Development and implementation of Avionics in fixed wing UAV

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ABSTRACT

The Unmanned Aerial vehicles have been in use for various applications for over a decade. In the past years, the need for optimum control, stability and autonomous control have prevailed. Thus, the Scorpio Mark-III is a fixed-wing UAV which is capable of autonomous control and eliminates the need for continuous monitoring by RC pilot. Pixhawk module is used which is autopilot hardware and used as an interface to connect servos, transmitter and GPS. The controller design is made in Simulink using 2 axis stabilization of roll and pitch by using Pixhawk library components and control theory basics. The waypoints for navigation are given by Mission planner software for autonomous mission. The autonomous controller and way point navigation are tested in Software and in Hardware-in-Loop by various tests in X-Plane, Ground test and flight test. The avionics and communication elements are all electronics components installed in the aircraft which help in flying, data transmission, interface telemetry data from the plane to ground station. The ground and air telemetry module along with transmitter help to obtain flight parameters like speed, altitude, latitude, longitude. The OSD and camera are used to display plane position to the display device at the ground station. Various tests are carried out to test the working of all the electronics and their functionality.

INTRODUCTION

The fixed-wing aircraft have a fixed wing which is capable of generating lift by UAV's forward airspeed and are comparatively faster and simpler than rotary type. The need for the autonomous controller in flying UAV serves for many advantages like better stability, safety and less monitoring. The Pixhawk is open hardware that is used for autopilot design for aerial vehicles. It is used to control all the servo for control surfaces like ailerons, elevators and rudder and transmits data to the ground station.

The ground station is capable of monitoring aircraft and collecting and transmitting telemetry data at a fixed channel frequency. The other avionics components like OSD and camera helps to display live video feed to the user at the ground station. All the flight telemetry data can be viewed on the MATLAB window by using a ground module.

OBJECTIVES

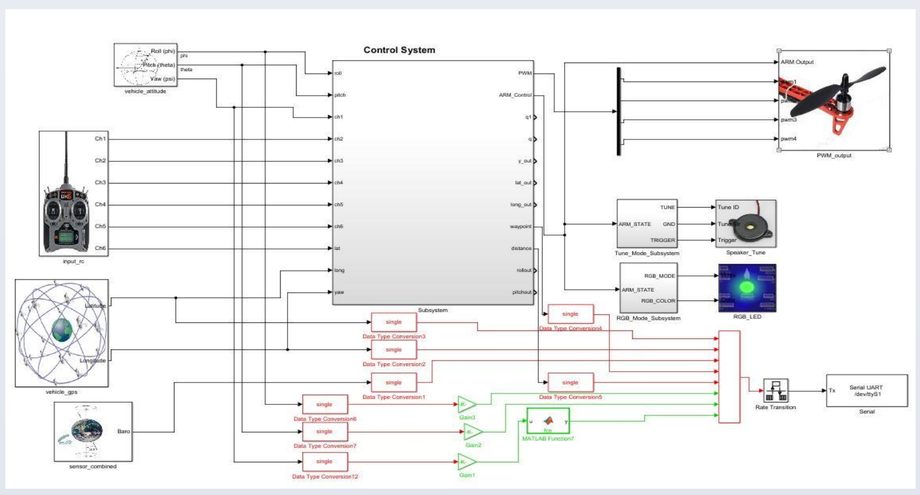
The main objective of project is to work with the UAV team to implement the avionics system in the MK-III successfully. The task required me to propose an autopilot design to navigate the aircraft without the need for human and to accomplish the installation and testing of all the avionics component in the aircraft.

METHODOLOGY

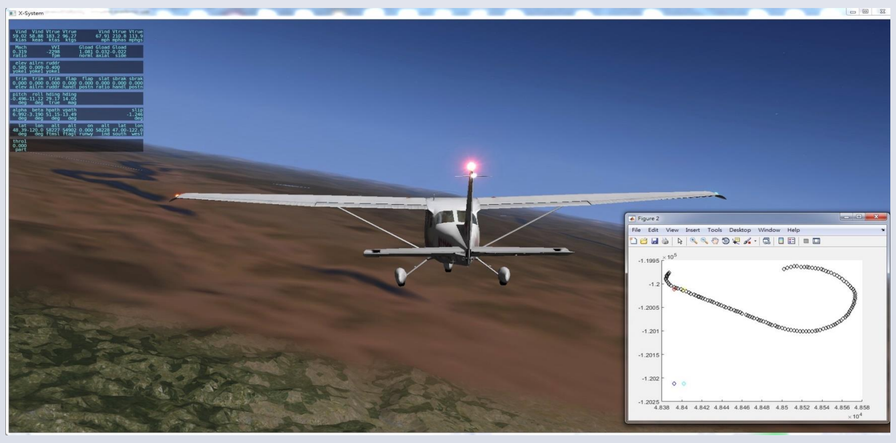
- The aircraft is made on base wood structure and the control surface using balsa wood as they are light weight and easy to shape. The savox servos are fixed on the ailerons, elevators and rudder to vary plane orientation and tested using multi-function tester.
- The futaba RC controller is used for 6 channel control and a model control switch to switch from manual to auto mode. The signals are transmitted from TX module to RX module attached with Pixhawk.
- The Pixhawk controls the aircraft attitude which is done by 2 axis stabilization of roll/pitch made using Simulink and converted to C code for all the operations.
- The controller uses commands from RC and from GPS to orient plane direction automatically by reducing error from the comparator. The range of RC is changed to -1 to 1 and it corresponds to any change in plane due to any disturbances.
- The Mission Planner is open source software which is used to set points for aircraft by setting a mission from take off to return to target and all the telemetry data can be viewed on the software display screen.

EXPERIMENTAL SETUP

CONTROLLER DESIGN



SIMULATION



CONCLUSION

The ground station is able to interact with the airplane communication system and move the servo, propeller and navigate to way-points. The ground test evaluates the full functioning of aircraft and components for over 54 minutes at full throttle. The attitude controller works effectively and it is verified using X-Plane test which simulates vehicle dynamics and its performance. The flight test verifies the performance of the Pixhawk controller and telemetry data transfer. Hence, the system is successful and can be employed for different autopilot missions.

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