بسم الله الرحمن الرحيم

SUDAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF GRADUATE STUDIES

DESIGN OF AIRCRAFT LANDING CONTROL SYSTEM USING FUZZY LOGIC

تصميم نظام تحكم في هبوط الطائرة بإستخدام المنطق الغامض

A Thesis Submitted in Partial Fulfillment to the Requirements for the Degree of M.Sc. In Electrical Engineering (Control and Microprocessor)

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الآية

بسم الله الرحمن الرحيم

(أَوَلَمْ يَرَوْا إِلَى الطَّــيْرِ فَوْقَهُمْ صَــافَّاتٍ وَيَقْبِضْنَ مــَا يُمْسِكُهُنَّ إِلَّا الرَّحْــمَنُ إِنَّهُ بِكُلِّ شَيْءٍ بَصِيرٌ)

(سورة الملك الاية 19)

DEDICATION

To my father and mother

To my wife and my daughter (omnia)

And my sons (Abdelrohman and Arife)

To my brothers and sisters

To all my friends

ACKNOWLEDGMENT

Thankfulness firstly and lastly to GOD for his blessing for accomplishing this project in this form.

I would like to express my sincere appreciation to my supervisor for their countless support, Dr. Awadalla Taifor Ali.

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ABSTRACT

Since the Climate factors have strong negative effect on the process of landing, which makes crew needs a proper automatic landing system, to reduce the total landing cost by landing the aircraft at prescribed time.

This project presents an intelligent control scheme that use a fuzzy logic controller in automatic aircraft landing control that will make the automatic landing systems (ALS) more intelligent. A design methodology has been proposed based on conventional control and repeated using fuzzy logic.

The main goal of this research is to design a fuzzy logic controller to aid in landing the aircraft safely in all weather conditions. To examine the fuzzy controller performance, MATLAB fuzzy tool box is used.

مستخلص

بما ان العوامل المناخية تؤثر سلباً وبقوة في عملية الهبوط, مما يجعل الطاقم في حوجة الي نظام هبوط آلي فعال, لتقليل تكلفة الهبوط الاجمالية وذلك بهبوط الطائرة في زمن الهبوط المحدد.

هذا البحث يعرض فكرة التحكم الذكي في الهبوط الآلي للطائرات باستخدام متحكم المنطق الغامض لجعل النظام اكثر ذكاءاً. خطة التصميم المقترحة هي التصميم باستعمال التحكم التقليدي من ثم اعادته باستخدام المنطق الغامض.

الهدف الاساسي لهذا البحث هو تصميم متحكم غامض للمساعدة في هبوط الطائرة بأمان في جميع حالات الطقس. لإختبار أداء المتحكم الغامض تم استخدام صندوق ادوات المنطق الغامض في برنامج الماتلاب.

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CHAPTER THREE: CONTROL SYSTEM DESIGN

TABLE OF SYMBOLS:

θ	Pitch angle , Motor shaft angle.
θ_c	Pitch command angle.
T_m	Motor Torque.
K_m	Motor Gain.
I	Motor current.
B_m	Constant of reverse E.M.F
δ	Control surface deflection angle.
δ_e	Elevator angle deflection.
ζ	Damping ratio.
ω_n	Undamped natural frequency.
K_a	Elevator servo gain.
v	Input voltage.
τ_m	Motor time constant.
$\emptyset$	Bank angle or wing level attitude.
$\emptyset_c$	Bank angle command.
K_{rg}	Rate gyro gain.
h	Height of airplane.
Δh	Rate of climb.
$u_{\circ}$	Reference flight speed.
δ_r	Rudder angle.
q	Pitch rate.
A_q, B_q	Matrix of pitch rate.
M_α, M_q, M_δ	The parameters of constrained pitching angle.
Γ	The difference between the actual and desired glide path angle.

α	Angle of attack.
γ	Flight path angle.
D	Normal distance of the airplane above or below the desired glide path.
R	The radial distance of the airplane from the glide path.
K_P	Gain in proportional path.
K_D	Gain in derivative path.
K_I	Gain in integral path.
G_u	Fuzzy controller scaling gain.

List of ABBREVIATION:

FCS	Flight Control System
FIS	Fuzzy Inference System
GA	General Aviation
ILS	Instrument Landing System
PID	Proportional-Integral-Derivative