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H-INFINITY Control for Pitch-Roll AR.DRONE

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Abstract

This paper describes the design and implementation of H-infinity controller applied to the AR.Drone to follow a given trajectory. The trajectory will be achieved by using two control signals, pitch and roll. Pitch and roll of the AR.Drone models are obtained by assuming that the transfer function of internal control for pitch and roll is the second order system. Two schemes of H-infinity controller designed for pitch and roll. H-infinity control for x-position has exogenous input of the x-reference, xref, control input of pitch value, exogenous output in the form of x-position and process output as error x. While H-infinity control for y-position has exogenous input of y-reference, yref, control input in the form of roll value, exogenous output of y-position and process output as error y. The results of simulation and implementation show that drone can follow multiple references of trajectories given.

Keywords*: AR.Drone control, H-infinity controller, pitch control, roll control*

1. Introduction

Various applications of Unmanned Aerial Vehicle (UAV) have been widely used today for news reporting, disaster missions, expeditions, videography for tourism, businesses and others. UAVs are mostly still controlled by humans from the ground station. The existence of autonomous flight feature will be very helpful when terrain and environment restrict human movement. This paper presents the development of an automated algorithm scheme on one type of UAV, the AR.Drone quadrotor.

AR.Drone has become one of the research platforms that are widely used by researchers, especially for those who focus on the development of algorithms. Algorithm development with AR.Drone platform is faster because AR.Drone is equipped with several sensors: 3 axis gyroscope, 3 axis accelerometer, a sonar altimeter, and the front and bottom cameras. AR.Drone is also equipped with an onboard computer that can be used for basic controls, such as: vertical take off landing, hovering, forward-reverse, right and left maneuvering by giving a value between -1 to 1 on the pitch, roll, yawrate, and vertical rate input. Providing a positive pitch value (+) means ordering the drone to fly backward while a negative pitch value (-) means ordering the drone to fly forward. Positive roll value (+) means ordering the drone to fly right sideward, and left sideward for negative roll value (-). To pivot clockwise motion, positive yawrate value must be given to the drone and negative (-) for the opposite motion. Positive (+) vertical rate value is given to the drone to maneuver vertically upward and negative (-) for reverse maneuver. Range values -1 and 1 are propotional to the minimum and maximum range of the actual value of each input that is set on the configuration of its innerboard. Through Wi-fi communication, control command can be sent from a PC in the ground system to the innerboard of the AR.Drone and vice versa innerboard can send navigation data to the PC. Navigation data that can be taken include actual roll value, sideward speed, actual pitch value, forward speed, actual yaw rate value, yaw value, vertical rate value and altitude value.

Many researchers have been conducting research using the AR.Drone. Pierre-Jean Bristeau, et al., [1] describe in detail the technology used in both hardware and software AR.Drone including the hardware description, vision algorithm, sensor calibration, altitude estimation, velocity estimation, and control architecture. Krajnik, et al., [2] used the measurement data to model the internal control of the AR.Drone into four models: pitch, roll, yaw rate and vertical rate. Michael Mogenson [3] makes the AR.Drone LabVIEW toolkit which

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