Advances in Intelligent Systems and Computing 691

Feng Qiao
Srikanta Patnaik
John Wang *Editors*

Recent Developments in Mechatronics and Intelligent Robotics

Proceedings of the International Conference on Mechatronics and Intelligent Robotics (ICMIR2017) - Volume 2

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Janusz Kacprzyk, Polish Academy of Sciences, Warsaw, Poland
e-mail: kacprzyk@ibspan.waw.pl

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Editors
Feng Qiao
Shenyang Jianzhu University
Shenyang
China

John Wang
Montclair State University
Montclair, NJ
USA

Srikanta Patnaik
SOA University
Bhubaneswar
India

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Preface

On behalf of the Organizing Committee I welcome all the delegates to the International Conference on Mechatronics and Intelligent Robotics (ICMIR2017) held at Kunming, China, during May 20–21, 2017. This annual conference is being organized each year by Interscience Research Network, an international professional body, in association with International Journal of Computational Vision and Robotics and International Journal of Simulation and Process Modelling, published by Inderscience Publishing House. I must welcome this year's General Chair Prof. Feng Qiao, Shenyang JianZhu University, Shenyang, China, for his generous contribution to ICMIR-2017. He has also contributed an issue of his journal International Journal of Simulation and Process Modelling to the selected papers of the conference.

Like every edition, this edition of ICMIR2017 was academically very rich and we had three eminent professors as keynote speakers namely Prof. John Wang, Dept. of Information Management & Business Analytics, School of Business Montclair State University, USA, Prof. Kevin Deng, Distinguished Professor and Executive Director of Automotive Research Institute, Jilin University, and Dr. Nilanjan Dey, Department of Information Technology, Techno India College of Technology, Kolkata, India.

There has been a rapid developments during last five years in various directions such as: robotic-assisted manufacturing; advanced mechanisms and robotics; systems modelling and analysis; instrumentation and device control; automation systems; intelligent sensing and control; medical robotics; and autonomous and complex systems. New technologies are constantly emerging, which are enabling applications in various domains and services. Intelligent Mechatronics and Robotics is no longer a functional area within the department of mechanical or electronics, but is an integral part of the manufacturing function of any organization. In the recent time, Intelligent Mechatronics and Robotics is probably the single most important facilitator of the manufacturing process. The result of research in this domain is now influencing the process of globalization, particularly in the

productive, manufacturing and commercial spheres. Creating economic opportunities and contributing to monotony reduction is another thrust area for the emerging epoch of Intelligent Mechatronics and Robotics.

This edition of ICIMR covered the following areas but not limited to intelligent mechatronics, robotics and biomimetics, novel and unconventional mechatronic systems, modelling and control of mechatronics systems, elements, structures, mechanisms of micro- and nano-systems, sensors, wireless sensor networks and multi-sensor data fusion, biomedical and rehabilitation engineering, prosthetics and artificial organs, AI, neural networks and fuzzy logic in mechatronics and robotics, industrial automation, process control and networked control systems, telerobotics, human–computer interaction, human–robot interaction, artificial intelligence, bio-inspired robotics, control algorithms and control systems, design theories and principles, evolutional robotics, field robotics, force sensors, accelerometers, and other measuring devices, healthcare robotics, human–robot interaction, kinematics and dynamics analysis, manufacturing robotics, mathematical and computational methodologies in robotics, medical robotics, parallel robots and manipulators, robotic cognition and emotion, robotic perception and decision, sensor integration, fusion, and perception. This volume covers various articles covering the recent developments in the area of Intelligent Mechatronics and Robotics categorized into seven (7) tracks, such as:

1. Intelligent Systems
2. Intelligent Sensor & Actuator
3. Robotics
4. Mechatronics
5. Modelling & Simulation
6. Automation & Control and
7. Robot Vision

Srikanta Patnaik
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John Wang	Department of Information Management & Business Analytics, School of Business Montclair State University, USA
Kevin Deng	Automotive Research Institute, Jilin University
Nilanjan Dey	Department of Information Technology, Techno India College of Technology, Kolkata, India

Acknowledgement

Like every year, this edition of ICMIR-2017 was also attended by more than 150 participants and 172 papers were shortlisted and published in this proceeding. The papers covered in this proceeding are the result of the efforts of the researchers working in various domains of Mechatronics and Intelligent Robotics. We are thankful to the authors and paper contributors of this volume.

We are thankful to the editor in chief and the anonymous review committee members of the Springer series on *Advances in Intelligent Systems and Computing* for their support to bring out the proceedings of 2017 International Conference on Mechatronics and Intelligent Robotics. It is noteworthy to mention here that this was really a big boost for us to continue this conference series.

We are thankful to our friends namely Prof. John Wang, from School of Business Montclair State University, USA, Prof. Kevin Deng, from Automotive Research Institute, Jilin University, and Dr. Nilanjan Dey, from Techno India College of Technology, Kolkata, India, for their keynote address. We are also thankful to the experts and reviewers who have worked for this volume despite the veil of their anonymity.

We are happy to announce here that next edition of the International Conference on Mechatronics and Intelligent Robotics (ICMIR2017) will be held at Kunming, China in association with Kunming University of Science and Technology, Kunming, China during last week of April 2018.

It was really a nice experience to interact with the scholars and researchers who came from various parts of China and outside China to participate the ICMIR-2017 conference. In addition to the academic participation and presentation, the participants must have enjoyed their stay, during the conference and sightseeing trip at Kunming.

I am sure that the readers shall get immense ideas and knowledge from this volume of AISC series volume on “Recent Developments in Mechatronics and Intelligent Robotics”.

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Robot Vision

Mechatronics

Research on the Application of Beidou System in Aviation Ammunition Support

Wei Chen[1(✉)], Di Zhang[1], Haikun Zhang[2], and Henhao Zhu[3]

[1] Air Force Logistics College, Xuzhou, 210000, Jiangsu, China
chenweijiangyiwa@126.com
[2] 94608 Troops, Nanjing, 221000, Jiangsu, China
[3] 94647 Troops, Fuzhou, 350026, Fujian, China

Abstract. This paper introduced the structure of the Beidou navigation and positioning system, analyzed the Beidou positioning solution principle, elaborated the application of Beidou system in aviation ammunition support command, could improve the efficiency of aviation ammunition support, and visual positioning of various support materials in the process of aviation ammunition support.

Keywords: Beidou system · Aviation ammunition · Support command

1 Introduction

In the processing of research of aviation ammunition visualization based on Beidou satellite, used positioning function of Beidou satellite to achieve precise positioning of the personnel, vehicles, ammunition [1, 2], and used the real-time transmission of positioning information to achieve the communication function of its command prompt feedback timely and ensure the implementation of present situation.

2 Beidou Navigation and Positioning System Structure

Beidou Satellite navigation and positioning system is an all-weather, all day long, high precision, regional satellite navigation and positioning system, can achieve 3 functions, including fast positioning, two-way short message communication, the two last functions are which global positioning system (GPS) couldn't provide, and the positioning accuracy in the areas of our country and the positioning accuracy of GPS, covering all areas of China and the surrounding area. The whole system consists of two geostationary satellites (respectively in the 80 o east longitude and 140o east longitude, 36000 km above the equator), the central control system, calibration system and user machine is composed of 4 parts, each part of the outbound link (i.e., the center of the ground to satellite to user link) and inbound links (i.e. the user machine to the satellite link is connected to the central station). As shown in Fig. 1.

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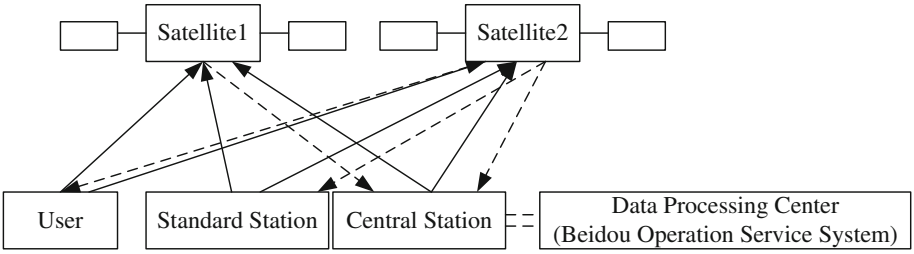

Fig. 1. Beidou navigation and positioning system structure

3 Beidou Positioning Principle

The central station at a specific frequency signal with a continuous wave emission of super frame, divided the frame structure of the pseudo code spread spectrum, the signal by two geostationary satellites to their respective antennas covering all user broadcast regions. When the user needs to position/communication service, location specific process is: first by the center signal, respectively by the two satellite reflection to the user terminal receiving part, and then reflected back by the user terminal two satellites were back to the central station, the central station is calculated in two ways the time required for T1, T2, and after calculation, you can measure the user to two satellite distance R1, R2, complete the positioning (as shown in Fig. 2).

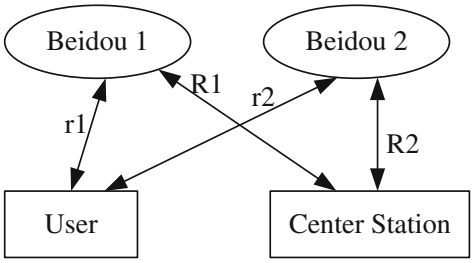

Fig. 2. Beidou positioning principle

The calculation formula is as follows:

$$c \times T1 = 2(r1 + R1) \tag{1}$$

$$c \times T2 = 2(r2 + R2) \tag{2}$$

In the formula (1) and (2), R1, R2 is known, T1, T2 is the light passes through two different outbound links in the link station added time, C is the speed of light, leaving two unknown r1, r2, the two equation solution. The location for geographic coordinate calculation of the user, because the two satellite locations are known, respectively two and two of the center of the sphere, spherical radius of r13, r2, the other is the spherical

earth ellipsoid basic parameters have been determined (in the center station store digital ground height data), the intersection point of three balls for the user position measurement (due to the two center in the equatorial plane of the earth, so the earth reference ellipsoid is two, the intersection point of one point in the northern hemisphere, as the position of the user, another point is in the southern hemisphere).

Positioning by the user terminal sends a request to the central station, the central station to locate its position information broadcast will get by the user, you can also take the initiative to locate the user specified by the central station, located after the location information will be sent to the user, and stored by the central station. The location information of the user is placed in the data section of a frame of the outbound signal and transmitted to the user via satellite 1 or satellite 2. The application of communication, the communication contents in the same way to the user. The first frame in each period data segment send standard time (day, ground station, signal and time correction data) and the position of the satellite information, the user receives the signal is compared with the local clock, and calculate the user's local clock and standard time signal of the difference, and then adjust the local clock with the standard time alignment (one-way timing); or comparing the results through inbound links via satellite to the ground by the forwarding center, the center of the ground accurately calculate the difference between the local clock and standard time, and then through the outbound signal via satellite or satellite 1 2 forwarded to the user, the user at this time to adjust the local clock and standard time signal align (two-way timing).

Signal frequency in the vicinity of the L band, the band of radio signals by the atmosphere, rain, fog, the impact is very small, so the positioning and communication process is very reliable, especially suitable for all-weather protection.

Different from the GPS system, the calculation of all user terminal positions is done in the ground control center. Therefore, the control center can retain all the Beidou terminal user location and time information. At the same time, the ground control center station is responsible for monitoring and management of the entire system.

The calibration station has a total of 20, to ensure the positioning accuracy, it is known as the point position compared with the actual measured position, the difference value were adjusted for position measurement data near the user's location, and the calculation process are completed in the ground station control center, is transparent to the user.

The user terminal is a device which is directly used by the user to receive the ranging signal transmitted by the satellite to the ground station. According to the different tasks, the user terminal is divided into the positioning communication terminal, the group user management terminal, the differential terminal, the terminal, etc.

4 Beidou System Application Solution

The general application of Beidou system by the Beidou terminal (including Beidou mobile command user machine and common user machine, Beidou Beidou) service center system composed of four Beidou navigation positioning satellite Beidou satellite

navigation system, the ground control center. Beidou satellite navigation system for real-time access to the user access, and the use of the Beidou satellite communication functions for positioning information and other resources to ensure real-time transmission of information. All Beidou users are subject to the Beidou satellite navigation system ground control center station management, as shown in Fig. 3.

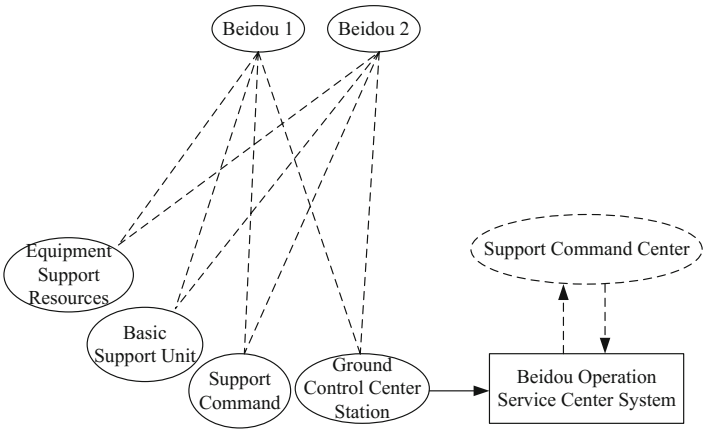

Fig. 3. Beidou system application solution

The service center system is designed for the security command center set up, user location information and short message by Beidou satellite transmitted to the ground station, and real-time push to Beidou service center, security command center through DDN, VSAT, etc. a variety of ways to access the Beidou dial-up service center, Beidou operation the service center sends information to security command center, security command center to realize the monitoring and management of its affiliated users.

There are two kinds of system structure modes of the Beidou missile ammunition support command system:

4.1 Security Command Center + Beidou User Machine (Including the Beidou Mobile Command Users and Beidou Basic User Machine)

The application mode of command system in large scale, through the ground command automation network center, interconnected to the service center to complete the Beidou mobile target monitoring and management of large-scale cross regional command and dispatch.

4.2 Mobile Command User + Beidou Basic User

Because of the limited communication capacity constraints, commanding user command capacity, this application mode is suitable for a small group of users, couldn't transmit through the terrestrial network, a communication device command type subscriber

machine as the command and dispatch center use and rapid construction of practical management system.

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Research on the Aviation Ammunition Support Technology of American Air Force

Di Zhang[1(✉)], Wei Che[1], Jie Xu[2], and Jiejun Dai[3]

[1] Air Force Logistics College, Xuzhou 210000, Jiangsu, China
chenweijiangyiwa@126.com
[2] 94865 Troops, Hangzhou 310021, Zhejiang, China
[3] Taiji Factory, Dongchen, Beijing 100005, China

Abstract. This paper analyzed the current situation of American Air Force ammunition support technology, introduced the application plans of American GPS, and the RFID technology in military ammunition transport application plans in detail, with reference to the construction of our military aviation ammunition support system.

Keywords: American air force · Aviation ammunition · Support technology

1 Introduction

In order to adapt to the characteristics of modern warfare, to achieve the rapid tracking of the rapid process of aviation ammunition support, the U.S. department of defense used the visual technology as an important issue of Aviation Ammunition command. In this paper, the technology of aviation ammunition support was analyzed, which provided the reference for the application of aviation ammunition support technology.

2 The Present Situation of American Aviation Ammunition Support Technology

Currently the U.S. military is speeding up the development and equipment of the whole material visual system (TAV: Total Asset Visibility) and in the transport of materials visible (IAV: Intransit Asset Visibility) system [1, 2]. The former can be sent to the factory to the front from the rear of a foxhole material tracking, including the location, status of materials and equipment and carrier. The latter will use radio frequency apparatus, search apparatus and satellite network computer system, material database, track transportation supplies. These two systems will greatly improve the speed, accuracy and economy of the U.S. According to the U.S. Department of defense report, the U.S. military has built four sub systems: the Army (Army Total Asset Visibility visual materials); Navy materials (Navy Total Asset visual Visibility); air supplies (Air Force Total Asset visual Visibility); the Marines (Marine Corps Total visual material Asset Visibility [3]). “The whole material visual system enables the commander to timely and accurately

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understand the location, quantity, status, trend and status of the materials of the Department of defense, and control the information". "For ammunition storage, processing, transportation and demand information have accurate knowledge", "rapidly reduce the processing time distribution, the main benefits include the storage of material list and receipt, and because of the material tracking and less demand list". U.S. military plans to build a joint asset visualization management system based on RFID technology in 2030.

Because the Americans use such as RFID technology and advanced automatic identification technology in ammunition supply chain, through the RFID card reader, etc., the data can be easily and quickly entered into a shared information system. At the same time, it uses cellular communication, satellite communication, GPS positioning and other wireless tracking methods. Figure 1 is the American global tracking network based on RFID technology, satellite positioning technology, satellite communications technology. Built by the U.S. Savi-Technology for the department of defense, the world's largest real-time tracking system, able to track about 250000 pieces of moving objects from toilet paper to ammunition. In more than 480 locations in 40 countries have built automatic identification device with radio frequency identification as the main body, such as by satellite, military communication network connected, as long as users have access permissions, you can have the exclusive right to conduct real time management of goods and materials.

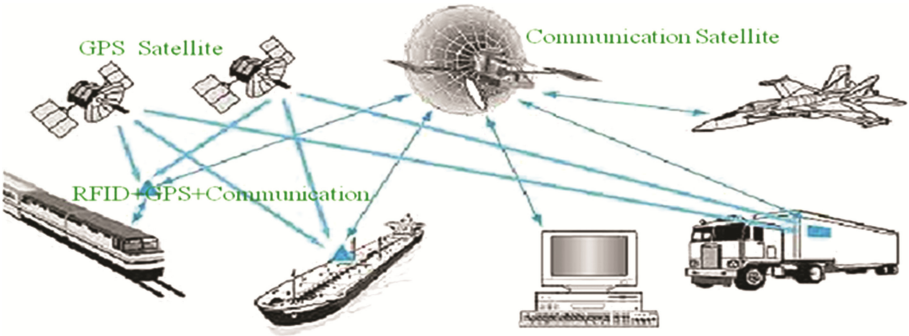

Fig. 1. The American global tracking network

Aviation ammunition support process started from the defense warehouse to the pallet. A automatic radio frequency identification card list of aviation ammunition support materials and a Savi-Technology card could be attached to the tray, the tray of the aviation ammunition support materials in the information contained above, including the name of goods, quantity, number, storage and transport control number, document number. The information is then automatically sent to a central information system. Only in almost all of the supply chain, such as aircraft, ships, truck loading ramps are mobile, manual or automatic Savi-Technology reader, used to track goods to where. To achieve the whole process of tracking the whole process.

3 GPS Application

GPS (Global Positioning System global positioning system) is a global, all-weather, real-time, automation and high efficiency advantages of navigation, positioning and timing, speed measuring system, which can provide seven dimensional high precision for the user (three-dimensional position, three-dimensional velocity and time). GPS consists of three parts: satellite, ground control center and user. GPS uses the satellite as a reference point to calculate the location, positioning accuracy to meter level. There are 24 satellites in the air, located in the orbit of the surface of about 6 km, about 201 million 830 thousand km, about 55° orbit. Each star has 4 high-precision cesium atomic clock and a real-time update of the database, the satellite is constantly sending data to the earth's surface. GPS receiver on the ground whenever and wherever the data can be received at the same time 4 satellites, and then according to these data automatically calculate the latitude and longitude of the receiver and the direction of movement speed, time and other data.

The GPS receiver uses a three edge measurement mechanism to calculate the position of a point in a three-dimensional space. So at least three satellites are needed. GPS satellites broadcast their location information and the exact time at this time. GPS receiver through the reception of the signal, to know the location of the satellite and the signal transmission time, you can measure the distance to the satellite, and then calculate their position, as shown in Fig. 2. Suppose we measured a satellite distance of 11000 km, that we are in a satellite as the center, 11000 km radius of the sphere. As of two satellites in addition, also in their center, the corresponding distance as the radius of the sphere. The three balls intersect at two points, one of which is the position of the receiver, and the other can be easily eliminated by judgement.

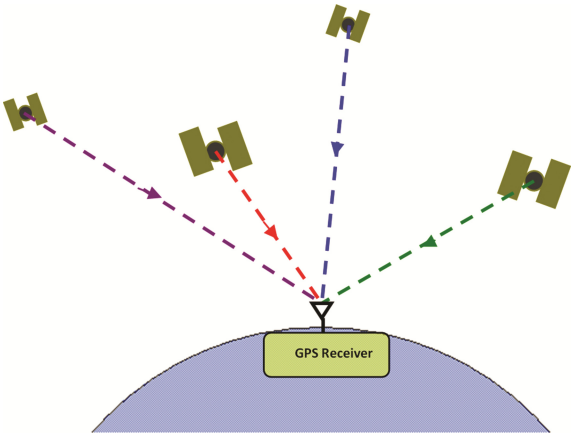

Fig. 2. GPS positioning principle

The information transmission time between the satellite and the ground receiver is measured, which is the basis of the GPS distance measurement. For satellites, the use of very accurate atomic clock timing, very accurate. But the GPS receiver atomic clock

on the ground is too expensive, so the use of fourth satellites for the timing, time synchronization and GPS receiver time, accurate time synchronization to ensure accurate positioning.

There are two methods of GPS positioning: one is the single positioning method, by a receiver to receive the data of the 4 stars, the positioning accuracy is low, the error has tens of meters. The other is a relative positioning method, at the same time from the same set of satellite receiving data from multiple receivers, and at least one receiver at a known point (known longitude, height), this point as the reference point for the other point to the reference point of the distance. This approach can achieve very high accuracy, also known as DGPS (wide area GPS differential correction), which requires a large number of reference points composed of infrastructure to support. GPS positioning data through the GSM (global mobile communication network), CDMA SMS (short message) or cluster communications and other means to the ground monitoring center, displayed on the mobile phone with GIS or large screen projector. The center can monitor the current position, the route, the direction and the speed of the target for 24 h.

4 RFID Application Plan of U.S

American Air Force established the visual logistics supply network coverage of important regions of the world based on RFID standard EPC, extensive communication network, efficient information processing, strong security against ability. There are 480 monitoring point of 38 countries in the world, real-time tracking of 270000 container including military and commercial purposes and important goods.

Figure 3 is the RFID application plan of U.S.

1. air ammunition support material can only be read through the passage, in the case of the destruction of the database, the site can not achieve the automatic statistics;

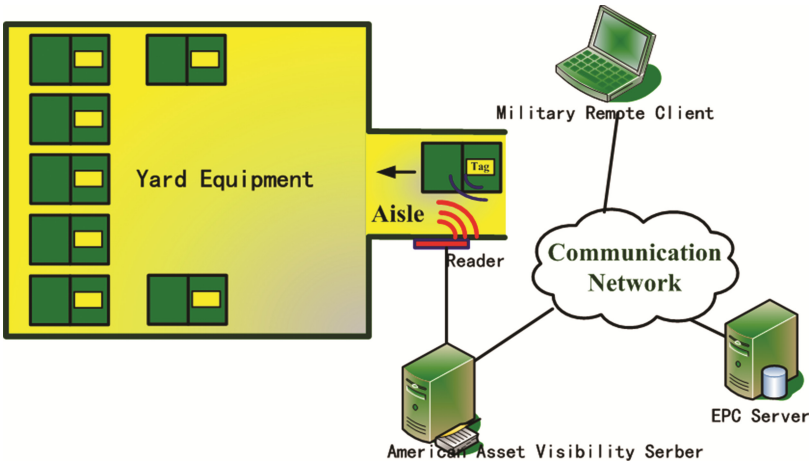

Fig. 3. RFID application plan of U.S.

2. using UHF passive tags to identify the distance of less than 5 meters, and has a directional;
3. tags can only store a EPC code, equipment information must be resolved through the EPC server to obtain.

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The Assembly Redesign of Cage Rotor Separator

Li Kunshan and Li Yang(✉)

School of Mechanical Engineering, University of Jinan, Jinan 250022, People's Republic of China
742674@qq.com

Abstract. The method of using three-dimensional design of the main components cage rotor separator were optimized, according to the green design theory, to meet the minimum number of parts of the design method and the direction of the minimum assembly direction; according to the part interlock feature, to achieve the main assembly process in the equipment outside the design method and structure of the principle of symmetrical design. The numerical simulation method is used to simulate the flow field of the separator, especially the influencing factors of the flow field of the rotor system. The optimal performance of the redesign is verified by the experimental data.

Keywords: Separator · Assembly · Design · Numerical simulation · Green environmental friendly

1 Preface

The purpose of the cage-type rotor separator assembly is to assemble the rotor system, housing, power and drive system of the separator as quickly as possible and to ensure the assembly quality of the separator. Therefore, the quantitative analysis of the application to the cage rotor separator design process is essential, especially in the cage rotor separator design research early, the program demonstration and selection stage is particularly important, the purpose of optimizing the design of the separator in order to reduce the equipment assembly time, reduce assembly costs.

2 Three-Dimensional Design and Assembly Design Analysis of Cage Rotor Separator

Three-dimensional solid modeling software has a powerful parametric design and surface modeling capabilities, high-performance assembly and finite element structure analysis functions. The design of the cage-type rotor separator is due to the different specifications and performance specifications. At the same time, due to technical reasons, it is not possible to form a standardized design. The two-dimensional design can not meet the requirements of its assembly design. The three-dimensional design can be used to solve the redesign some of the problems in the process.

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