AUS-UAV HILS SETUP OF DYNAMIC FLIGHT PATH PLANNING

Mohammed Mahedi Hasan, Candidate for the Masters of Science Degree in Mechatronics Engineering

American University of Sharjah, 2006

ABSTRACT

My research will utilize the existing UAV test-bed consisting of the TRI-60 RC airplane, the Avionics Unit, the embedded controller system, and the Ground Station to test minimum time flight path algorithms and mission planning capability in three dimensions. The research will be two pronged: with one area being directed toward an up-to-date reliable simulation capability to test the UAV to ensure its flight readiness and the other area being to create actual test scenarios to collect data, and verify the validity of the simulations and fine tune the mechanical and electrical configurations. The Ground Station will be used to monitor the UAV status during flight, and to make the UAV “flexible missions” capable. For the purpose of this research, missions are described as the ability of the UAV to move between two different coordinates in the map, indicated by their Global Positioning Satellite (GPS) coordinates and altitude.

A successful demo of the Hardware in the Loop Simulation of the Ground Station and Avionics Unit depicts the embedded microcontroller of the UAV accepting mission waypoints and then controlling the virtual TRI-60 RC airplane over them according to the path strategy devised. The path strategy takes the aircraft between two waypoints in ***three dimensions*** using the ***shortest path*** and at the same time ensures that the aircraft faces a ***certain heading*** once it reaches its waypoint. During the course of the thesis, minimum time paths, dead reckoning (inertial navigation) algorithms, and practical real time effects were researched.

Future UAV research for this university should include the ability to land and take off autonomously, and the ability to do formation flights. The UAV test-bed should also be upgraded using new design technologies to create a more sophisticated Avionics Unit capable of auto-navigation. The ability to do surveillance should also be incorporated into the UAV by including an onboard camera and an image processor. This would require upgrading to a bigger fuselage (or airframe) to store the required components.

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ABBREVIATION

α , β	Angle of attack, and side slip
ϕ , θ , ψ	Euler angles (roll, pitch, and yaw)
ρ	Density of air
AUS-UAV	American University of Sharjah Unmanned Aerial Vehicle
C_L	Lift coefficient
CAN	Controller Area Network
CCP	Concurrent Constraint based Programming
COTS	Commercial off the Shelf
CRC	Cyclic Redundancy Code
DFCS	Dynamic Flight Controller System
FGFS	Flight Gear Flight Simulator
FSR	Full Scale Range
g	Acceleration due to gravity (9.78 m/s^2)
GNC	Guidance Navigation and Control
GPS	Global Positioning System
GPS/INS	Inertial Navigation System and Global Position System Integration
GUI	Graphical User Interface
h	Altitude
HILS	Hardware in the Loop Simulation
IMU	Inertial Measurement Unit
INS	Inertial Navigation system
LQR	Linear Quadratic Regulator
MFC	Microsoft Foundation Classes
NIDAQ	National Instruments Data Acquisition Unit
p, q, r	Angular rates (roll, pitch, and yaw)
PAH	Pitch Attitude Hold
PCB	Printed Circuit Board
RAH	Roll Attitude Hold
RCU	Remote Control Unit
S	Surface area of the wings

SAS	Stability Augmentation System
SCI	Serial Communication Interface
SPI	Serial Peripheral Interconnectivity
TBI	Text Based Interface
TRH	Turn Rate Hold
u, v, w	Body frame longitudinal, lateral, and vertical airspeed
UAV	Unmanned Aerial Vehicle
W	Aircraft weight

ACKNOWLEDGEMENTS

First of all I would like to say Al-Hamdu-Lillah for being able to able to reach this far. None of this would be possible if Allah did not give me the patience and steadfastness especially when things became really hectic.

I would also like to thank my parents for having patience with me and supporting me, and especially my mother for ensuring that I was properly looked after at home so I could wholeheartedly focus in my work.

Most of all I would like to thank Dr. Mohammed Ameen Al-Jarrah for guiding me through this endeavor. His enthusiasm for UAV research was an inspiration to all of us who worked under his supervision. Although this thesis only accomplished a small part of his vision, I was honored to have been a part of it.

I would also like to give especial thanks to my colleagues who helped me tremendously, and who slaved through this as much as I have. I would specifically like to thank Rami Al-Shanaah, Saeed Islam Said, and Oubadah Al-Dabbas.

I cannot forget my other Mechatronics colleagues who kept me company and made my experience rich and wonderful. I would like to thank Ihab Mohammed Abu Younis, Fadi Al-Saleem, Mohammed Jarrah, Joudeh and others who I cannot mention in this short space.

Last but not least I would like to thank the Mechatronics Faculty for there role in making this program an internationally recognized one.