position of the moving motor because the motor is already at the far end. Changing the chain is difficult and difficult to operate. We can't tell if the gear is damaged or not, because the gears are inside the center console. Flight simulation equipment is mainly divided into flight simulator, fixed simulator and dynamic simulator. Since the first flight simulator was put into operation in the last century, the simulator has made continuous progress in both hardware and software technology, especially in software technology.

Over the past ten years, more manufacturers have been involved in the R & D and production of simulators, and the simulation equipment with independent intellectual property rights has been designed and used in China. For example, in

December 2005, huawing blue sky Co., Ltd., cooperated with the three parties of CAAC and CAAC, and launched the company's "Boeing 737NG simulation flight training equipment" independently developed by the company. The device uses the core software of the "virtual flight trainer" of the Chinese wing blue sky company, designed according to the features of the Boeing 737 aircraft, and is a second series of products adapted to the needs of large civil aviation aircraft in China, and the equipment has been delivered to the flight Institute to use [2]. As shown in Figure 1, a large number of new technologies and ideas are adopted in the new simulator, especially the overall progress of the computer system, the visual system, the flight control system, the interface system, the motion system, the instrument system and the software development model technology. On the basis of inheriting the advantages of the traditional analogue machine, the technology breakthrough has been achieved in [3].

The control system provides the pilots with the rod and rudder, and the control feedback force of other equipment. The real degree directly affects the performance of the simulator. There are many tests on the QTG flight quality objective evaluation system. Recently, the electric control system has gradually replaced the traditional hydraulic control system. The early electric control system adopts DSP and simple embedded control program. It is difficult to develop and debug the system. The ECOL-8000 system adopts a common industrial PC machine, which has PCI slot and multiple professional AD-DA conversion cards.

The interface system is the main channel for data exchange and communication between simulator PC and avionics equipment in the cockpit. In recent years, the serialization trend of the interface system has been popular, especially the application of USB interface has promoted the adoption of the industrial standard serial bus.

The Canadian Mechtronix simulator manufacturing company used 4 ports and nearly 100 Canbus nodes on its B737-800 simulator. Every simulation instrument and panel has a single chip computer with Canbus interface, which is communicated with PC through the bus. Canada's CAE simulator manufacturing company uses the plug and play USB bus to maximize the convenience of troubleshooting. The use of "HOST TO PANEL" makes each cockpit panel become a USB device, which is directly communicated with PC, and the failure of a single excuse unit will not affect the normal operation of the entire interface system.

2 RESEARCH SIGNIFICANCE

Fault phenomenon: the balancing wheel makes a loud noise (mechanical friction sound), cannot be balanced by electric power, and can be balanced manually. In this paper, the research for the improvement of China's civil aviation college of flight simulator training center, maintenance, operation efficiency, and save the maintenance cost plays an important role, and lay the foundations for the subsequent series of the maintenance of the simulator.

The computer system is mainly responsible for the calculation of flight simulation and the exchange of data with the interface system. The complex computing and graphic display which needed expensive computer workstations to be accomplished by expensive computer workstations. Now it only needs to buy ordinary personal computers to complete the distributed multi computer network with multiple computers in a single cabinet or multi cabinet. The simulator system is becoming the mainstream [4]. In this system, different computers are responsible for different tasks through data exchange and synchronization.

The visual system is responsible for the simulation of visual images, which provides virtual external world for pilots. The image generation system is responsible for real-time 3D image generation, and the projection system is responsible for projecting real-time 3D images onto the 180 degree ring surface screen. The progress of the visual system mainly includes the progress in these three aspects. The widely used "three gun" kinescope projection system has gradually been replaced by silicon based LCD projector [5].

The new LCOS projector has great progress in these three aspects, such as the DLA-HD10K projector of JVC company used by RSI company's visual system, which uses non mobile mirror technology, with color stability, high resolution, resolution up to 1920 x 1080, contrast to 2500:1, with cinema level color grade and black. The color gamut shows the effect. This type of projector has finally replaced the "three gun" projection system, which has been widely used in the high-end flight simulator. Pilots fly to all parts of the world, and the terrain and geomorphology they see are close to the virtual environment brought by the simulator. The effect of simulated flight training is largely influenced by the quality of the visual image, and the quality of the visual image depends on the completion of the debugging work. At the same time, the image debugging work is big, the

requirement is high, and it has certain risk. Therefore, in the process of debugging, we should be careful and patient, and use all kinds of debugging techniques and means reasonably to get the best effect [6].

The sports system provides pilots with other kinds of flight sensation such as jolting in flight. In the motion system, the electric motion system begins to replace the hydraulic motion system gradually. Compared with the hydraulic motion system, the system has the advantages of saving electricity, low noise, no pipe pollution and no oil leakage. However, the electric motion system is still a new thing, and its technology is not very mature, in which the supply of parts is a problem. The problem of traditional hydraulic systems is basically not [3].

3 FAULT ANALYSIS

The control system provides the pilots with the rod and rudder, and the control feedback force of other equipment. The real degree directly affects the performance of the simulator. There are many tests on the QTG flight quality objective evaluation system. Recently, the electric control system has gradually replaced the traditional hydraulic control system. The early electric control system adopts DSP and simple embedded control program. It is difficult to develop and debug the system. The ECOL-8000 system adopts a common industrial PC machine, which has PCI slot and multiple professional AD-DA conversion cards.

The interface system is the main channel for data exchange and communication between simulator PC and avionics equipment in the cockpit. In recent years, the serialization trend of the interface system has been popular, especially the application of USB interface has promoted the adoption of the industrial standard serial bus. The Canadian Mechtronix simulator manufacturing company used 4 ports and nearly 100 canbus nodes on its B737-800 simulator. Every simulation instrument and panel has a single chip computer with canbus interface, which is communicated with PC through the bus. Canada's CAE simulator manufacturing company uses the plug and play USB bus to maximize the convenience of troubleshooting. The use of "HOST TO PANEL" makes each cockpit panel become a USB device, which is directly communicated with PC, and the failure of a single excuse unit will not affect the normal operation of the entire interface system.

Cockpit meters provide various parameters to provide various dynamic data for pilots. From the development of the instrument system in the past few years, the traditional simulator used a large number of real aircraft electric instruments. Because of the complex structure, the difficulty of driving, the high maintenance cost, the simulation instruments are gradually using the simulation instruments. The appearance and performance of the simulation instruments are the same as the aircraft instruments, but the maintenance is maintained. It's more convenient. The use of the simulation instrument will no longer need to drive the instrument through the ARNIC-429 and other buses which are unique to the simulated aircraft, and no longer need the 115V/400HZ power supply, and the system failure rate will be further reduced. In particular, modern aircraft gradually use flat instruments, which are suitable for computer graphics.

4 REMOVE STEPS

The reset button cannot be reset, and the reloading model cannot troubleshoot.2. Open the cockpit power supply cabinet to find the auxiliary operator left amplifier error, error code: 51. 3. After the amplifier is reset, the error code will be converted between 91 and 72, and the balancing wheel will automatically hit the low limit card to die. Card after death error: 72. 4. The flight crew requires to continue to fly, turn off the CB1 switch, and let the auxiliary amplifier not work. in the process of doing QTG find balancing wheel and the mechanical noise, the simulator observation found at the bottom of the motor is in position, can't adjust, chain loose problem failed to solve for the time being.2, remove the balancing wheel to observe the mechanical structure, found that main shaft screw loose, tighten the screw, found that fastening balancing wheel can be normal, regardless of position or to be obtained power balancing, did not happen, noise fault a temporary solution, for further research and treatment.

Open the instrument panel, found that the main shaft screw is loose, unable to tighten, prompted a twisting balancing wheel mechanical position phenomenon, find the reasons, found that the tail and central axis of the screws are loose.2. Tighten the two screws, the spindle is no longer loose;3. The chain is noticeably loose from the 227 model, which is temporarily not processed, and the chain is lubricated by oil.

At present, the overall debugging is normal, whether it is electric balancing or manual balancing,

no abnormal sound is found; Relocations and no mechanical noise.5. Install TCAS panel and FMS. 6. Install the front cover, left and right side cover, and install the knob.

When the balancing wheel turns, the CB1 switch of the SCL will be turned off, and the manual balance will be temporarily used.2. Mechanical noise appeared at around 6 o 'clock on April 18th, but recently, the balancing wheel was observed and the operation was good.3. For the sake of safety, 20 orders of original screws have been ordered, and the order sheet has been delivered to the shipping materials. The number of the order is 171-00000147-00-000.4. After the mechanical noise was found in the balancing wheel, two new screws were found to be broken again, and the spindle was found to be loose, and the gear could not be fastened, and the suitable solution could not be found for a while.

The abnormal condition was found before the balancing wheel was disassembled, with 3 screws falling in the ground; After fastening, check the cal_0.dat file of SCL and recalibrate the position data of the balancing wheel.-720 degrees and 1280 degrees are recalibrated. Reload the program again, test the balancing work is normal.2. It is found that the two adjacent screws of the balancing wheel have already been broken, and it is speculated that the fault of the balance wheel in the near future is caused by two broken screws: the failure of the screw causes the torque to push the pointer not enough.3. Only two screws are fastened, the balancing wheel can work normally, the needle is working normally, and the other two screws will be replaced next time.

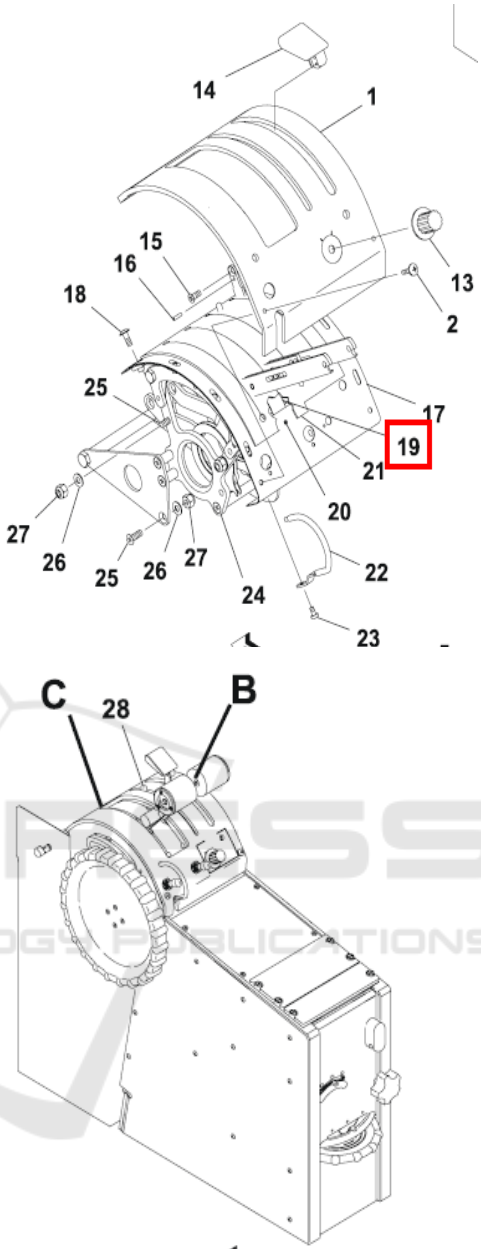

Fig. 1 the structure diagram of the balance wheel.

Remove the balancing wheel, select the take-off position and fix its position.2. Recalculated, found that there was mechanical noise inside the reloading model, and suspected that there was mechanical failure around the motor, and the process was disassembled when scheduled maintenance on May 2nd.

Find that the balancing wheel is loose, and when it is tightened again, the wheel is no longer skidding.2. Once again disconnect the auxiliary computer and restart it, enter the SCL-TEST and

restart the SCL computer after calibration of the upper and lower positions. After loading the program, the TEST work is normal. If it is found that the balance wheel is loose, please tighten it in time to prevent the deviation after slipping. Check the cal_0.dat file of SCL. Observe the position data of the balancing wheel, and the number of two positions in the two positions of 720 degrees and 1280 degrees is recalibrated by the operation of the SCL test program.2. After power failure of SCL computer, reload the program again, the fault remains.

3. Repeat the above method, and power off and power on the operation, test the balance, the fault is still, and cannot be balanced by electric power.4. Since it has already arrived at 2 o 'clock in the night, we will be excluded next time. Check the operation manual of the auxiliary operating amplifier of the balancing wheel.

5 CONCLUSIONS

The reset button cannot be reset, and the reloading model cannot troubleshoot. Turn on the cockpit power cabinet and find the auxiliary operator left amplifier error. The fault remains after the restart. After the amplifier is reset, the balance wheel will automatically hit the low limit card to die. Let the auxiliary amplifier not work. At the bottom of the simulator, the motor was found to be in the farthest position and could not be adjusted. Check the mechanical structure drawing remove the wheel balancing observation found that main shaft screw loose, tighten the screw, found that fastening balancing wheel can be normal, regardless of position or to be obtained power balancing, without noise, troubleshooting.

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