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CODEN:LUTFD2/(TFRT-6014)/1-028/(1984)

MASTER THESES IN AUTOMATIC CONTROL 82/83

BJÖRN WITTENMARK

DEPARTMENT OF AUTOMATIC CONTROL LUND INSTITUTE OF TECHNOLOGY

JANUARY 1984

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MASTER THESES IN AUTOMATIC CONTROL 82/83

B. Wittenmark

Department of Automatic Control Lund Institute of Technology Lund, Sweden

<u>Abstract</u> The report contains abstracts of Master Theses (examensarbeten) made at the Department of Automatic Control, Lund, during the academic year 82/83. During this year 23 theses were made by 25 students. Most of the theses are written in Swedish with an English abstract.

1. INTRODUCTION

The education for civilingenjörsexamen (Master Degree in Engineering) is completed with an independent work, the Master Thesis (examensarbete). It should show the student's ability to attack and solve a larger problem. The time devoted to the thesis is about three month of full time work. The thesis can be made individually or by two students together.

This report is a collection of the document pages of the theses completed during the academic year 1982/1983. During this time 23 theses were finished by 25 students. The major part of the theses is made within the framework of the research program at the department. Some of the theses are made as feasibility studies or in cooperation with the industry or other departments at the university.

Further information concerning the results can be obtained from the Department of Automatic Control by contacting the advisor. The theses may be borrowed through your library service or from the following libraries in Sweden:

Linköpings Universitetsbibliotek Svensktrycket, S-581 83 Linköping, Sweden

UB 2, Svenska Tryckavdeln. Box 1010, S-221 03 Lund, Sweden

Stockholms Universitetsbibliotek Svenska Tryckavdeln., S-106 91 Stockholm, Sweden

Kungliga Biblioteket Box 5039, S-102 41 Stockholm, Sweden

Umeå Universitetsbibliotek Box 718, S-901 10 Umeå, Sweden Uppsala Universitetsbibliotek Box 510, S-751 20 Uppsala, Sweden

2. LIST OF THESES

- TFRT-5278 Henriksson J: PI-algoritmer vid digital reglering. (Digital algorithms for PI-control). Aug 1982.
- TFRT-5279 Fohlin G: Mätvärdesinsamling med mikrodator utförd på en margarinprocess. (Microcomputerbased data collection system for a margarin process). Aug 1982.
- TFRT-5280 Rignell M: Tre dimensionell datorgrafik och animering av industrirobot. (Three dimensionel computer graphics and animation of an industrial robot). Sept 1982.
- TFRT-5281 Jönsson H-A, Svensson K: Styrning av fiberutläggning. (Control of fiberdistribution in insulation material). Aug 1982.
- TFRT-5282 Andersson F, Lindh G: Självinställare baserade på gradientmetoder. (Self-tuning regulator based on gradient methods). Sept 1982.
- TFRT-5283 Palmgren M: En självinställande PID-regulator för system med variabel tidsfördröjning. (A self-tuning PID-regulator for systems with variable time delay). Sept 1982.
- TFRT-5284 Hansson L: Studier av syre-reglering i biologisk avloppsrening. (Studies of Dissolved Oxygen Control in Biological Wastewater Treatment). Sept 1982.
- TFRT-5285 Svensson P-E: Experiment med en linjär-kvadratisk självinställare. (Experiments with a linear-quadratic selftuner). Sept 1982.

- TFRT-5286 Lund M: Neutronflödesystem med SPN-detektorer. Kompensering för neutronaktiveringseffekter med datoriserad signalbehandling. (Neutron flux monitoring system based on SPN-detectors. Compensation for effects due to neutronactivation by computerized signal processing). Oct 1982.
- TFRT-5287 Andersson K: Uppbyggnad av en digital bildhantering i ett svepelektronmikroskop. (Subroutines for taking up and displaying pictures from a computer controlled scanningelectronmicroscope. Oct 1982.
- TFRT-5288 Kai Siew W: Methods for Automatic Tuning of PID Regulators. Dec 1982.
- TFRT-5289 Giver S: Modell och styrning av tvåmotorprocess med kopplade likströmsmotorer. (Model and control of process with coupled DC-motors). Sept 1983.
- TFRT-5290 Delacour O: Elektroniska bromssystem en lämplighetstest. (Electronic airbrake systems - A feasibility study). Febr 1983.
- TFRT-5291 Möllerström A: Referat av handbok för TA 6500 mikrodatorbaserad reglerenhet. Undersökning av några olika inställningsregler för PI-regulatorer. (Handbook for TA 6500 microprocessor control unit and ivestigation of some tuning rules for PI-controllers). March 1983.
- TFRT-5292 Nilsson K: Analys och syntes av en industrirobots dynamik. (Analysis and syntesis of the dynamics of an industrial robot). March 1983.
- TFRT-5293 Hansson L G: En självinställande regulator för frekvensreglering av kraftsystem med högspänd likström. (A self-tuning regulator for frequency control of power systems with high voltage direct current). March 1983.

- TFRT-5294 Tocaj R: Ellipsoidmetoden: Khachijans Algoritm för linjär programmering. (The Ellipsoid method: Khachijans algorithm for linear programming). April 1983.
- TFRT-5295 Rasmusson U: Simulering av dynamiken i en kokarreaktor. (Simulation of boiling water reactor dynamics). April 1983.
- TFRT-5296 Persson P: Simulering och feldetektering i ett ventilservo för tryckreglering av en kokarreaktor. (Simulation and faul-detection of a pressure control servosystem in a Boiling Water Reactor). April 1983.
- TFRT-5297 Salmi M: Temperaturreglering av torkprocess med digital regulator. (Temperature control of dryingprocess with a digital controller). May 1983.
- TFRT-5298 Olsson J: Reglerad peroxidmiljö i en mikrobiell process. (Controlled peroxidlevel in a microbial process). May 1983.
- TFRT-5299 Wingertz B: Practical Aspects on Self Tuning Regulators. May 1983.
- TFRT-5300 Falkvall K: LQG-regulator för flygplan. (LQG-controller for an aircraft). June 1983.

3. LIST OF SUBJECTS

Thesis
5882, 5283, 5285, 5288, 5293, 5299
5281, 5289, 5290, 5295, 5296, 5300
5284, 5298
5280, 5292
5279, 5286
5278, 5291, 5297
5292, 5295, 5296
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5280, 5292

4. DOCUMENT PAGES

The following pages contain the document pages of the theses. Most of the theses are written in Swedish with only an abstract in Enlish.

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	Document name Report
DEPARTMENT OF AUTOMATIC CONTROL	Date of issue
Box 725	August 1982
S 220 07 Lund 7 Sweden	Document number
	CODEN: LUTFD2/(TFRT-5278)/1-057/(1982
Author(s)	Supervisor
T	D Renborg, J Ancker, B Wittenmark
Jan Henriksson	sponsoring organization
lifle and subfifle	
Digital algorithms for PI-control	ð
(PI-algoritmer vid digital reglering)	
Abstract	
In this report a theoretical and an experi	imental investigation is made of differ
twoon of DI-placerithms in disital control	Four different more to translate
cypes of it argorithms in digital control,	, rour utitetent ways to translate
transfer functions from the Laplace- and t	to the 2-transform are investigated.
Six different programs for PI-controllers	are presented, and are tested with
different sample times and constants The	comparison is made for different types
	comparison is made for different types
or transfer functions. Setting time, overs	shoots, static errors and "reset windup
are compared.	
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	Document name Report
DEPARTMENT OF AUTOMATIC CONTROL	Date of issue
Box 725	August 1982
S 220 07 Lund 7 Sweden	Document number
Author(s)	LUTFD2/(TFRT-5279)/1-087/(1982)
	Lars Pernebo, Biörn Wittenmark
Gerth Fohlin	Sponsoring organization
Title and subtitle	
Microcomputerbased data collection system	n for a margarine process
(Mätvärdesinsamling med mikrodator utförd	d på en margarinprocess)
Abstract	
Following report describes a computerized	d measuringsystem based on the swedish
micro-computer ARC 80 The system use ch	le to handle up to 30 measuring channels
micro-computer Abt out the system was ab.	te co nanute up co so measuring channels.
Received measuring data was stored on a d	ilscett. The control of the system was
carried out by a program in the computer	. For analysis of the result, a few
program was developed.	
The system was applicated on a margariner	naking process and found out to have the
desirable function.	· -
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S 220 07 Lund 7 Sweden	LUTFD2/(TFRT-5280)/1-067/(1982)
Author(s)	Supervisor Hilding Elmovist
Mikael Rignell	Sponsoring organization
Title and subtitle	
Three dimensionel computer graphics and	animation of an industrial robot
fre dimensionell datorgrafik och animeri	ng av industrirobot.)
ADSTRUCT	8
A three dimensionel graphics package has	been developed. It encludes scan
conversion of polyqous, hidden surface r	emoval, shading and transformation of
coordinate systems. It has been used for	animation of an industrial robot.
The movement of the robot is specified i	n a cartesian coordinate system
using jousticks.	-
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Computer graphics, robotics	
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LUND INSTITUTE OF TECHNOLOGY	Report
	Date of issue
Box 725	August 1982
S 220 07 Lund 7 Sweden	Document number CODEN:LUTFD2/(TFRT-5281)/1-078/(1982)
Author(s)	Supervisor Bášar Mittonmank
Here She Iwnson	Sponsoriog organization
Hans-Ake Jonsson	sponsoring organization
Kjell Svensson	
Title and subtitle	
Control of variation in density of a fibe	erglasscarpet.
(Styrning av fiberutläggning)	8
ADSTRUCT	
The subject of this master thesis was ori	iginally proposed by the fiberglasscompany
Cullfibor in Billocholm The surrous of t	the accimment was to find methods to
Guilliber in billesnorm, the purpose of t	che assignment was co iina methous co
decrease and control the variation in der	nsity of a fiberglass insulating carpet.
After a brief description of the process	and the conditions for the further work
	-leafer the second second second second
we then compute the ideal frequency in re	elationship to the velocity of the
receiving line. We then explain the measure	urements done to confirm the theory.
With frequencyanalysis we can show that t	the wig-wag frequency is not very strong
with frequencyanarysis we can show that I	ene wig wag includincy is not very serong
as distinct as frequencies of densityvar:	iation. Instead the variation is more
IF Therefor we found a more probable can	
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Box 725	Document number
S 220 07 Lund 7 Sweden	CODEN:LUTFD2/(TFRT-5282)/1-052/(1982)
Author(s)	Björn Wittenmark
Fred Andersson	Sponsoring organization
Goran Lindn	
Title and subtitle	
Self-tuners based on gradient methods	201
(Självinställare baserade på gradientmet	oder)
Abstract	
The report presents a scheme for self-tu	ning regulators based on gradient methods.
ine report presents a scheme for serie to	
The feasibility of the scheme is studied	in some special cases, the scheme is used
together with different estimation techn	iques such as extended least squares (ELS)
method and indirect estimation using a c	ne to one correspondance with the regulato
parameters.	
The method is illustrated using simulati	ons of two different processes.
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DEPARTMENT OF AUTOMATIC CONTROL	Date of issue
Box 725	September 1982
S 220 07 Lund 7 Sweden	Document number
	CODEN:LUTFD2/(TFRT-5283)/1-058/(1982)
Author(s)	Supervisor
Martin Palmoren	Björn Wittenmark
	Sponsoring organization
	5 A A A A A A A A A A A A A A A A A A A
Title and subtitle	
A Selftuning PID-Controller For Systems	with Timevarying Timedelay
(En siälvinställande Pid-regulator för	system med variabel tidsfördröining)
	System med variabel slastorarojning,
Abstract	
A selftuning PID-controller is investig	ated. It is assumed that the processorder
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in serieuring rib concretier is investigated, it is assumed that the processorier
is two. A pole-placement-algorithm is used to get the desired closed loop poles.
Two methods is studied for the calculation of the controlparameters. The first
method is based on solving a system of equations. The second method makes a
two-steps-estimation of the controlparameters. The only à-priori knowledge of the
process needed is, except the order, the maximum timedelay.
The two methods are compared using simulated systems. It is shown that the
discussed controller can adapt to changes in the timedelay.

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S 220 07 Lund 7 Sundar	Document number	
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Author(s)	Supervisor	
	Gustaf Olsson	
Lennart Hansson	Sponsoring organization	
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studies of Dissolved oxygen control in bi	lological wastewater ife	atment
(Studier av syre-reglering i biologisk av	loppsrening)	
Abstract		
In this report, the dynamics of an aertor Two control strategies for the dissolved	of an activated sludge oxygen concentration an	e process is studied ce tested. One con-
ains either a PI-controller or a on-off croller.	controller, the other a	a self-tuning con-
There are two key-parameters in the syste	em, K _L a, the total oxyge	en transfer rate, a
OUR, the oxygen uptake rate of the micros	reanisms in the aerator	. The narameters
are difficult to obtain from direct mesur	cements. An estimator is	derived. The
estimates will be calculated from the pro	cess output, DO-concent	ration, and from t
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The estimator is also part of a colf-turi	ng controllor Horo +1	o controllor comba
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the simulations show, that the estimates	contain a bias, if the	estimation of the
the simulations show, that the estimates two parameters are done at the same time.	contain a bias, if the Different methods are	estimation of the tested to avoid
the simulations show, that the estimates two parameters are done at the same time. this problem. Even if bies cannot be avoi tuning controller because the total estim	contain a bias, if the Different methods are ded, the estimator can	estimation of the tested to avoid be used in a self-
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	Björn Wittenmark
Per-Erik Svensson	Sponsoring organization
The and subtitle	
Experiment med en linjar-kvadratisk sjalv	/installare
(Experiments with a linear-quadratic self	Etuner)
Abstract	
This report describes a program for a lin	pear-quadratic selftuner. It also include
into report deberibeb a program for a fin	qualities officiates it also include
results from experiments with the regulat	or. In the experiments different
managed has been similated as as and	computor An important requilt from
processes has been simulated on an analog	3 computer. An important result from
the experiments is that if an antialiasfi	llter is used when regulating a process.
the dynamics of the the filter must be in	ncluded in the processmodel. It is also
necessary to take into account the time-d	lelay in the regulator when using short
necessary to take theo account the time-o	ieray in the regulator when using short
samlingperiods.	
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Michael Lundh	Sponsoring organization			
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NEUTRONFLÖDESMÄTSYSTEM MED SPN-DETEKTORE ter med datoriserad signalbehandling. (N DETECTORS. Compensation for effects due Abstract	R. Kompensering för neutronaktiveringseff EUTRON FLUX MONITORING SYSTEM BASED ON SP to neutronactivation by computerized sign / process			
A grater for poutronflux monitoring is u	nder development. It is based on Self-pow			
neutrondetectors with cobaltemitter. The	characteristic of this type of detector			
abange due to irradiation and must be	compensated for. A model based on the two			
change, que co infactación, and must be	ront has been developed. One component is			
domination components in the detectorcur	the mastifue of the isotope 59 is the			
proportional to thermal neutronflux and	the quantity of the isotope to in the			
emitter. The other is a not wanted backg	round current caused by the beta-decaying			
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Author(s)	Supervisor
	Björn Wittenmark
Kaj Andersson	Sponsoring organization
Title and subtitle	
Uppbyggnad av en digital bilhantering i e	tt svepelektronmikroskop. (Subroutines

for taking up and displaying pictures from a computer controlled scanningelectronmicroscope (SEM)). Abstract

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DOKUMENTO ATABLAD

The programs are made to decide testingpoints in an integrated circuit. The measurements on the IC are performed in a SEM using digital electronbeamdeflection and digital secondary-electrondetection. A PDP11/23 computer and a QRGB-256 video-interface are used. Programs are written in MACRO-assembler and FORTRAN. Pictures may be taken up and stored on a massstorage (floppy-disk) for later retrieval. The picture image may be changed (color and displayingarea). Co-ordinates in the displayed pictures may be estimated with a joystickmovable cross. Also the picturearea may be moved with the joystick.

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	Tore Hägglun	d	
- AR	Sponsoring organiza	tion	
Kai Siew.Wong			
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Title and subtitle			
Methods for automatic tuning of PI) regulators		18.1
Abstract			
A self-tuning PID-regulator has been int	estigated. The des	ion method is	based on t
very well-known and simple Ziegler-Nicho	ls self oscillati	on method. By	introducing
the describing function technique and ha	connecting a rel	av in the clo	and loop
evetem an oscillation is obtained subar	tionlly The to set	icod that thi	a casilist
system, an oscillation is obtained automa	ituda of the mole	nceu that thi	s osciitati
whose amplitude is depending on the ampli-	include of the rela	the 7tester N	le lichole 1 (
characteristics as the one, which is obtained in a set of the set	ined manually by	ine Liegier-N	ilchois seli
uscillation method, i.e. only proportional	. regulator is use	a and the osc	LILATION 18
then obtained by increasing the gain gra	dually.Two method	is, namely the	peaks and
zero-crossings method and the recursive	least squares met	hod, are propo	sed for
estimating the amplitude and the frequar	ncy of the oscilla	ition,in order	to determi
the critical gain and the ultimate period	d The cottings of	the DTD see	lator are t
	Maine serrings of	: the PiD-regu	ITALVI ALE I
determined according to the tuning rules	The investigatio	ons have carri	ed out fire
determined according to the tuning rules without any disturbance with four proces	The investigations of the second	ns have carri ons one of the f	ed out first our process
determined according to the tuning rules without any disturbance with four proces with measurement noise and load disturba	The investigations of the second seco	ons have carri ons one of the f yels of the me	ed out firs
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LUND INSTITUTE OF TECHNOLOGY DEPARTMENT OF AUTOMATIC CONTROL Box 725	Document name Report Date of issue September 83 Document number CODEN:LUTFD/(TFRT-5289)/(1-051)/(1983)		
S 220 07 Lund 7 Sweden			
Author(s)	Supervisor Björn Wittenmark		
Sören Giver	Sponsoring organization		
Title and subtitle			
Modell och styrning av tvåmotorprocess med kopplade likströmsmotorer.			
(Model and control of process with coupled DC-motors.)			
Alstract			

The goal of this work is to build a dynamic model for a scalemodel of a process with coupled drives, using frequency and step-response analysis and to construct a regulator for this model. The scalemodel, constructed by the English company Tecquipment, is primarily intended for laboratory use by students.

The main problem is to reduce the interaction between the dynamics of the tension and the dynamics of the speed in the material which is transported between the DC-motors. This is solved by introducing a decoupling device in the regulator which makes it possible to control speed and tension with two independent control signals.

A model based on physical laws has been constructed and simulations have shown satisfactory resemblances to the real system.

Key words

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DEPARTMENT OF AUTOMATIC CONTROL Box 725	Date of issue February 1983			
S 220 07 Lund 7 Sweden	Document number CODEN:LUTFD2/(TFRT-5290)/0-081/(1983)			
Author(s)	Supervisor G.Olsson, LTH,			
Olivier Delacour	S. Stomrud, SAB och K.Edvardsson, SAB			
Title and subtitle Electronic Airbrake Systems - A Feasibility study. Elektroniska bromssystem - en lämplighetstost				
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Title and subtitle Electronic Airbrake Systems - A Feasib Elektroniska bromssystem - en lämpligh Abstract During recent years, the application o grown tremendously. Increased environm economy, comfort and safety have creat	ility study. etstest f electronic devices to road vehicles has ental concern and requirements on fuel ed a need for compact and advanced micro-			

A vehicle is a problematic environment for electronic devices due to dust, damp, vibrations, noise and glitsches.

This report first gives an overview of electronic applications on road vehicles and concentrates later on truck and bus airbrake systems. Dynamic problems like delay, wheel lockning and load compensation are discussed.

A model of a feed back brake system that compensates for some of the delay and that can be combined with a load compensating and anti-skid system is derived and simulated.

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S 220 07 Lund 7 Sweden	Document number CODEN:LUTFD2/(TFRT-5291)/0-040/(1983)	
Author(s)	Supervisor Björn Wittenmark	
Anders Möllerström	Sponsoring organization	

Title and subtitle

Handbook for TA 6500 microprocessor control unit and ivestigation of some tuning rules for PI-controllers.

Abstract

This work contains two independent parts.

The first part is mainly a report on a documentation of a microprocessed control device called TA 6500, manufactured by Tour & Anderson AB.

The other part contains a documentation of an investigation concerning different adjustment rules for PI-controllers.

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S 220 07 Lund 7 Sweden			
	CODEN:LUTFD2/(TFRT-5292)/0-079/(1983)		
Author(s)	Supervisor		
	Björn Wittenmark		
Klas Nilsson	Sponsoring organization		
4			
Title and subtitle f			
Analysis and syntesis of the dynamics of an industrial robot (Analys och syntes			
av en Industrirobots dynamik)			
Abstract			
Encourage analysis of the machanical part of an ASEA industrial robot is nonformed			

Frequency analysis of the mechanical part of an ASEA industrial robot is performed. For the axis that limits the performance, the poles and zeros are calculated by means of curve fitting. An approach is made to design a speed regulator using polynomial synthesis. Due to the very high sensitivity of modelling errors the conclusion is that it is uncertain if the required rize time of 15-20 ms can be reached by using theorys for sampled systems.

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DEPARTMENT OF AUTOMATIC CONTROL	Date of issue March 1983
S 220 07 Lund 7 Sweden	Document number CODEN 11 JITED 2 / (TERT - 5293) /0-138 / (1983)
Author(s)	Supervisor Bičken Wittenmank
Leif-Göran Hansson	Sponsoring organization
Title and subtitle	
En självinställande regulator för frekve likström. (A self-tuning regulator for f high voltage direct current.)	nsreglering av kraftsystem med högspänd requency control of power systems with
Abstract	entrol of nouse quaters by UNDC
A seri-curring concrotter for frequency c	ontrol of power systems by HVDC.
One of the advantages of High Voltage Di control the powerflow between different is being used when disturbances in the f eliminated. Simulation studies on a phys transmission" has been done. Also a mode connected power-areas is simulated on an	rect Current, HVDC, is the possibility to parts of an A.C. network. This property rewuency, caused by load variations, is ically scaled model of the "Gotland- l of frequency oscillations between two analog computer.
The controller is based on the criterion deviation combined with the recursive me	to minimize the variance of the frequency thod of least squares.
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LUND INSTITUTE OF TECHNOLOGY DEPARTMENT OF AUTOMATIC CONTROL Box 725 S 220 07 Lund 7 Sweden	Document name Report Date of issue April 1983 Document number CODEN: LUTED2/(TERT-5294)/0-061/(1983)
Author(s)	Supervisor
Ronny Tocaj	Sponsoring organization
Title and subtitle Ellipsoidmetoden: Khachijans Algoritm fö	r Liniär Programmering.
(The Ellipsoid method:Khachijans Algorith	m for Linear Programming)
Abstract	
This thesis treats the ellipsoid method	for linear programming. The method is
described both from a theoretical and a	practical point of view. A subroutine,
LPEM, which solves LP-problems with the	ellipsoid method, is presented and
described. LPEM is written in Pascal. Fi	nally some computational results from
running LPEM on two testexampels, Klee-M	inty's problem and the double integrator
controlled by the LP-regulator, are pres	ented and discussed.
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Key words The ellipsoid method, Khachihan's algorithm, Linear programming.

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S 220 07 Lund 7 Sweden	Document number CODEN:LUTFD2/(TFRT-5295)/1-44/(1983)
Author(s)	Supervisor Sten Bergman
Ulf Rasmusson	Sponsoring organization

Title and subtitle

(Simulering av dynamiken i en kokarreaktor.) Simulation of Boiling Water Reactor dynamics.

Abstract

This master thesis describes a mathematical model of a boiling water reactor and address the dynamic behaviour of the neutron kinetics, boilding dynamics and pressure stability.

The simulations have been done using the SIMNON-program.

The meaning were that the result from this work possibly would be adjust to supervision methods suitable for application in computer systems.

This master thesis in automatic control has been done at the Department of Automatic Control, Lund Institute of Technology. The initiative to the work came from Sydkraft AB. At the realization of the work, civ.ing. Sten Bergman, Sydkraft AB has been the instructor.

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AUTHOR(S)	Supervisor Sten Bergman
Por Porsson	Sponsoring organization
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Title and subtitle	
(Simulering och feldetektering i ett v kokarreaktor.) Simulation and fault-d in a Boiling Water Reactor.	entilservo för tryckreglering av en letection of a pressure control servosystem
Abstract	
This master thesis describes a Simnon	model of a boiling water reactor to be use
in simulating faults and disturbances	. These faults and disturbances will be
detected by noise analysis. Some math	ada in identification 1
also describe la la statistica some metro	ous in identification and noise analysis ar
also described and are applied on some	e malfunctions of a servo. A Pascal program
for recursive parameter identification	n was also written and testcd. This program
is to be used in an expert system for	noise analysis on the nuclear power plant
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DEN:LUTFD2/(TFRT-5297)/1-54/(1983)
ervisor rl Mannerfeldt, Matz Lenells
nsoring organization

Temperature Control of Dryingprocess with a Digital Controller. (Temperaturreglering av torkprocess med digital regulator.)

Abstract

In this report, the dynamics of a drying drum in a fertilizer industry have been studied, and a digital temperature controller have been designed.

A number of step responses were measured, to get an idea on how the process worked. From the step responses the conclusion were drawn that a cascads-controller, feedbacked from both the temperature into and out from the drying drum, would control the temperature sufficiently. To find the best parameter values two different strategies were used: the first one is to optimize the step response of the temperature and the other one is to simulate a physical model of the drying drum with a simulation-program.

For both the strategies a sampling-interval of one minute were used. The program was implemented in the computer and the controller were tested on the real process. The parameter values were adjusted and the final result was: K = 0.3, $K = 31 1/{}^{\circ}C$, $T_{i} = 8.5$ minutes.

Although the simulation were made with a rough physical model, its parameter values were much closer to the final ones than the values from the optimization, This shows that one can get good results even with a simple model. However, it is not always that easy to put up a physical model.

In the last chapter the control system has been examined. The meaning is to show how a working system in industry can look like, and to show how the actual control design is put into the computer.

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LUND INSTITUTE OF TECHNOLOGY DEPARTMENT OF AUTOMATIC CONTROL Box 725 S 220 07 Lund 7 Sweden Author(s)	Document name Report Date of issue May 1983 Document number CODEN:LUTFD2/(TFRT-5298)/1-073/(1983) Supervisor Per Hagander Olle Holet
Jonny Olsson	Sponsoring organization
Title and subtitle	1
Controlled peroxidelevel in a microbial p	rocess.
(Reglerad peroxidmiljö i en mikrobiell pr	ocess.)
Consumption of oxygen in microbial proces	ses is often rapid and in dense cultures
the supply of oxygen might be limiting. C	onventional aeration, e.g. agitation, is
not possible when using immobilized cells	due to the low mechanical stability of
the preperations. The acetic acid bacteria	a <u>Gluconobacter</u> oxydans catalyses the
conversion of glycerol to dihydroxyaceton	e and the decomposition of hydrogen
eroxide to oxygen. Oxygen is necessary fo	or the first conversion and consequently
ydrogen peroxide might be used as an oxyg	cen source in a process for production of

dihydroxyacetone.

However, hydrogen peroxide is toxic to microorganisms and thus a controller addition based on measured peroxide-concentration is necessary. A PI-controller and a controller using a Kalman filter are tested on the process. Reaction rate and viability tests gives information about the cell functions. Two different processes have been investigated, one utilizing immobilized cells and one system with membrane reactors.

Key words

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Microbial process, Gluconobacter oxydans, Dihydroxyacetone, Hydrogen peroxide, PI-controller, Kalman filer, Immobilized cells. Classification system and/or index terms (if any)

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S 220 07 Lund 7 Sweden	Document number CODEN:LUTFD2/(TFRT-5299)/0-031/(1983)	
Author(s)	Supervisor Karl Johan Setröm	
Bo Wingertz	Sponsoring arganization	
DO WINGCI (Z		
Title and subtitle	1	
"Practical Aspects on Self Tuni	ng Regulators"	
(Praktiska aspekter på sjävinställand	de regulatorer)	
Abstract		
Self Tuning Regulators are rega of view. Different problems and the problems are discussed base tory experiments.	arded from a practical point d some of the solutions to ed on experiences from labora-	
Praktiska aspekter på självinst Olika problem och en del försla	ällande regulatorer behandlas. Ig till lösningar av dem dis-	
kuteras med utgångspunkt från f	örsök med en labprocess.	
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Author(s)	Supervisor Joe Wall, Günter Stein, Björn Wittenmark.	
Klas Falkvall	Sponsoring organization	
Title and subtitle		

LQG-controller for an aircraft (LQG-regulator för flygplan)

Abstract

A method of design for multivariable systems is presented. It is used in an application design of a controller for an advanced aircraft. The main designcriteria, singular values plot, is discussed in detail. A must for the use of the method is that computer assistance is available. Two different interactive program packages allowing LQG-design are presented and somewhat compared.

Key words

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