UNMANNED AERIAL VEHICLE DESIGN FOR IMPROVED MANUVARABILITY

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Declaration

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The above candidate has carried our research for the MPhil Dissertation under my supervision.

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Abstract

This thesis presents a non linear automatic unmanned aerial vehicle (UAV) control simulation demonstrating high maneuverability and precise tracking performance on a simulation testbed. High maneuverability leads to satisfy the requirements of future missions. Much of the recent research on UAVs focus on multiple UAV coordination planning and path planning and the high maneuverability controllers are given minimal attention. Major requirements for the high maneuverability are better dynamic stability with fast response and low coupling between control commands. This research work is presented that way to modify classical system with merging with modern concepts to achieve high maneuverability. State feedback method, decoupling techniques and duel loop method are used for autopilot controller implementation. Simulation results confirm the validity of proposed techniques, which have been used to enhance autopilot capabilities with less complexity. Non liner effects due to normal mission profile were also measured.

To my parents and teachers

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Acronyms

UAV	Unmanned aerial vehicle
UCAV	Unmanned combat aerial vehicle
GCS	Ground control station
EP	External pilot
IP	Internal pilot
GUI	Graphicle user interface
SAS	Stability augmentation system
FCS	Flight control system
LQR	Linear quadric regulator
COG	Center of gravity
CGF	Computer generated force
GPS	Global positioning system
INS	Inertial navigation system
PID	Proportional, integral, derivative controller
DOF	Degree of freedom
w.r.t	With respect to
r.p.m.	Resolutions per minute

Nomenclature

A, B, C	State, Control and output matrix of the linearized aircraft model
g	Acceleration due to gravity in ms^{-2}
K	State feedback gain
p	Perturbation in roll rate from trim value in radians/sec
q	Perturbation in pitch rate from trim value in radians/sec
r	Perturbation in yaw rate from trim value in radians/sec
u	Perturbation in speed along axis in meters/sec
v	Perturbation in speed along axis in meters/sec
w	Perturbation in speed along axis in meters/sec
V	Velocity vector of the aircraft
x	State vector of of the linerized aircraft model
F	Total force vector
M	Total momentum vector
I	Total inertia
h	Height
ω	Propeller rpm
α	Angle of attack
α_T	Trim angle of attack
β	Slide slip
β_T	Trim slide slip
ϕ	Roll angle
ϕ_T	Trim roll angle
θ	Pitch angle
θ_T	Trim pitch angle
θ_d	Pitch demand
δ_a	Deflection of aileron
δ_{aT}	Trim deflection of aileron
δ_e	Deflection of elevator

δ_{aT}	Trim deflection of elevator
δ_r	Deflection of rudder
δ_{rT}	Trim deflection of rudder
α_n	Throttle value
δ_{nT}	Trim throttle value
ψ	Actual heading
ψ_d	Heading demand
ω_n	Natural frequency
ζ	Damping factor
{E}	Earth fixed reference frame
{A}	Airplane fixed reference frame
{B}	Body fixed reference frame