ABSTRACT

Helicopter is a nimble vehicle with flight property. It can take off or land vertically, move in any direction and hover. Because of the innate instability and highly nonlinear property, designing autonomous flight control system of helicopter is of much difficulty. The main consideration in helicopter flying control is to hover and to land. In this paper, we consider the case that a CCD is hang on helicopter as an auxiliary sensor. The CCD can get the image of H-type hardstand on the ground and calculate the horizontal shift error and height of helicopter by PC. It can apply to observe the river, disaster area, science and military detection. In order to get the information about aerial photography and observation, we add the function of taking picture and video recording.

Keywords — Image-Guided Position estimation, Unmanned Helicopter, Image Height Estimation.

1. INTRODUCTION

Unmanned helicopter is a flexible vehicle which can carry out many difficult tasks. In order to achieve its autonomous property, various control schemes and realization techniques for helicopters have been developed in recent years [1]-[2]. In the control procedure, hovering of helicopter is the basic and most important mode which needs to be concerned firstly. Moreover, the accurate position and height are required for achieving the excellent hovering control of helicopters. The global position system (GPS) is the most commonly used sensor for obtaining the position information. However, the position error of GPS is usually in the range of ±10 meter, which is not good enough for hovering and landing [3]. In order to deal with the accuracy problem, we consider employing the computer vision to estimate the position and height of helicopters.

In recent years, the computer vision has been maturely developed in the applications of autonomous vehicles [4]-[5], which include submersibles, land-based vehicles, aerial vehicles, and unmanned aerial vehicles (UAV). Accordingly, we consider the image-guided method for the position and height estimation of unmanned helicopters.

In the proposed method, we firstly establish the look-up table by the practical experiment. Instead of the nonlinear and complex computation, the look-up table can be easily used to obtain the height of moving target. According to the knowledge of the height, we then estimate the horizontal displacement of the target. The experimental results indicate that the proposed image-guided method with less computation load and better accuracy seems to be more potential for the position and height estimation of the unmanned helicopters.

2. IMAGE-GUIDED METHOD

The evaluation algorithm of the proposed image-guided method in this paper is illustrated in Fig. 1. As shown in Fig. 1, the algorithm is divided into several steps. The brief explanations of each step are described in the following:

Step 1. Getting the binary image of the captured image by the pre-processing procedure.
Step 2. Computing the area of target for constructing the relation between the area of target image and the height of camera.
Step 3. Calculating the basic rectangle and the area of target by image tracking procedure.
Step 5. Calculating the value \( k \) to find out the relation between the pixel length and the target length.
Step 6. Calculating the horizontal displacement by the geometric relation between the camera and the target.

The complete introduction of the algorithm will be described in detail in the following subsections.