Development of the second prototype of a half drone inverted pendulum transportation robot to improve the safety and the controllability

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Ⅰ. Abstract

In recent years, the labor shortage due to the increase in demand in the delivery industry has become a problem. To solve this problem, drones and vehicle-type transportation robots have been developed [1]. In our laboratory, a half-drone inverted pendulum type transportation robot that integrates a drone and wheels has been developed. This is a robot that uses a new mobile mechanism that can overcome the short cruising range of the drone, the small load capacity, and the difficulty of raising and lowering the steps of the wheeled vehicle. This paper proposes a second prototype designed based on the findings obtained from the primary prototype developed for theoretical research [2].

The appearance of the second prototype is shown in Fig. 1, and the system configuration is shown in Fig. 2. In the second prototype, two rotors are placed at the bottom of the loading platform to prevent contact with the outside of the rotors. Although safety can be ensured by this, the balance of the loading platform cannot be controlled by this alone. So, a DC servomotor is attached to the rotating shaft of the loading platform.

Figure 1. Half drone inverse pendulum transportation robot Second Prototype

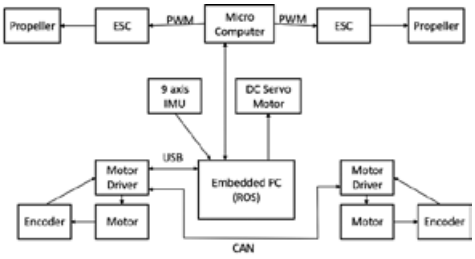

Figure 2. System configuration for Prototype2

Ⅱ. Results & Discussion

Several experiments were conducted to verify the validity of the structure of the second prototype. First, in this robot, it is thought that the air flow is obstructed by the bottom surface of the loading platform and the thrust of the rotor is attenuated, so the degree of the effect was measured. As a result, it was confirmed that the thrust of the rotor used in the selected actual machine had a damping of at least 24%.

Next, the thrust of the rotor was measured in a state close to that of the actual machine, using a device that reproduced the tilted state of the machine. As a result, it was found that the thrust of the rotor was further attenuated by about 8%. At this time, the sum of the thrusts of the two rotors satisfies the required thrust, but the counterrotating rotor does not simply add the thrusts,

and the thrust is further attenuated. Therefore, it is necessary to design in detail in consideration of these. Since the control of the inverted pendulum robot is the same as that of the primary prototype, the control of the loading platform is integrated with it.

Ⅲ. Conclusion

This paper described the second half-drone inverted pendulum type transportation robot and the verification of the validity of the design of the loading platform drone section. Future goals are the development of the control system for the loading platform drone and the integration of the control system.

Ⅳ. References

[1] Kenichiro Nagaiwa, Shoto Takeda, "The Future of Logistics in the Rural Area",NAVIGATION, pp.7–12, 2018.

[2] Rintaro Hoji, Shoichi Maeyama, "Position Control for Half-Drone Wheeled Inverted Pendulum Robot", ICMA2021 Proceedings, to appear.