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Application of switching control by two types of drones of different sizes

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Introduction

In the present study, autonomous four rotor helicopter movement control strategy using pitch and roll movement control alternately was proposed, and the autonomous flight test evaluation was performed.
To realize over 50 m long distance flight of the drone under unstable GPS signal situations such as under the bridge or inside tunnels for the periodic inspection, the improvement of the control method is important for the stable control.
The aim of this study is to compare three control strategies - simple PD control, boundary condition and using pitch and roll movement control alternately strategy in over 50 m range autonomous four helicopter movement.
Our proposed method would be effective in the situation that there is no skilled the drone control operator and the flight by visual confirmation of man are hard conditions.

Methods

The experiment, the red marker is used to measure the left-right deviation for each drone when flying over a distance of 50 m or more.

The drone was controlled by the red marker's position on the front camera image, and it was moved back and forth within 3.0 m about 30 turns by changing the control parameter of pitch direction γ positive or negative.

The position of the drone was measured by another camera attached to the ceil, and the x and y position was continuously measured by the image. Axis x and y correspond to the roll and pitch direction of the drone respectively. In this situation, three control methods (P-D control, boundary condition, using pitch and roll alternately) were performed.

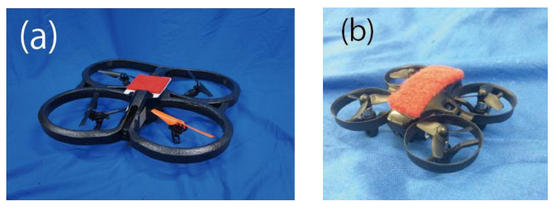

Fig. 1 Experimental setup devices. (a)AR Drone2.0 (b)A20W

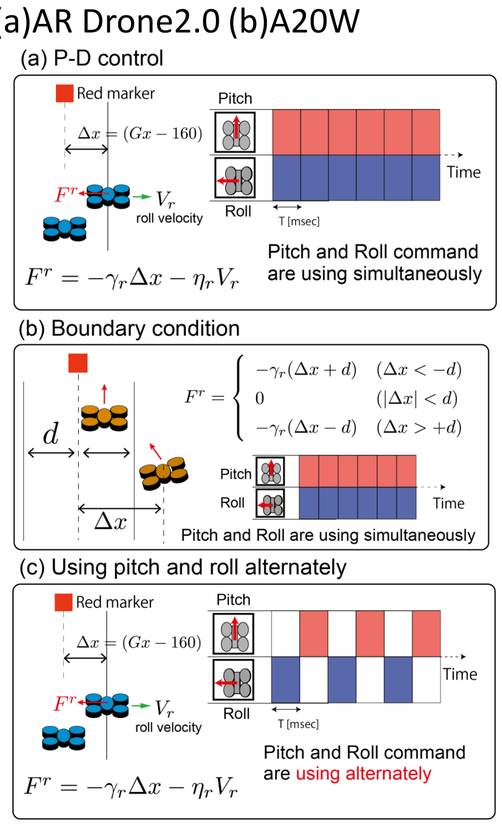

Fig. 2 Three control strategies

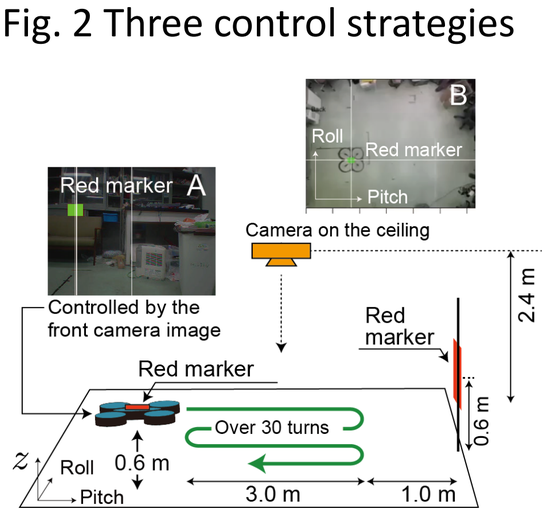

Fig. 3 Experimental setup

Results

Compare the accuracy difference when switching control and boundary control are applied to A20W.
When boundary control was applied, the standard deviation was kept low, but it was not possible to reciprocate a sufficient number of times.
When the switching control was applied, it was possible to reciprocate the reference number of times, and the total standard deviation was suppressed compared to the boundary control.
Almost the same results were obtained when applied to the AR Drone, but there was a difference in that the standard deviation of the part drawn in blue when the boundary control was applied was significantly different.
(ARDrone moves so that the tip bulges, and A20W moves so that it tapers)

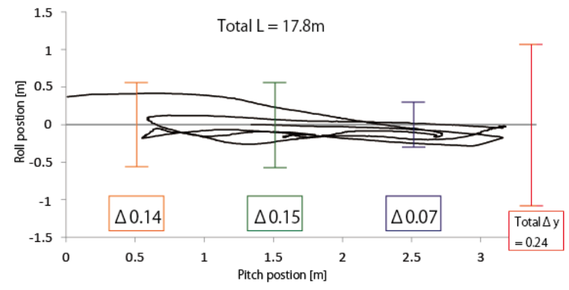

Fig. 4 Result of the boundary condition control using A20W

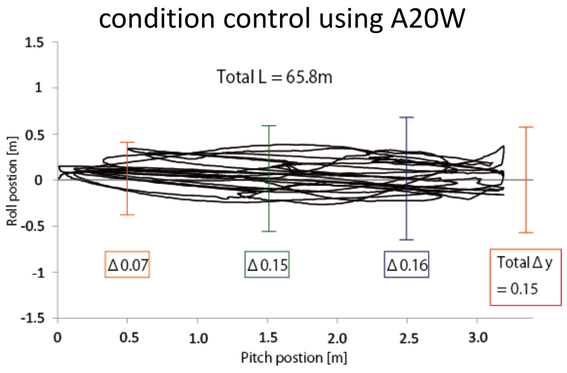

Fig. 5 Result of the pitch and roll alternately condition control using A20W

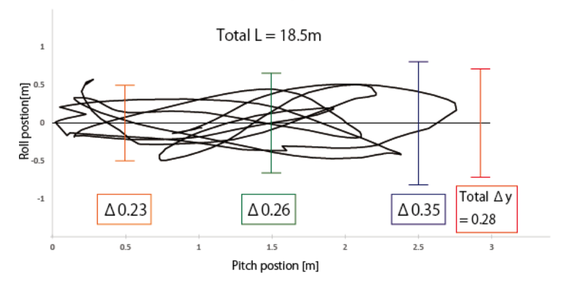

Fig. 6 Result of the boundary condition control using AR.Drone

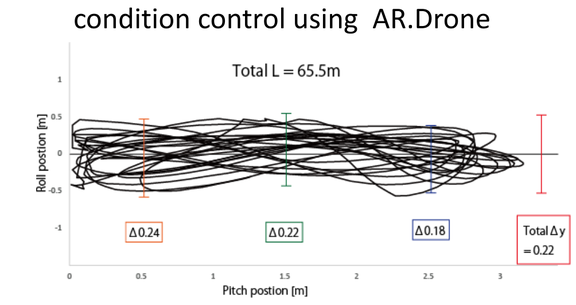

Fig. 7 Result of the pitch and roll alternately condition control using AR.Drone

Conclusions

It was found that the two controls tested this time provided excellent stability by adding them to the simple PD control, and among them, the switching control was particularly effective.
A certain effect was obtained even when the control was applied to a drone with a performance different from that of the experiment so far, and it was shown that the control may be effective regardless of the size and performance of the drone.