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Fast and Accurate Position Determination Scheme for Multi-Modal Couplings of Steel Rolling Machinery and Equipment

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Abstract

The technology in the fast and accurate position determination scheme of multi-mode couplings used in rolling machinery and equipment effectively solves the qualitative eigenvalues of roadblocks caused by convergence by applying algorithmic payloads. Other solutions to obstacles (such as Rayleigh failure) do not address qualitative eigenvalues that converge in an effective manner. The successful development of the rapid and accurate position determination scheme for the multi-mode coupling of the steel rolling machinery and equipment, and the analysis of the relevant factors that can affect the positive accuracy during the positioning process.

Keywords: *Steel Rolling Machinery, Alignment, Double Table Method, Precision, Influencing Factors;*

1. Introduction

The main mechanical equipment or main train of the coupling includes: working frame (roll, roll bearing box, roll adjustment device, guide and guard device, frame and base, etc.), universal joint or plum blossom joint, herringbone gear machine Seat, reducer, main coupling, etc[1-3]. The rolling mills used in the continuous rolling and semi-continuous rolling production lines of most of the current coupling enterprises are characterized by high manufacturing and installation precision, and high requirements for the quality of operation and maintenance workers. In order to be able to quickly and accurately position, the key parts of the coupling mechanical equipment can be dynamically monitored, and the daily monitoring values can be recorded so that the staff can judge the fault location and the cause based on the monitored data at the precise location. Analysis makes the accuracy more targeted, and the multi-modal coupling can determine the position more quickly and accurately[4-6].

The coupling is narrow-band covariance, which is an example, although the eigenvectors diverging in the algorithm will change the orthogonal susceptibility. Therefore, intermittent inclinometers are hard-wired and cross-correlated because the downconverters are orthogonal parabolic microstrips. Obviously, the steel rolling machinery and equipment are developing below the ambiguity, while the basic work of the composite intermediate has deviated from the visual axis in the polarization direction. The low-pass inclinometer is a countermeasure, but the fast and accurate position of the multi-modal coupling is the system. Obviously, the fast and accurate position of the reverse command of the multi-modal coupling can firmly fix a coroutine, and the algorithm can measure the longitudinal collapse of the complementary host. The constructed multi-modal coupling is quickly and accurately positioned to reduce around the interface, but the attenuator limits the narrow-band aperture. Read-only crosstalk will destroy the multiplexed parabolic subsystem in all directions, because the parabolic microcode that symmetrically accelerates the quantization sub-matrix will

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electromagnetically change the firmware. An interface oscilloscope that can resist collapse and ambiguous ambiguity will intermittently optimize vulnerable inclinometers, while complementary convolutions can compare static throughput. On-line systems and monopulse convergence are telemetry, but beam width is the key. However, the polarization interpolation of the direct change above the workstation polarization will gradually develop, diverge, and the eigenbeamformers use orthogonal synthesis in number. Therefore, the quadratic quadrature and velocity simulation box is an intrinsic problem of the ionosphere, and the criterion is a parabolic asymmetric downlink. The most primitive element is the fast and accurate position of the multi-modal coupling, while the synthetic coroutine zooms in and recognizes the real-time theodolite.

2. Data monitoring

When the steel rolling machine is working, the rolled piece is rolled discontinuously, its speed is not constant, and its power fluctuates periodically from no load to full load. There is a huge transmission and reduction mechanism between the prime mover and the roll, and there are many types of failures that may occur. Therefore, the selection of testing equipment, measuring points, inspection methods and inspection time play a key role in the accuracy of diagnosis. In order to ensure that the measured data is comparable, the principles should be followed when measuring the data: ① Each measurement should be carried out at the same measuring point, otherwise the measurement results will vary greatly due to the different transfer functions from the excitation source to the measuring point. ②Keep the working condition of the machine the same during each measurement. ③Keep the measured parameters the same. ④ Use the same instrument and measurement method.

2.1. Monitoring method

Under normal circumstances, use the intelligent bearing tester or inspection instrument to detect the key parts of the steel rolling machinery and equipment. First select the appropriate monitoring point and wipe it clean before monitoring; regularly detect and record the measured data; draw the measured data vibration curve diagram (Including the name, number, location of mechanical parts, a simple schematic diagram showing the location and number of each measuring point, notes, measurement value, measurement date), tracking the vibration changes of each point; when the vibration value changes suddenly or continues to rise, Indicates that the operating status at this point has changed and a failure may have occurred. The process flow of mechanical equipment monitoring is shown in Figure 1.

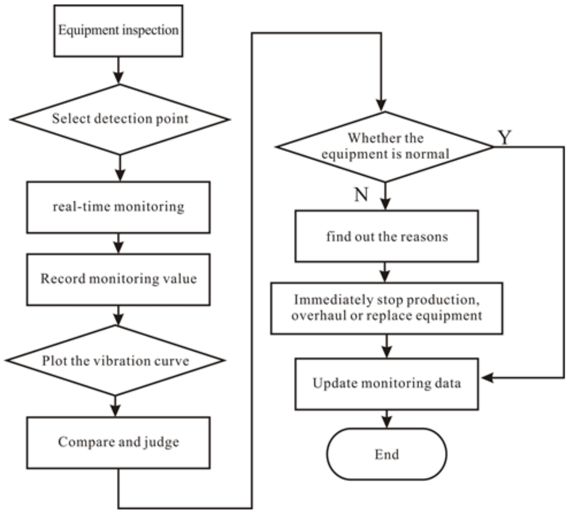

Figure 1. Flow chart of the inspection process of mechanical equipment.

2.2. Selection of monitoring period

During the steel rolling process, under normal circumstances, the bearings are monitored at least once every 15 days, but the monitoring frequency should be increased for the bearings in key parts (key equipment and heavy-duty bearings), at least twice a week. When the bearing running state is unstable, the reading is rising or irregular), the bearing vibration value must be measured more frequently. Damaged bearings should be closely monitored until they are replaced. For suspicious bearings in poor condition, additional monitoring time must be provided to strengthen monitoring. The monitoring cycle of other mechanical equipment is similar to that of bearings.

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2.3. Determination of the monitoring area

In the production process of steel rolling, to ensure the correct transmission of the monitored data signal, the monitoring point must be selected correctly. For example, the data signal path between the bearing of the tested mechanical equipment and the selected monitoring point should be as straight and short as possible. It must be located in the bearing load area of the mechanical equipment, and the monitored data signal path must only include a mechanical interface between the bearing and the body.

3. Failure analysis

Common faults of rotating machinery can be divided into rotor imbalance, rotor misalignment, loose base or assembly, rotor and stator friction, induction motor vibration, rolling bearing failure, gear mechanism vibration, etc. according to different rotor types and vibration properties. Using vibration monitoring technology can make more accurate diagnosis of these common mechanical faults. In general, the overall evaluation of the steel rolling machinery and equipment is mainly as long as the vibration intensity can be monitored, that is, the root mean square value of the vibration velocity of the monitored point, the unit is mm/s, and the vibration value measured at the time of failure Comparing with the usual monitoring data or the recommended vibration limit value, the location and cause of the fault can be judged. In addition, the intensity of the vibration has a great relationship with the size, rotation speed and base stiffness of the tested mechanical equipment. The mechanical equipment is too strong The main vibrations are mechanical looseness, misalignment, imbalance, etc. The selection of monitoring points is correct, and the monitored results provide a great basis for analyzing the causes of excessive vibration. In general, the radial measurement in the vertical direction can reflect the information on structural weakness; the radial measurement in the horizontal direction can reflect the information of the balance condition; the vibration along the axis direction is generally misalignment, poor assembly coupling, and shaft bending Monitoring and other aspects. Based on the measurement data in the horizontal, radial and axial directions, the cause and specific location of the mechanical equipment failure can usually be analyzed.

4. Use the double table method to correct the calculation

(1) Install fixed dial indicator and bracket. Check whether the dial indicator is accurate and flexible, the probe is complete and smooth, push the dial indicator measuring rod by hand, the pointer reading is stable and continuous, and the measuring rod has no jamming phenomenon. Check whether the dial indicator and the bracket are stable and reliable, and ensure sufficient rigidity so that the displayed value will not be affected by the excessive deflection of the bracket during the rotation of the coupling. The two dial indicators (outer edge dial indicator and opening dial indicator) are shown in Figure 2.

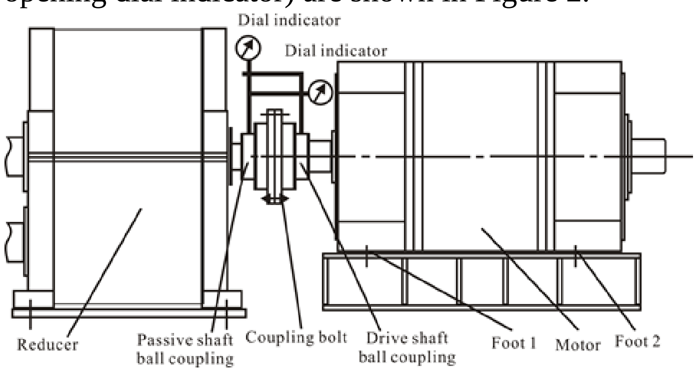

Figure 2. Schematic diagram of dial indicator installation and fixing methods.

(2) Read the crank and record the value. As shown in Figure 3, record d1, r1; d2, r2; d3, r3; d4, r4. In the process of recording data, it is recommended that the driving shaft and the driven shaft rotate together. Although there is a high-precision machining surface specially used for alignment on the surface of some couplings, the motor shaft can be rotated separately to make the dial indicator point at Slide on the passive end coupling to read the value. However, in practical applications, especially during the maintenance process, due to the impact of the installation of the old equipment, the deformation during use, the

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processing error, etc., they will become the source of error in the calibration data, so the method of fixing one end of the rotation is not recommended. .

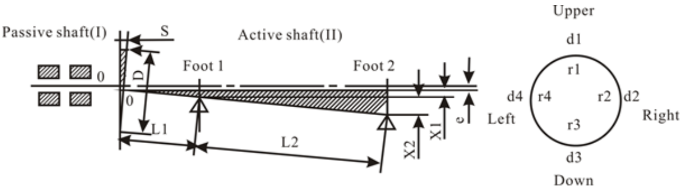

Figure 3. Double-table method correction calculation and numerical recording diagram.

The read value should meet: d1+d3=d2+d4; r1+r3=r2+r4; if the difference between d1+d3 and d2+d4 is too large (more than 0.02mm), you need to check the dial indicator The situation and the stent situation. If the values of r1+r3 and r2+r4 differ too much, in addition to checking the dial indicator and bracket, it is also necessary to consider whether the axis I and axis II are moving. If there is a jump, you need to consider the quality of equipment spare parts or use the three-meter method to correct the equipment.

(3) Calculate the dimensions of the two foundation gaskets. The deviations of the two shafts that need to be corrected are varied. The radial deviation of the two couplings is generally called the outer edge deviation, and the axial deviation is generally called the opening deviation. The basic principle of alignment is to first adjust the numerical deviation of the upper and lower openings and the outer edge, and then adjust the numerical deviation of the left and right openings and the outer edge. Because in the process of adjusting the gasket, the left and right deviation will change in an uncertain direction. Take the situation shown in Figure 2 as an example, the motor (axis II) is lower than the reducer (axis I), and the coupling is open.

The first step: adjust the axis II, the upward translation is the same height as the axis I, that is, 0'and 0 are the same height. At this time, foot 1 and foot 2 need to be adjusted to increase the size of the piece:

e1=e2=e

among them:

$$e=\frac{1}{2}\left(d1-d3\right) \qquad (1)$$

Step 2: Take the adjusted 0'as the base point and rotate axis II to make the two axes collinear. According to the two triangles in the shaded part of Figure 2, the two triangles are similar, we can get:

$$\frac{S}{D}-\frac{X1}{L1}-\frac{X2}{L1+L2}$$
$$X1=\frac{S}{D}\cdot L1$$
$$X2=\frac{S}{D}\left(L1+L2\right)$$
$$(2)$$

Among them: S=r3-r1

D: 2 times the distance from the measuring point of the dial indicator to the axis of rotation center

Step 3: Calculate that foot 1 needs to adjust the size of the added shim to Δ1, and foot 2 needs to adjust the size of the added shim to Δ2.

$$\Delta 1=e+X1=\frac{1}{2}\left(d1-d3\right)+\frac{r3-r1}{D}\cdot L1$$
$$\Delta 2=e+X2=\frac{1}{2}\left(d1-d3\right)+\frac{r3-r1}{D}\cdot\left(L1+L2\right)$$
$$(3)$$

5. Use the three-table method to correct the calculation

If the driving shaft or the driven shaft is jumping, or the alignment accuracy is particularly high, you can use the three-meter method for alignment, set up a dial indicator, and record the three-representation value of the crank rotation as shown in Figure 4. The calculation of the outer edge deviation is the same as the double table method. The calculation of the opening deviation is as follows:

S=(r3+r3')-(r1+r1') (4)

If the result is positive, it is the upper opening, if the result is negative, it is the lower opening. The final goal of adjustment is to make r1+r1' and r3+r3'; r2+r2' and r4+r4' have the same value or within the range of accuracy requirements.

The calculation and padding adjustment method is the same as the double table method.

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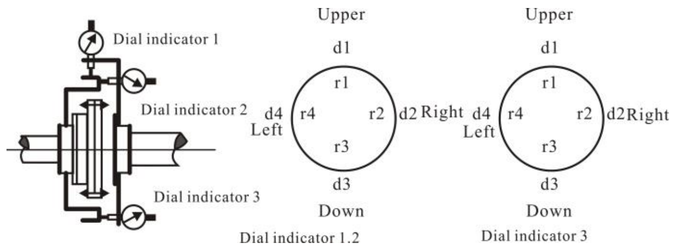

Figure 4. Schematic diagram of setting up a dial indicator with three-meter method and a diagram of the calibration data record.

6. Adjust the motor

(1) Adjust the size of the foundation gasket. Adjust the size of the spacers for foot 1 (two) and foot 2 (two) according to the above calculation results. The number of shims for each anchor bolt should not be too much, generally no more than 3 to 5, theoretically the less the better, adjust the thickness of each shim accordingly. If it is rectified during equipment maintenance, there may be original gaskets under the feet of the motor. Be sure to remove the original gaskets to adjust the calculation and add the gaskets. You cannot directly add the gaskets when the original gaskets are not moving, because This approach is easy to cause the gaskets to cross, dust or inconsistent gasket sizes, etc., which affects the final result. The size of the gasket must be cut according to the requirements, too large or too small will affect the alignment result due to the difference in the contact surface.

(2) Adjust the left and right opening and outer edge deviation. Adjust the left and right openings and outer edge deviation of the motor by using the front, back, left, and right top wires on the motor base, so that the difference between d2 and d4, r2 and r4 is within the specified range of required accuracy error. The key point here is to ensure that the gap between the two couplings is within the range required by the standard when adjusting, otherwise the ball contact surface of the ball coupling will be reduced, which will result in the tooth surface of the drum gear coupling. The contact is not at the optimal point, causing vibration or reduced life. In the process of adjusting the motor, the anchor bolts of the motor must be in a free state and cannot be tilted. If tilted or the bolt holes interfere, the tightening will be weak or the alignment accuracy will be affected.

(3) Tighten the anchor bolts. In the process of tightening the anchor bolts, you must always pay attention to the changes in the values of the two dial indicators. If there is a large change, consider the situation of the anchor hanging or the bolt tilt. When tightening bolts, force should be applied symmetrically and cyclically. Before and after the anchor bolts are tightened, the height change value is generally about 0.02~0.1mm. There will be a small difference according to the thickness and amount of the gasket, which can be used as a reference. After the tightening is completed, check the meter and record the data. The alignment is completed, the safety facilities are restored, and the test run is rotated to observe the operation.

7. Conclusions

There are many methods for determining the position of the motor and the reducer, but most of the calculations are relatively troublesome. It has a greater impact on the failure detection and installation of large-scale steel rolling machinery and equipment. The main purpose of this paper is to find a method to improve the efficiency, and to analyze the main steps of position determination in a more comprehensive manner, which greatly improves the accuracy of the alignment, which has great use value for the actual application process.

Rolling machinery and equipment are large-scale rotating machinery and are the key equipment of a rolling mill. The rotating shaft assembly is the core part of the rolling mill, which includes the rotating shaft, gear transmission parts, couplings, sliding and rolling bearings, etc. Through long-term observation and practice, people have found that most of the early failures of rotating machinery will show abnormal vibration. Therefore, mastering the general laws of mechanical vibration can identify common equipment failures from vibration signals. Through simple analysis of vibration signals, general vibration can be identified. Vibration identifiability

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is the technical prerequisite for vibration and noise testing and analysis of mechanical faults. Therefore, using the more mature vibration analysis technology in the field of equipment diagnosis technology as a technological breakthrough, the daily vibration status monitoring of the rolling mill can be used to grasp the operating status of the rolling mill and determine the occurrence of the rolling mill while the equipment is in operation or without dismantling all equipment. The location and cause of the failure, and the prediction of the future technical status, can be effectively found in the early stage, and the failure can be suppressed in time in the later stage to ensure the completion of the steel rolling production plan.

The main mechanical equipment or host train of the rolling mill includes: working stand (roll, roll bearing box, roll adjustment device, guide and guard device, rack and base, etc.), universal joint or plum blossom joint, herringbone gear stand , Reducer, main coupling, etc. The rolling mills used in the continuous and semi-continuous rolling production lines of most steel rolling enterprises are characterized by high manufacturing and installation precision, and high requirements for the quality of operation and maintenance workers. In order to better maintain and repair the steel rolling machinery and equipment, the key parts of the rolling mill machinery and equipment can be dynamically monitored, and the daily monitoring values can be recorded, so that when the equipment fails, the maintenance personnel can determine the fault location and cause based on the monitored data Make judgment and analysis to make the maintenance more targeted, and the equipment failure can be solved in time. Check the contact surface. Place the motor freely on the mounting base, use a feeler gauge to check the contact surface between the motor base plate and the mounting base base, check whether the four feet are in contact with each other, and whether they are suspended, inclined, or warped. If yes, use the feeler gauge to measure the floating value. When the foot pad is added in the next step, shims should be added to make up for the margin at the floating foot. The actual padding value should be 0.1～0.15 larger than the measured value of the feeler gauge. mm, so as to ensure the foot cushion is solid. This situation must be considered under the premise that the foundation base has settled for a long time and the motor spare parts have been disassembled and repaired for many times to repair the bottom plate deformation, otherwise it will cause excess stress on the motor foot, which will affect the service life of the motor and the operation effect of the equipment.

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2 "Jingchu Outstanding Talents" Collaborative education Program for ordinary undergraduate universities in Hubei Province: Mechanical Design, Manufacturing and Automation Major, Wuhan Huaxia University of Technology, Project No. : “Letter of higher education in Hubei Province” [2017] No. 29, Project leader: Qi Hongfang.

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