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Research on Mechanical Design of Multi Motion Dynamic Reconfigurable Wheel Shoe Compound Robot

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Abstracts: In some complex and changeable outdoor terrain survey, the work that may not be realized by manpower is mostly replaced by robots or unmanned machines. Based on the motion advantages of wheeled and tracked mobile mechanisms, a wheel shoe compound robot with diversified motion modes is developed.The robot is composed of control unit, two identical reconfigurable wheels, turnover mechanism and vehicle body, so it has the advantages of three modes. Based on the relevant motion mechanics, the relevant parameters are optimized to continuously promote the continuous change of motion trajectory and the continuous optimization of drive motor performance, which plays a positive role in improving motor efficiency. Through experimental research, it is found that this multi mobile dynamic mobile robot can continuously adjust its own mechanism, move freely in the complex and changeable outdoor environment, and has strong environmental adaptability, which shows the effectiveness of the design.

Keywords: Multi Movement Dynamics; Reconfigurable; Wheel Shoe Compound Robot; Machine Design

At present, the field of intelligent robot is developing rapidly. Mobile robot is an important branch of robot. It has great application value for investigation, patrol and mine clearance, and can cope with some tasks with high risk and bad environment. The current robot design includes the above three types of mobile structures, but different types of robots have their own advantages and disadvantages. Among them, the wheeled robot can meet the design requirements of fast running speed and realize all-round flexible movement; Tracked robot can be used in many complex terrain, and has strong ability to cross obstacles; The overturning working mode can realize the overall overturning operation of the crawler wheel, cross the fence and other vertical obstacles, and carry out the corresponding operation mode selection through the ground characteristics, which can effectively solve the obstacle problem. Therefore, a multi transport dynamic wheel shoe composite robot is designed, and the walking mechanism design scheme of this kind of composite robot is proposed, which realizes the change of robot wheel mode and uses crawler to walk, better improve the activity and flexibility of the robot, and improve the obstacle crossing ability and environmental adaptability of the robot .

1. Structural characteristics of wheel shoe compound robot

The structure of the robot designed in this paper is complex. In the middle box of the robot, there are multiple changeable track units, which are symmetrically distributed left and right through modular design. The box can load the

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motor, including sensors, control hardware, batteries, mechanical arms, etc., the middle box can be regarded as the main platform for carrying, which can ensure the horizontal attitude of the robot. The four crawler units of the robot here are deformable, and their specific motion can be realized by independent control. The corresponding deformable crawler unit and the driving wheels matched on both sides are driven by memory friction. Finally, the wheel movement and crawler movement are combined to ensure that the robot structure is more compact, and the robot volume and body structure are reconstructed under the condition of ensuring its performance.

2. Design of walking mechanism of multi transport dynamic wheel shoe compound robot

2.1 Wheel shoe variant design

This kind of wheel shoe compound robot can remember elastic deformation with the help of the extension mechanism inside the two driving wheels. When the extension mechanism returns to the inside of the two driving wheels, the track can shrink rapidly with the help of elastic force to form a circular state. The corresponding extension mechanism is applied through the linkage crank swing rod mechanism, which is between the two driving wheels. At this time, the crank and connecting rod and connecting rod and swing rod are connected with screws . In this way, the swing rod can be hinged in the fixed plate with the help of the pin, and the fixed plate is in a static state with the middle box. In addition, in order to further reduce the quality of the robot and make the machine lighter, in the specific structural design, through effective weight reduction, light metal materials with low density can be used as the main materials for robot manufacturing under stress and friction, and some light metal materials can be used to replace heavy mechanical materials, making the mechanical weight of the whole robot lighter.

2.2 Motor selection

Motor design is the core link in robot design. The motor capacity needs to meet the requirements. Here, it is necessary to grasp the heating conditions during motor operation. The specific heating conditions are related to the actual working conditions. In the long-term operation of the motor, the corresponding load shows a change trend. Even in the normal temperature environment, the motor operates for a long time, but as long as the load is within the rated value range, the motor will not overheat. Therefore, it is necessary to ensure that the rated power of the motor is greatly equal to the output power of the trolley motor. In the calculation of motor power, the rationality of its parameter value should be ensured, because excessive parameter value will lead to the increase of trolley movement speed, instability of vehicle structure and increase of control board load. Too small parameter value will lead to motor overload operation and motor failure. After experimental research, it is determined that the rated voltage should be controlled at 12V, the current should be 3.25A, and the speed should be controlled at 200 rpm.

2.3 Track design

In the design of multi transport dynamic reconfigurable composite robot, the track is also an important part. Because the robot needs to adapt to different and complex terrain, the wheel and track design are combined to build a composite track structure. Considering that the vehicle body should adapt to various regional states such as mountains, hills and depressions, crawler transmission should be designed. The specific design should drive the landing gear in front of the vehicle body at the position in front of the electric cylinder to meet the needs of different terrain and obstacle crossing, and effectively cross the obstacles in front through crawler transmission.

2.4 Design of turnover mechanism

In the design of multi transport dynamic reconfigurable composite robot, the design of turnover mechanism is also an important part. The relevant robot turnover mechanism should include telescopic device, electric cylinder and swing frame. The bearing can be fixed with the help of the central hole, and the turnover frame can be fixed in the vehicle body to realize the unity of the rotation of the swing frame and the rotation of the crawler. The turnover arm can effectively promote the ability of the robot to cross obstacles, which is also the need to realize the environmental adaptability of the robot motion platform.

3. Control system design

There are many main components of multi operation dynamic reconfigurable composite robot. In terms of specific

control, it is necessary to use multiple control equipment and communication modules to monitor and control the robot and realize the centralized control effect of the robot. In the system design, several PLC control units are included, which together constitute the corresponding data transmission network to ensure the benefits of scale control and monitor the whole process of belts and equipment in the system. Before the control system is started, the central control console is required to release the advance notice information. After half a minute, it can be automatically started if the on-site start requirements are met. Start and stop buttons are set in the middle box, which can meet the operation of start and stop at any time. If the centralized control startup mode is adopted for relevant equipment, the control system can stop instantaneously after receiving the stop signal to ensure equipment safety and prevent secondary failure.

In the selection of control mode, there are three modes: automatic control, manual control and centralized control. The control mode can be changed at will. In the system work, the automatic control mode is mostly adopted, and the corresponding equipment starts and stops the central console according to the process requirements, sequence and process; By adopting centralized control and manual control, the relevant equipment can be operated by the central console, and there is no locking relationship. The system needs to implement centralized monitoring of the robot, effectively monitor the equipment operation status and parameters, and store the corresponding data information in the system hard disk. In addition, the system carries out alarm processing for equipment failure and abnormal signals, and also appears audible and visual prompts at the same time to ensure that relevant personnel can pay attention to abnormal signals in time. For fault alarm, generally simple faults only give alarm prompt, while for abnormal shutdown and serious faults, timely shutdown operation is required, and delayed locking operation is carried out for key equipment such as motor.

4. Conclusion

Multi mobile dynamic reconfigurable composite robot is an indispensable tool in terrain survey and military survey. It has a strong auxiliary function for related work. In specific applications, it is necessary to do a good job in the design of key parts, optimize the control mode, and promote the continuous improvement of robot man's intelligent operation level.

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