بسم الله الرحمن الرحيم

قال تعالى:

« وَقُلِ اعْمَلُوا فَسَيَرَى اللَّهُ عَمَلَكُمْ وَرَسُولُهُ وَالْمُؤْمِنُونَ وَسَتُرَدُّونَ إِلَى عَالِمِ الْغَيْبِ وَالشَّهَادَةِ فَيُنَبِّئُكُمْ بِمَا كُنْتُمْ تَعْمَلُونَ »

صدق الله العظيم

الاية ١٠٥ من سورة التوبة

Dedication

To those who helped me in my life,

and they are many,,,

I dedicate this effort...

Abdallah

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First of all, I deeply thank my advisor, Prof. **Saad Daoud Suleiman** whose help, advice and supervision was invaluable.

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مستخلص

ان النمـوذج الرياضـي مـن المفـاهيم الأساسـية فـي العلـم والتقنيـة، و النموذج الرياضـي هـو وصـف رياضـي للنظـام مـن خصائصـه الديناميكيـة. إن استنتاج النموذج الرياضي من البيانات التجريبية يعرف بمعرفة النظام.

بما أن ديناميكا الأنظمة الحقيقية متغيـرة مـع الزمـن و/أَو لاخطيـة فـي الطبيعـة، فـإن تصـميم المتحكـم ذو الضـبط الـذاتي ملائـم عنـدما تسـتخدم خوارزميـة معرفـة تكراريـة لمراقَبـة أَو تعقـب سـلوك العمليـةَ. مـدي متانـة وموثوقية الضبط الذاتي يعتمد كليا علـي متانـة وموثوقيـة خوارزميـة معرفـة النظام وقدرتها علي إكتشاف وتعقب التغييرات السريعة فـي أداء أو ديناميكـا النظام، وهذا هو السبب في استعراض وتقديم معرفة النظام في هذا البحث.

في هذا البحث تم استخدام محـرك تيـار مسـتمر كحالـة دراسـية، وتـم اشتقاق دالته التحويلية. تمت اعمال محاكاة وأعمال تجريبية للحالة الدراسية. لاستنتاج معاملات النظام المحاكي، تم عمـل برنامـج بواسـطة المـاتلاب. تـم توضيح مقارنة بين النظامين الأصلي والمستنتج من بيانات نظام المحاكاة.

لاستنتاج نموذج للنظام الحقيقـي، تـم اسـتخدام وحـدة تدريبيـة (XPO PID) بالاضافة لعدة برامج بواسطة الماتلاب وذلك لمعالجة البيانات واستنتاج معاملات النموذج. أيضا تمت المقارنة بيـن معـاملات النمـوذج المسـتنتج مـن البيانـات الحقيقيـة ومعـاملات البيانـات الحقيقيـة، وقـد كـان الإختلاف بينهمـا حوالي ١٦٪ ، هذا الاختلاف يرجع إلـى الـديناميكا الغيـر مـأخوذة فـي الاعتبـار،

الضوضاء العشوائية التي تؤثرعلى العملِ التجريبيِ، وأسـباب أخـرى نوقشـت في هذه الإطروحة.

ABSTRACT

A fundamental concept in science and technology is that of mathematical modeling. The mathematical model is a mathematical description of dynamic characteristics of a system. The determination of the mathematical model from experimental data is known as system identification.

Since the dynamics of real systems are time varying and/or nonlinear in nature, the self-tuning controller design is appropriate where a recursive identification algorithm is utilized to monitor or track the process behavior. The robustness of self tuning is totally dependent upon the robustness of the system identification algorithm and its ability to detect and track rapid changes in system performance or dynamics, that’s why the system identification is introduced in this research.

In this dissertation a DC servomotor system has been taken as a case study and its transfer function has been derived. Simulation work and experimental work have been done for the case study. In order to get the simulated system parameters, a program is developed under MATLAB

environment. The comparison between the two models is illustrated.

In order to get model parameters of the real system, a control trainer (XPO PID) kit is used, and m-file programs was developed to process the data and to estimate the model parameters. Also the comparison between the estimated model parameters of the real data and real data parameters is conducted, and the difference between them is about 16%, this difference referred to system un-modeled dynamics, stochastic noise affecting the experimental work, and other reasons which have been discussed in this dissertation.

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LIST OF SYMBOLS

e(t)	Zero-mean white noise
u(t)	Input signal
y(t)	Output signal
$\varphi(t)$	Regression variables vector
θ	Parameter vector
$\varepsilon(t)$	Residual error vector
$V(\theta)$	Loss function
$\hat{\theta}(t)$	Estimates parameters vector
θ_0	True parameters vector
$R_N(\theta)$	Sample covariance matrix
$P(t)$	Covariance matrix
$K(t)$	Weighting factor
λ	Forgetting factor
ω	Servomotor rotation speed
R_m	Armature resistance
L_m	Armature inductance

K_t	Torque constant or armature constant
K_b	Back EMF constant
B	Viscous friction coefficient
J	Rotor moment of inertia
E	Expectation operator
tr	trace (of a matrix)- summation of main matrix diagonal
$\delta_{t,s}$	Kronecker delta (= 1 if s = t, else = 0)

LIST OF ABBREVIATIONS

RBS	Random Binary Signal
PRBS	Pseudo-Random Binary Signals
AR	Auto Regressive
ARX	Auto Regressive with external input
ARMAX	Auto Regressive Moving Average with external input
BJ	Box Jenkins
OE	Output Error
LS	Least Squares
RLS	Recursive Least Squares
PEM	Prediction Error Method
ADC	Analog to Digital Converter
EMF	Electro-Magnetic Force
DC	Direct Current
PCB	Printed Circuit Board