Research Article

Optimal Design of Sliding Bearings Based on Artificial Intelligence Algorithm and CFD Simulation

Caiping Guo

School of Mechanical and Electrical Engineering, Jiaozuo University, Jiaozuo, 454003 Henan, China

Correspondence should be addressed to Caiping Guo; guocaiping@jzu.edu.cn

Received 24 February 2022; Revised 11 March 2022; Accepted 12 March 2022; Published 12 April 2022

Academic Editor: Rashid A Saeed

Copyright © 2022 Caiping Guo. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Sliding bearings have a long history, simple manufacturing, and low cost. However, the function of sliding bearings is very large. As a key component of rotating machinery, thrust sliding bearing is directly related to the overall performance of the machine. The machines that can be seen in life, whether simple or complicated, have been used. However, with the development of science and technology and economy, all kinds of new things have been inoculated. One of the current issues is how sliding bearings can continue to keep machinery stable. CFD is the abbreviation of English computational fluid dynamics. It is developed with the development of computer technology and numerical computing technology. Simply put that CFD is equivalent to “virtually” doing experiments on the computer to simulate the actual fluid flow. The purpose of this article is to study the optimal design of sliding bearings by artificial intelligence algorithms and CFD simulation. This paper uses intelligent design methods to optimize the appearance, shape, and manufacturing process of sliding bearings and to carry the bearing capacity, friction coefficient and temperature rise of sliding bearings. Comprehensive research then establishes the objective function. The finite element algorithm, genetic algorithm, and matrix theory are used to calculate the stability of the sliding bearing under various conditions. The artificial intelligence algorithm is used to sort the calculated data. The CFD simulation is used to obtain the most reasonable result. Algorithm, as well as the appearance, shaft diameter, and material of the plain bearing, maintains stability under various conditions. The experimental data show that the classification using artificial intelligence algorithms and CFD simulation can significantly improve the performance of sliding bearings. It is found that the relationship between the sliding bearings is related to the speed, the diameter of the bearing, and other factors. Experimental data show that artificial intelligence algorithms and CFD simulation can provide reliable data references for the optimal design of sliding bearings, and the optimized sliding bearings can meet the stability under relevant conditions.

1. Introduction

Because the thrust sliding bearing has good load-bearing performance, its application range is very wide, and it is mostly used in key rotating parts. It plays a key role in the operation of the entire overall equipment, that is, the performance of the thrust sliding bearing determines the working performance of the entire equipment. Bearings are one of the earliest machine parts invented by human beings. Because of its simple shape, low cost, and wide application, China has had this application for a long time [1–3]. Bearings have brought great convenience to people’s production and life and also promoted the development of science and technology. Although the bearing is a small component that fixes and reduces the load friction coefficient during the mechanical rotation, it plays a very important role in the operation of the machine [4–8]. Later, it developed into plain bearings, so now, there are cars that can gallop on the road, and airplanes can soar in the sky. With the development of science and technology, all industries have entered the fast track of rapid development. Various new technological products such as new hydropower stations, high-end automobiles, and space shuttles have emerged endlessly, and new sliding bearings are urgently needed to
support their development [9, 10]. Therefore, sliding bearings must be optimized to adapt to new development forms.

In this paper, the CFD method is used, and the influence of temperature on the lubrication performance is considered in the analysis. With the development of China’s economy and society, the number of cars in China has increased dramatically, and the number of accidents each year has also increased. There are many reasons for this. Because of the long-term use of cars, the design of sliding bearings cannot meet the stability of other parts of cars in the new era. The most important reason is that the designed shape and shaft diameter cannot meet the bearing capacity and friction requirements of other parts [11–13]. In addition, there are many high-speed running machinery at home and abroad that often have serious accidents. Bearings account for a large proportion. The main factor is sliding bearings. Based on the above, it can be found that in the new era, the optimization of sliding bearings is imminent.

Whether the bearing can work normally is closely related to the selection of operating load, operating speed, lubricating medium, and bearing geometrical parameters, but the bearing material also plays a decisive role in the bearing capacity. Wear resistance, antiadhesion, corrosion resistance, fatigue resistance, good thermal conductivity, and other properties are the properties that bearing materials should have. In order to improve the real-time detection of bearing test equipment, Wei and other experts analyze and model the detection depth of a self-propelled leveling test machine designed as a research object. Based on the test procedure, the error factors affecting the accuracy of the ball detection depth were analyzed and a complete error detection model of the depth detection system was created using the multibody system (MBS). The final element method is used to calculate the load diffusion of the relevant elements of the total error model. Complete model correction under error loading test conditions has been demonstrated [14]. Liang discovered that the extrusion casting process, as the basic technology of self-lubricating bearings, directly affects the overall performance of self-lubricating bearings. Focusing on the problems of insufficient strength of the extruder and the loading of the outer ring material into the cavity during the extrusion process of the wide range of large bearings, Liang proposed the external dimension of the extrusion groove machining and designed the separator strong and clean DYNA simulation simulation. Liang researched effective plastic jets, effective drilling and drying after spring, and application of the pressure effect. Liang found that after the operation of the extrusion hole in the recess of the outer ring, the contact of the bearings can meet the requirements, and the extrusion process requires less extrusion force [15]. Because of its ability to withstand axial loads, sliding bearings are widely used in electric power, water pumps, ships, metallurgy, and other fields. They are key components of rotating machinery and heavy machinery. The life and bearing performance of thrust sliding bearings directly affect the life of the entire mechanical equipment work performance. Because sliding bearings are rotating elements, they are often used in high-speed, heavy-load and complex environments, and bearing failures often occur.

With the rapid development of modern industry, there are higher requirements for the operating speed and load of mechanical equipment and higher requirements for the performance of sliding bearings in all aspects. This article uses intelligent design methods to optimize the appearance, shape, and manufacturing process of sliding bearings, establishes objective functions for the bearing capacity, friction coefficient, and temperature rise of sliding bearings, and uses finite element algorithms, genetic algorithms, and matrix theory for sliding bearings. Maintain stability in various situations for calculations, use artificial intelligence algorithms to organize calculation data, and use CFD simulation to simulate and to obtain the most reasonable algorithm and the appearance and shaft of sliding bearings that maintain stability in various situations, diameter and making materials, and collect experimental data and analyze experimental data. The experimental data shows that the artificial intelligence algorithm is used for classification. After CFD simulation, the performance of the sliding bearing can be significantly improved. The thrust bearing with pit, convex pit, groove, and convex groove texture was analyzed and studied, and it was found that the bearing structure, bearing running speed, and lubricating oil viscosity are the main factors affecting the bearing performance.

2. Proposed Method

2.1. Overview of Artificial Intelligence

2.1.1. Artificial Intelligence. In the field of transportation, general users use applications such as maps and navigation. Unmanned driving has also become a research project of major automobile companies and technology companies. In the medical field, artificial intelligence can analyze inspection results and screen inspection reports through big data. Assist doctors in diagnosis and speed up medical efficiency [16, 17]. Traditional intelligence, abbreviated as AI, is a science that explores and develops advanced technologies, methods, technologies, and applications for the involvement, extension, and expansion of human beings. The answer is mechanical understanding. Artificial intelligence objects in this area mainly include intelligent robots, language recognition, image recognition, natural language processing, and specialist programs. Since the birth of artificial intelligence in the 1990s, science and technology have become increasingly popular, and the scope has also expanded. It can be concluded that the technology products that will emerge from artificial intelligence in the future will be “boxes” of human understanding. Traditional intelligence can process and analyze basic consciousness, thought process and human information. Although artificial intelligence is not a basic human understanding, it can be considered human, or it can go beyond human understanding. Understanding traditional intelligence is a very demanding science, and anyone involved in this profession should understand and comprehend computer science, psychology, and computer science. Traditional intelligence is a multifaceted computer science, covering a wide range of research areas, such as...
machine learning and computer vision. In general, the main goal of artificial intelligence research is to allow machines to perform complex and complex tasks that usually require a human to complete. But different technological ages and different people have different ways of defining and understanding "complex work."

2.1.2. The Usefulness of Artificial Intelligence. The optimization of sliding bearings through artificial intelligence algorithms is also an innovation of the article. In addition, I have further discussed the optimization of sliding bearings in the article. In sliding bearings, temperature rise is one of the main reasons for bearing lubrication failure. Therefore, it is the key to analyze the bearing lubrication failure to consider the influence of temperature on lubrication performance in the process of studying thrust sliding bearings. Scientific and technological calculations depend mainly on the human brain to complete. Computers can now perform many complex calculations, and calculations can be performed faster and more accurately by the human brain. Therefore, people no longer believe that the definition of complex equations is supported by this. This particular concept of complex computer function changes with the changes in the age of artificial intelligence and the advancement of information technology. Certain spheres of artificial intelligence also develop naturally with changes over time. On the one hand, it continues to make new progress and, on the other hand, it tends to become more and more essential and demanding training grounds. In general, the basic mathematical principles of "machine learning" are mainly mathematics, process information, and government. It also includes other nonmathematical topics. This type of "machine learning" depends a lot on "experience." Computers often need to acquire new knowledge and training techniques from the experience of identifying a category of problems. When computers face similar complex problems, they use the accumulated knowledge in the experience to solve similar problems and combine new knowledge and experience. This type of training can be called "continuing education." But people have the opportunity to have and learn from scientific experience, and they also create, that is, "leap education." These special conditions are what we call "inspiration" or "surface."

2.2. Overview of Plain Bearings

2.2.1. Sliding Shaft Bearings. Sliding bearing is one of the core components in the operation of machinery; it can ensure the rapid operation of the machine, making the machine need to work at high speed. In heavy-duty vehicles, the sliding bearings can ensure the normal operation of the vehicle and keep the vehicle climbing vigorously. The main role of sliding bearings is as follows:

1. Low running noise
2. Load and speed are almost unlimited
3. In theory, as long as the sliding bearing is lubricated, it can be used unlimited times. Even if the bearing is broken, the parts in contact with it will not cause damage. Even if the bearing is damaged, it will not affect the application performance of the part. Due to the different ways and methods of force on sliding bearings, their classification methods are also different. According to the direction of force, it can be divided into radial sliding bearings and thrust sliding bearings. Of course, the life of mechanical equipment is also related to people's maintenance of the machine. If it is often maintained, it will have a longer life, so we should pay attention to the maintenance of machinery when using machinery. Only in this way can we guarantee the normal performance of the machine.

2.2.2. Common Motion Failure of Sliding Bearings. The sliding bearing must run fast, and the journal and the bush will move very fast. Moreover, the two will transmit axial load to each other. The running force at high speed is very large, so if the lubricant does not work, or the effect is not large, the bearing is prone to wear and bite, which causes the machine to fail and stop running. The process and type of the failure are shown in Figure 1.

2.3. Main Factors Affecting the Performance of Sliding Bearings

2.3.1. The Aspect Ratio of the Bearing. Bearings with different ratios of width to diameter will have different pressure distributions. A small width-to-diameter ratio is conducive to bearing pressure, which can increase the speed of operation, which indirectly improves the stability of the machine, increases the service life of the machine, and benefits people. However, if the width-to-diameter ratio is too small, the oil film distribution line will be too low, and it is easy to cause the problem of overheating of the bearing pads [18–20].

When the width-to-diameter ratio is too large, the oil space in the bearing will be greatly reduced, resulting in an increase in the pressure on the oil, but the oil film has a high rigidity and can withstand this pressure, which indirectly increases the bearing capacity. However, when the width-to-diameter ratio is too large, heat will be generated due to the excessive oil pressure, which will cause the temperature to rise and the viscosity of the oil to increase, resulting in bearing damage. Through research and search of data, it is found that the width-to-diameter ratio of ordinary sliding bearings is more appropriate to take 0.3-1.5.

2.3.2. Bearing Clearance. The bearing clearance has a great impact on the running performance of the bearing. If the bearing clearance is too small, the two friction surfaces will wear a lot and generate a lot of heat. The bearing clearance is too large to form oil pressure, and the side leakage is too large. At the same time, the shaft guidance cannot be guaranteed [21–23]. In short, it is concluded from the tribological mechanism that a large load and a low sliding speed require a small bearing clearance; a small load and a high sliding speed require a large bearing clearance.
2.3.3. Manufacturing Accuracy of Journal and Journal Surface. For sliding bearings, the smaller the contact between the shaft diameter and the bearing, that is, the smaller the thickness of the flowable oil paving between the two, the greater the pressure the bearing can withstand. But this acceptable pressure is not wireless, because the paving oil mold cannot be wireless. Because the collision between the two will occur in a very small time, causing mechanical wear and corrosion of the relatively soft bearing pads affects the normal operation of the machine and eventually causes damage to the machine and stops the operation. Reduce the service life and load capacity of the machine.

2.4. Mathematical Model of Optimal Design

2.4.1. Design Variable. The main parameters that affect the working performance of sliding bearings are width to diameter ratio $b/d$, gap $\psi$, and lubricant dynamic viscosity $\eta$. Therefore,

$$ x = \begin{bmatrix} b \\ d \\ \phi \\ \eta \end{bmatrix}^T = [x_1, x_2, x_3]^T. \quad (1) $$

Table 1: Effect of speed changes.

| Speed under normal conditions | Decreased carrying capacity (%) | Increased friction temperature coefficient (unit%) | Temperature rise (unit:%) |
|------------------------------|---------------------------------|-----------------------------------------------|--------------------------|
| Speed increased to 10% of original | 2.0                             | 2.3                                            | 4.0                      |
| Speed increased to 20% of original | 9.3                             | 6.0                                            | 8.1                      |
| Speed increased to 30% of original | 6.2                             | 5.3                                            | 12.0                     |
| Speed increased to 40% of original | 5.1                             | 5.3                                            | 18.3                     |

Figure 1: Types of plain bearing failure.
2.4.2. Objective Function. The optimal design of a hydrodynamic plain bearing contains multiple objectives and its comprehensive objective function
\[
fx(x) = w_1 f_1(x) + w_2 f_2(x) + w_3 f_3(x).
\]

\(f_1(x)\): maximum carrying capacity
\(f_2(x)\): coefficient of friction
\(f_3(x)\): calories
\(w_1, w_2, w_3\): weighting factor.

2.4.3. Bearing Function. An important parameter that reflects the bearing capacity of hydrodynamically lubricated radial plain bearings is the load factor:
\[
Ap = \frac{P\phi^2}{\eta\omega},
\]

\[
\min f_1(x) = \frac{1}{Ap}.
\]

Ap represents the load factor, and \(\min f_1(x)\) represents the minimum bearing force.

2.4.4. Friction Function. To minimize the coefficient of friction, therefore,
\[
\min f_2(x) = \frac{\pi\eta\omega}{P\phi} + 0.55\phi \xi.
\]
The constraints are:

\[ g_2 = x_1 - \left( \frac{b}{d} \right)_{\text{max}} \leq 0, \]  

\[ g_3(x) = \left( \frac{b}{d} \right)_{\text{min}} - x_1 \leq 0. \]  

Specific pressure

\[ p_{\text{min}} \leq p \leq p_{\text{max}}. \]  

2.6. Plain Bearing

2.6.1. Features of Sliding Bearings. The most common sliding materials used are transport materials (also known as pasteurized alloy or white alloys), sliding bearings, cast iron, coated cast iron, and alloys, based on aluminum, powdered metal materials, plastics, rubber, hardwood and carbon-graphite fluorocarbons (Teflon, PTFE), modified polyoxy-}

mitts energy between the component relative motion, maintaining the position and alignment of the two parts. In addition, the directional motion must be converted to rotational motion (such as reciprocating piston).

2.6.2. Composition Structure. Sliding friction often occurs during the working of sliding bearings, and the magnitude of sliding friction has a great relationship with the precision of the manufacturing process of sliding bearings. The quality of the products made by the process of the sliding bearing is related to the materials used. After the sliding bearing is manufactured, it has a self-lubricating function because its surface yields smoothly. The material can be classified into nonmetallic sliding bearings and metal sliding bearings. Nonmetallic sliding bearings produced by processing plants with excellent technology have a very long bearing capacity and long life and can even exceed metal sliding bearings. Because of the good bearing, it is hardly worn under the wrap of the oil film, because the sliding bearing only plays a sliding role and hardly contacts. Therefore, the sliding bearings produced by good technology are durable and economical.

2.6.3. Common Materials

(1) Metal materials, such as cast iron, bronze, aluminum-aluminum, zinc-based materials, and other related materials: powder materials also include known white materials, especially tin, lead, antimony, or other metals, due to their good quality. Wear high strength and plastic, durability, good thermal conductivity, good adhesive resistance, and good oil absorption, therefore, good for heavy load and high speed conditions, the durability of the transport material is low; the cost is more expensive

(2) Slippery material (metal powder materials) and heavy type material: powdered metal is a powder-coated material. If there is movement in the lubricant, the micropores are filled with lubricant and become a self-healing oil. The strength of the cast iron material is low and is only suitable for impact-free stability and medium stability load and low speeds.

(3) Nonferrous plastics: the most commonly used plastics are phenolic plastic, grease, polytetrafluorocarbons, etc. Plastic bearings have high tensile strength and abrasion resistance. They can be lubricated with oil and water, while they also have natural property poor heating system

2.6.4. Prevention Methods

(1) Prevent paint rust: paint rust is characterized by a sealed motor. When the motor was first used, because the steel was new, there was no need for maintenance. But over time, the motor is susceptible to rust, and once it is running, the bearing will be
seriously damaged. However, spray painting also has
its disadvantages. The main problem is that the vol-
atile acids in the insulating varnish are damp at a
certain temperature, corrosion protects the metal,
forms corrosive substances, and causes corrosion
damage to the channel sliding bearings. Therefore,
in order to prevent damage to the sliding bearings,
the motor must be kept dry and protected from
moisture. In addition, we also need to research new
materials to prevent paint and sliding bearing mate-
rials from reacting

(2) Strengthen enterprise management and strictly
investigate and deal with enterprises that have not
sprayed paint strictly in accordance with the antitrust
procedures during the production process. They
should be treated with antitrust before and after
spraying

(3) Strictly check the quality of steel and seriously deal
with the failure to meet the requirements. In order
to save costs, some companies use sliding steel with
excessive magazine content to produce sliding
bearings. The result was a delay in the lives of others. There are endless construction production events caused by bearing problems in China every year. Therefore, we must strengthen the publicity of the legal system and also popularize science to let people understand the importance of bearings and then consciously resist low-quality sliding bearings.

(4) The environmental conditions of some enterprises are poor, the content of harmful substances in the air is high, the turnover site is too small, and it is difficult to carry out effective antitrust treatment. Coupled with the hot weather, production workers violate the antitrust regulations and other phenomena.

(5) Some industrial anticorrosion papers, paper towels (bags) and plastic rollers, and other coated packaging materials do not comply with the requirements of rust-resistant rolling machine oil which is also one of the causes.

(6) The rotation and twisting of the sliding transfer rings of some coated devices are minimal, and the oxide and charcoal layer in the outer circle will not be completely removed.

2.7. CFD Simulation

2.7.1. CFD Simulation Definition. CFD stands for computational fluid dynamics, which was developed with the advent of computer technology and computing technology [24]. To put it simply, CFD is equivalent to "virtual" computer tests for real-time stream simulation and comparison [25–27]. The basic principle is to solve the number of flow equations that control the flow and to obtain a separate distribution of the flow region in the continuous region, in order to approximate the flow rate [28]. CFD can be considered as such a modern simulation technology.

2.7.2. Advantages of CFD Simulation. CFD is a modern simulation technology, which has a wide range of applications, mainly used in interior decoration and decoration. This technology can be used to simulate the environmental conditions of the building, simulate the air flow and various rainy weather conditions, and provide basic data for decoration. In terms of predicting indoor air, one of the four more mature technologies is the CFD simulation experiment. Although the other three technologies are also available, the process is complicated. Due to the development of society, people's requirements for life are getting higher and higher, resulting in more and more complicated, diversified, and large-scale space forms of buildings. In actual life, the air flow patterns of the entire room are diversified, and the traditional jet theory analysis has been unable to meet the production and living requirements. Traditional theoretical methods have errors in calculating the axial velocity and temperature changes, and there are also shortcomings in the prediction of jet trajectories [29–31]. On the other hand, the jet analysis method can only obtain some general data in the room, and cannot provide the designer with detailed information, which cannot meet the designer's requirements for understanding the indoor air distribution.

3. Experiments

3.1. Experimental Settings

3.1.1. Experimental Overview. This article uses intelligent design methods to optimize the appearance, shape, and manufacturing process of sliding bearings, establishes objective functions for the bearing capacity, friction coefficient, and temperature rise of sliding bearings, and uses finite element algorithms, genetic algorithms, and matrix theory for sliding bearings. Maintain stability in various situations for calculations, use artificial intelligence algorithms to organize calculation data, and use CFD simulation to simulate and to obtain the most reasonable algorithm and the appearance and shaft of sliding bearings that maintain stability in various situations, diameter and making materials, and collect experimental data and analyze experimental data.

3.1.2. Experimental Steps

(1) Use it as a map software to make a car plain bearing commonly used in cars, and build it into a 3D model.

(2) Using the same type of sliding bearing, test its bearing capacity, friction temperature coefficient and temperature rise, establish the objective function model, and calculate and simulate using finite element algorithm, genetic algorithm, and matrix theory.

(3) Sort and sort the simulated data and use artificial intelligence algorithms for calculation.
(4) Use CFD to simulate the results of the calculation

(5) The correct experimental data is made into a real object, and the service time is tested on the machine that has reached the end of its service life

3.1.3. Matters Needing Attention

(1) When carrying the bearing capacity test, friction temperature coefficient test, and temperature rise are calculated using finite element algorithm, genetic algorithm, and matrix theory for calculation, it should be operated by skilled and experienced experimenters.

(2) When establishing the coordinates, the sliding bearings participating in the test should be of the same model, produced by the same manufacturer and produced in the same period of time to avoid errors.

(3) When using the finite element algorithm, genetic algorithm, and matrix theory for calculation, it should be operated by skilled and experienced experimenters.

(4) When sorting the obtained simulated data, pay attention to the classification of each set of experimental data, and mark to prevent errors.

(5) When using CFD simulation to calculate, pay attention to the calculation operation and should be instructed by skilled operators.

(6) In the physical experiment, every step of the operation must be done carefully.

4. Discussions

4.1. Simulation of Function Coordinate Establishment

(1) When carrying the bearing capacity test, friction temperature coefficient test, and temperature rise with the same model and the same batch of products, it is found that the relationship between the sliding bearings is related to the speed, the diameter of the bearing, and other factors. When these factors change, the sliding bearing capacity and the friction temperature also change with temperature rise, so the environment of the sliding bearing must be taken into consideration when optimizing. The data during the experiment is shown in Table 1 and Figure 2, and the bearing diameter is shown in Table 2 and shown in Figure 3.

(2) The obtained data of the model is analyzed to obtain the three-dimensional view of the experimental sliding bearing required for the experiment. The model is calculated using finite element algorithm, genetic algorithm, and matrix theory, and the effective improvement of the sliding shaft wheel and the size of the oil film are obtained. The thickness of the oil film has the characteristics of extending the service life and fatigue resistance of the sliding bearing and the limit thickness of the oil film at different speeds. The calculated data are shown in Table 3 and Figure 4.

4.2. CFD Simulation

(1) Sorting the experimentally obtained sliding bearing data, simulating the new sliding bearing design with CFD, optimizing the radial bearings through experimental simulation, and establishing the simulation of bearing parameters and the geometry of the lubricant analyze the model to determine the number, size parameters, and internal temperature of Youpu port. The specific optimized parameters are obtained through simulation. The specific optimized design parameters are shown in Figure 5.

(2) Design the sliding bearings for the obtained experimental parameters. The designed bearings are installed on the same batch of cars that are about to be scrapped, and the speed is tested. The operating conditions of several machines are observed with the naked eye. The degree of damage to the rear plain bearing is shown in Figure 6.

5. Conclusions

(1) Analysis and calculation of the sliding bearing to obtain the speed, diameter-width ratio, and bearing radius of the sliding bearing and the relationship between bearing capacity, friction temperature coefficient, and temperature rise. By establishing the objective function model, the finite element algorithm and genetic algorithm are used and matrix theory for calculations and simulations. It was found that the service life of sliding bearings is related to factors such as speed and bearing diameter. In addition, through the establishment of the model and the calculation using the finite element algorithm, genetic algorithm, and matrix theory, it is concluded that the effective improvement of the service life of the sliding bearing is related to the thickness of the oil film characteristic. In terms of speed, setting different thicknesses of oil films at different speeds can increase the service life of the bearing pads and indirectly increase the service life of the bearings.

(2) The design of the sliding bearing was optimized through experimental simulations. A simulation analysis model of bearing parameters and the geometry of the lubricant was established. The number of oil ports, dimensional parameters, and internal temperature were determined. The specific optimized parameters were obtained through simulation. Through these specific optimized parameters, the service life of the bearing can be greatly improved.
and this optimization design improves the use environment of the sliding bearing, which cannot meet the different mechanical environment of the sliding shaft at this stage. There are some implications in terms of carrying capacity and stability. As a result, the stability of the sliding bearing is improved, so that it can adapt to the new and developing environment as soon as possible.

(3) The purpose of this article is to study the optimal design of sliding bearings based on artificial intelligence algorithms and CFD simulations. This paper uses intelligent design methods to optimize the appearance, shape, and manufacturing process of sliding bearings, the bearing capacity, and friction coefficient, and Wen Sheng conducts comprehensive research to establish an objective function. The finite element method, genetic algorithm, and matrix theory are used to calculate the stability of the sliding bearing under various conditions. The artificial intelligence algorithm is used to sort the calculated data. The CFD simulation is used to simulate and get the most reasonable algorithm, as well as the appearance, shaft diameter, and material of the plain bearing that maintain stability under various conditions. Collect experimental data and analyze experimental data. The experimental data show that the classification using artificial intelligence algorithms and CFD simulation can significantly improve the performance of sliding bearings. Experimental data show that artificial intelligence algorithms and CFD simulation can provide reliable data references for the optimal design of sliding bearings, and the optimized sliding bearings can meet the stability under relevant conditions.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References

[1] S. Zhao and D. Zelazo, “Bearing rigidity and almost global bearing-only formation stabilization,” IEEE Transactions on Automatic Control, vol. 61, no. 5, pp. 1255–1268, 2016.

[2] R. Li, M. Xie, J. Zhang et al., “Genetic characterization of mcr-1-bearing plasmids to depict molecular mechanisms underlying dissemination of the colistin resistance determinant,” The Journal of Antimicrobial Chemotherapy, vol. 72, no. 2, pp. 393–401, 2017.

[3] G. Shukla, M. Cococcioni, and R. M. Wentz教授, “Thermoelectricity of Fe3+- and Al-bearing bridgmanite: effects of iron spin crossover,” Geophysical Research Letters, vol. 43, no. 11, pp. 5661–5670, 2016.

[4] L. Zhou, G. H. Li, C. L. Liu et al., “Effect of rotation speed on microstructure and mechanical properties of self-reacting friction stir welded Al-Mg-Si alloy,” International Journal of Advanced Manufacturing Technology, vol. 89, no. 9-12, pp. 3509–3516, 2017.

[5] S.-C. Kim, B.-K. Han, and D.-S. Kwon, “Haptic rendering of 3D geometry on 2D touch surface based on mechanical rotation,” IEEE Transactions on Haptics, vol. 11, 2017.

[6] T. Yin, H. Wu, Q. Zhang et al., “In vivo targeted therapy of gastric tumors via the mechanical rotation of a flower-like Fe3O4@Au nanoprobe under an alternating magnetic field,” NPG Asia Materials, vol. 9, no. 7, article e408, 2017.

[7] J. Zhao, J. Huang, R. Wang, H. R. Peng, W. Hang, and S. Ji, “Investigation of the optimal parameters for the surface finish of k9 optical glass using a soft abrasive rotary flow polishing process,” Journal of Manufacturing Processes, vol. 49, pp. 26–34, 2020.

[8] J. Zhao, J. Huang, Y. Xiang et al., “Effect of a protective coating on the surface integrity of a microchannel produced by micro-ultrasonic machining,” Journal of Manufacturing Processes, vol. 61, pp. 280–295, 2021.

[9] Y. K. Ruan, J.-P. Chen, and J.-W. Zhan, “Multivariate method for identifying structural domain boundaries: an example from Maji Hydropower Station in China,” Chinese Journal of Geotechnical Engineering, vol. 39, no. 1, pp. 148–153, 2017.

[10] L. Chuangang, J. Changming, W. Boquan, L. Minghao, and L. Rongbo, “The hydropower station output function and its application in reservoir operation,” Water Resources Management, vol. 31, no. 1, pp. 159–172, 2017.

[11] D.-E. Kessler, J. Weiss, H. Rempp et al., “In vitro artifact assessment of an MR-compatible, microwave antenna device for percutaneous tumor ablation with fluoroscopic MRI-sequences,” Minimally Invasive Therapy & Allied Technologies, vol. 27, no. 1, pp. 60–68, 2018.

[12] H. Chen, Y. Shang, and K. Sun, “Multiple fault condition recognition of gearbox with sequential hypothesis test,” Mechanical Systems and Signal Processing, vol. 40, no. 2, pp. 469–482, 2013.

[13] H. Chen, L. Fang, D. L. Fan, W. Huang, and L. Zeng, “Particle swarm optimization algorithm with mutation operator for particle filter noise reduction in mechanical fault diagnosis,” International Journal of Pattern Recognition and Artificial Intelligence, vol. 34, 2019.

[14] L. I. Wei, H. U. Zhan-Qi, and Y. L. Yang, “Comprehensive error modeling of real-time wear-depth detecting of spherical plain bearing tester,” Optics and Precision Engineering, vol. 24, no. 4, pp. 844–854, 2016.

[15] L. Xin, “Optimal design of the process for self-lubricating spherical plain bearings based on finite element analysis,” IOP Conference Series Materials Science and Engineering, vo. 452, 2018.

[16] K. Ouriel, R. L. Ouriel, Y. J. Lim, G. Piazza, and S. Z. Goldhaber, “Computed tomography angiography with pulmonary artery thrombus burden and right-to-left ventricular diameter ratio after pulmonary embolism,” Vascular, vol. 25, no. 1, pp. 54–62, 2017.

[17] S. Xie, Z. Yu, and Z. Lv, “Multi-disease prediction based on deep learning: a survey,” Computer Modeling in Engineering and Sciences, vol. 128, no. 2, pp. 489–522, 2021.
[18] S. Wan, Z. Gu, and Q. Ni, “Cognitive computing and wireless communications on the edge for healthcare service robots,” *Computer Communications*, vol. 149, pp. 99–106, 2020.

[19] K. S. Chung, Y. S. Kim, S. K. Kim et al., “Functional and prognostic implications of the main pulmonary artery diameter to aorta diameter ratio from chest computed TOMOGRAPHY in Korean COPD patients,” *PLOS ONE*, vol. 11, no. 5, article e0154584, 2016.

[20] O. B. Sezer, D. Çelik, N. Tutar, and F. Özçay, “Can platelet count/spleen diameter ratio be used for cirrhotic children to predict esophageal varices?,” *Journal of Hepatology*, vol. 8, no. 33, p. 1466, 2016.

[21] V. D. Tyutyuma, “Some specific features in the formation of pressure in sliding bearing clearance,” *Journal of Friction and Wear*, vol. 39, no. 6, pp. 451–456, 2018.

[22] H.-C. Li, Z.-L. Sun, and J.-L. Feng, “Reliability analysis of rolling bearing clearance based on sparse response surface and polar transformation,” *Dongbei Daxue Xuebao/Journal of Northeastern University*, vol. 38, no. 11, pp. 1579–1583, 2017.

[23] Y.-L. Zhu and Z.-Q. Zheng, “Dynamic responses of the rotor supported by a new type zero-clearance catcher bearing,” *Modern Physics Letters B*, vol. 31, no. 19-21, p. 1740014, 2017.

[24] B. Lu, H. Luo, H. Li et al., “Speeding up CFD simulation of fluidized bed reactor for MTO by coupling CRE model,” *Chemical Engineering Science*, vol. 143, no. APR, pp. 341–350, 2016.

[25] X. Zhang, Y. Cheng, and L. Xi, “CFD simulation of reverse water-hammer induced by collapse of draft-tube cavity in a model pump-turbine during runaway process,” *Iop Conference*, vol. 49, no. 5, article 052017, 2016.

[26] P. Mössinger and A. Jung, “Transient two-phase CFD simulation of overload operating conditions and load rejection in a prototype sized Francis turbine,” *IOP Conference Series Earth and Environmental Science*, vol. 90, no. 1, article 012025, 2017.

[27] S. Taoyong, W. Huishan, and J. Zhou, “Stability of multidimensional uncertain differential equation,” *Soft Computing*, vol. 20, no. 12, pp. 4991–4998, 2016.

[28] M. Colli, L. G. Lanza, R. Rasmussen, and J. M. Thériault, “The collection efficiency of shielded and unshielded precipitation gauges. Part I: CFD airflow modeling,” *Journal of Hydrometeorology*, vol. 17, no. 1, pp. 231–243, 2016.

[29] Y. Liu, Y. Zhao, Z. Liu, and J. Luo, “Numerical investigation of the unsteady flow characteristics of human body thermal plume,” *Building Simulation*, vol. 9, no. 6, pp. 677–687, 2016.

[30] Y.-Y. Feng, Y.-P. Song, and R. E. Breidenthal, “Model of the trajectory of an inclined jet in incompressible crossflow,” *AIAA Journal*, vol. 56, no. 2, pp. 458–464, 2017.

[31] E. Yu Kozlovtsева, V. N. Azarov, and I. V. Stefanenko, “Analysis of the dust particles distribution and ventilation as a way to improve indoor air quality,” *IOP Conference Series Earth and Environmental Science*, vol. 90, no. 1, article 012025, 2017.