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## Master's Theses in Automatic Control 1980-1981

Pernebo, Lars

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LUND UNIVERSITY

**PO Box 117** 221 00 Lund +46 46-222 00 00 CODEN: LUTFD2/(TFRT-6012)/1-19/(1981)

MASTER THESES IN AUTOMATIC CONTROL 1980/81

LARS PERNEBO

DEPARTMENT OF AUTOMATIC CONTROL Lund Institute of Technology November 1981

LUND INSTITUTE OF TECHNOLOGY	MS theses report Date of issue		
JEPARTMENT OF AUTUMATIL LUNIKUL Box 725			
S 220 07 Lund 7 Sweden			
Author(s)	CODEN: LUTFD2/(TFRT-6)	<u>)12)/1-19/</u>	/(19
Lars Pernebo	Sponsoring organization		
Title and subtitle			_
Master theses in Automatic Cont	rol 1980/81		
Abstract			
The report contains abstracts of	of master theses (examensar	bete)	
made at the department of Autom	natic Control. Lund. during	the	
acadomic year 1070/80 During t	his year 12 theses were ma	de by	2
academic year 1979/00. During t	this year is cheses were ma		
15 students. The theses are wri	ltten in Swedish with an En	grisu	
abstract.			
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Key words Classification system and/or index terms (if any)			1
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DOKUMENTDATABLAD RT 3/81

## 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 months of full time work. The thesis can be done individually or by two students together.

This report is a collection of the document pages of the theses completed during the academic year 1980/1981. During this time 12 theses were finished by 15 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 made in cooperation with the industry or other departments.

Further information concerning the results can be obtained from the Department of Automatic Control by contacting the advisor. The theses are available at the University Library in Lund (Address: University Library 2, Box 1010, S-221:03 LUND, Sweden).

- TFRT-5236 <u>INGVAR BÄCKESTRAND</u>: Extremalsökande regulatorer (Extremal seaking regulators). August 1980.
- TFRT-5237 CHARLOTTE STALIN: Elektrohydrauliskt Bromssystem (Electro-hydraulic breaking system) August 1980.
- TFRT-5238 <u>LENNART MÅNSSON</u>: CONDIS En vidareutveckling av simuleringspaketet Combinedsimulation (CONDIS – A development of the simulation package COMBINEDSIMULATION) April 1980.
- TFRT-5239 SVEN LIDEMYR: MÄTGIVAREDYNAMIK. Modellering, simulering och experimentell validering av systemdynamik för ett kopplat nivåmätsystem i en BWR anläggning (Transmitter Dynamics. Modelling, simulation and experimental verification of system dynamics for a coupled level measuring system in a BWR plant) September 1980.
- TFRT-5240 <u>ANDERS HELLAEUS</u>: Experiment med självinställande PID-regulator (Experiment with self-tuning PID-controller) August 1980.
- TFRT-5241 <u>ANDERS FREIJ, SÖREN ROMARE</u>: Fartygsstyrning vid sjögång (Automatic steering of ships in heavy seas) October 1980.
- TFRT-5242 JAN SWIETLICKI, ANDERS WALLENBERG: Analys av insulinglukos dynamik (Analysis of insulin-glucose dynamics) December 1980.

- 4 -

- TFRT-5243 <u>GÖRAN OLESKOG</u>: Cellcykelsimulering (Cell cycle simulation) March 1981.
- TFRT-5244 <u>BENGT LEVIN</u>: Eliminering av störningar vid försegling med ultraljud (Elimination of disturbances at sealing with ultrasound) March 1981.

- 5 -

- TFRT-5245 <u>ANDERS HELMERSSON</u>: Dual reglering En optimal dual regulator för en integrator med konstant men okänd förstärkning (Dual control - An optimal dual regulator for an integrator plant with constant but unknown gain) March 1981.
- TFRT-5246 <u>HENRIETTE WEIBULL</u>: Some Programs for Frequency Analysis in IDPAC April 1981.
- TFRT-5247 JAN-ÅKE MÅNSSON, STEN-ÅKE BERGMAN: Simulering av fjärrvärmenät (Simulation of a district heating system) April 1981.

# 3. LIST OF SUBJECTS

# Subject

Modelling and simulation	5237,	5239,	5247	
Adaptive control	5236,	5240,	5241,	5245
Biological systems	5242,	5243		
Computer programs	5238,	5246		
Analysis and synthesis	5244			

Thesis

## 4. DOCUMENT PAGES

The following pages contain the document pages of the theses. All theses, except one, are written in Swedish with an abstract in English. One (TFRT-5246) is written in English.

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Organization	Document name	
Department of Automatic Control	Date of issue	
P 0 Box 725	August 1960	
S-220 07 LUND 7, Sweden	CODEN: LUTFD2/(TFRT-5	5236)/1-044/(1980)
Author(s) Ingvar Bäckestrand	Sponsoring organization	
	ania 11	
Title and subtitle		
Extremalsökande regulatorer (Extremal seaking regulators)		
	A4	A5
Abstract Three discrete time algorithms for extrem	um control are tested a	a simulated anatoma
The model contains a linear dynamic part	of at most accord arder	n simulated systems.
and and contains a finear dynamic part	the measure late t	with a static
quadratic nonlinearity attached to obtain	the measured output.	he ability to
include and stay at the extremum point wit	n and without process o	ilsturbances 1s
investigated. Slow control is gained by t	he perturbation and ste	epping methods.
A slight modification of the stepping met	hod shows great similar	rities with a
simple form of the <u>self-driving method</u> an	d these also give faste	er control. Methods
to get insensitivity to disturbances are	also suggested and test	ed on the different
algorithms. This has not changed the rela	tive behaviour of the m	nethods.
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9 <sup>12</sup>		Swedish
ISSN and key title		ISBN
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Organization LUND INSTITUTE OF TECHNOLOGY	Document name MASTER THESIS		
Department of Automatic Control P O Box 725	Date of issue AUGUST, 1980		
S-220 07 LUND 7, Sweden	CODEN:LUTFD2/(TFRT-5237)/1-170/(1980)		
Author(s)	Sponsoring organization		
Charlotte Stalin	t es.m		
Title and subtitle			
Elektrohydrauliskt bromssystem (Electro-hydraulic breaking system)			
Abstract	A4	A5	
SAB Industry AB is today working on the d brake systems. With respect to the applic other types of systems.	levelopment of electro-hydraulic cation time they are superior to		
The aim of this work was to calculate and for a system of this type.	l simulate the transfer-fuction		
While the system was non-linear it was no function. In Simnon (the programming pack to simulate non-linear systems, and model systems has been built.	ot possible to put up any transfer age used) it is however possible s with dynamics similar to the real	1	
The application for this sort of model-bu construction. In this way it is possible expensive prototypes, and both money and	uilding is in the early stage of to test ideas without building time can be saved.		
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LUND INSTITUTE OF TECHNOLOGY	MASTER THEIS
Department of Automatic Control	Date of issue
$P \cup Box / 25$ S=220 07 LUND 7 Sweden	APRIL 1980
5 220 07 Lond 7, Sweden	CODEN: LUTFD2/(TFRT-5238)/1-119/(1980)
Author(s)	Sponsoring organization
Lennart Mansson	
CONDIS - En vidareutveckling av simulerin	gspaketet Combinedsimulation
(CONDIS - A development of the simulation	package Combinedsimulation)
Abstract	A3
Extensions of the simulation package Comb Combinedsimulation is suited for simulati equations in combination with events.	inedsimulation is given in the report. on of differential and difference
There are two main extensions done in Con corrector method is used for the integrat a run is done by changing the error and e	dis. First a fourth order predictor ion. Secondly, new ways to continue xit handling.
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Key words	A4 A5
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ISSN and key title	ISBN
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Organization LUND INSTITUTE OF TECHNOLOGY	Document name Master thesis	
Department of Automatic Control Box 725	Date of issue September 1980	
S-220 07 LUND 7 SWEDEN	CODEN: LUTFD2/(TFRT-5239)/1-077/(1980)	
Author(s) Sven Lidemyr	Supervisor: Sten Bergman	
Title and subtitle Mätgivardynamik (Transmitter Dynamics. Modelling, simulation and experimental verification of system dynamics for a coupled level measuring system in a BWR plant)		
Abstract	A3 A5	
In this thesis a modelling of a parallel	level measuring system is done. The	
system consists of relatively long water	tubog at called involve the	
two contra of process liss	cubes, so carred impulse tubes, and	
two solls of pressure difference transmit	ters. The nonlinear model is studied	
by means of simulation. Since the models	of the pressure difference transmitters	
have a great influence on the model of the	e level measuring system, an adaptation	
of these models has been carried out with	experiments and simulations	
	superimentes and simulations.	
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Department of Automatic Control	MASTER THESIS	
Box 725	August 1980	
S-220 07 LUND 7		
Sweden	CODEN: LUTFD2/(TFRT-	5240)/1-027/(1980)
Author(s)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	pervisor:
Anders Hellaeus	Björn Wittenmark	2) 2)
Title and subtitle		
Experiment med självinställande PID-regu	lator	
(Experiment with self-tuning PID-control)	ler)	
	A4	A5
Abstract		
An algorithm, Slupid, for a self-tuning l	PlD-controller based or	i pole-
The algorithm has been implemented on an	IST-11	control.
	DOT II.	
This master thesis considers tests of ST	JPID on an analog compu	iter, an
electric servo and a level control system	n. Comparisons between	STUPID
and a traditional PID-controller on the p	processes above have be	en done.
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Organization	Document name	
LUND INSTITUTE OF TECHNOLOGY	Date of issue	
Box 725	October 1980	
S-220 07 Lund 7 Sweden	CODEN: LUTED 2/(TRDT	52/12/1 00/(1000)
	CODER: LUIFD2/(IFRI-	-5241)/1-80/(1980)
Author(s) Andors Fraii	Company K I & atu	cöm
Sören Romare	Supervisor: K J Ast	
Title and subtitle	J	
Fartygsstyrning vid sjögång (Automatic et	corring of ching in her	
allygsseyrning vid sjögang (Automatic st	eering of ships in nea	vy seas)
	A4	A5
Abstract		
This namer deals with automatic stoor		
into paper deals with automatic steeri	ing of ships under th	e
influence of disturbance from waves. I	he disturbance has b	een of
two different types, a sinusoidal wave	and a disturbance i	n the
yaw rate. We have used both convention	al state feedback re	gulators
and adaptive regulators based on locat	coupro cotimotion	
	square estimation a:	na
minimum variance control. In particula	r, we have investiga	ted the
behavior of the adaptive regulator in	quarterly seas. Diff	erent
ways to improve the performance of the	regulators have been	n
tested. Additional proposals for impro	uments which are not	
totod have also have at	vments which are not	yet
tested, have also been given.		
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Organization	Document name
LUND INSTITUTE OF TECHNOLOGY	Masters thesis
Department of Automatic Control Box 725	Date of issue December 1980
S-220 07 Lund 7 SWEDEN	CODEN: LUTFD2/(TFRT-5242)/1-32/(1980)
Author(s) Jan Swietlicki Anders Wallenborg	Supervisor: Per Hagander
Title and subtitle	
Analys av insulin-glukos dynamik (Analy	vsis of insulin-glucose dynamics)
Abstract	A4
The structure and usage of PAGIC 80, a plasma glucose, insulin, and C-peptide secretory stimuli in man, is described. Simple dynamic models for the plasma gl of glucagon and the insulin/C-peptide r	program system for analysis of responses to different insulin ucose response to an injection esponse to an intravenous glucose
tolerance test (IVGTT) are discussed an	d fitted to experimental data.
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LUNU INSTITUTE OF TELMINULUUT	Date of issue
Box 725	March 1981
S 220 07 Lund 7 Sweden	Document number
	CODEN: LUTFD2/(TFRT-5243)/1-055/(1981)
Author(s)	Supervisor
	Per Hagander
Göran Öleskog	Sponsoring organization
Title and subtitle	
Cellcykelsimulering (Cell cycle simula	ation)
Abstract	
The growth of a population of calls can in	a name depend he expressed here
couple of more or less complicated differ	ential equations. For the most
these have to be solved numerically, which	n means that you have to work
with difference equations instead. A more	direct way is to create a model
in some computer language and simulate the	e cell culture growth. A flow
system model in Fortran has been developed	d as an alternative to a Monte
Carlo model, and these two models are desc	cribed and compared with each
other. The influence of characteristic cel	ll parameters and of the choice
of sample interval is examined, and the di	ifference between the two models
in simulation time and flexibility is also	o discussed. Three simulations
nave been done with both of the models:	
2. Simulation with growth and a single new	l disting dass
3. Simulation with growth and weekly radi	liation dose
J. Simulation with growth and weekly fault	ation in 4 weeks.
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DEPARTMENT OF AUTOMATIC CONTROL	Date of issue
Box 725	March 1981
S 220 07 Lund 7 Sweden	Document number
	LUTFD2/(TFRT-5244)/1-039/(1981)
Author(s)	Supervisor
Bengt Levin	Lars Pernedo
	sponsoring organization
Title and subtitle	
Eliminering av storningar vid forsegling	g med ultraljud
(Elimination of disturbances at sealing w	vith ultrasound)
Abstract	
Packages made of plastics may be welded b	y ultrasonic. An electrical signal with
high energy is converted in a piezoelectr	rical crystal to a mechanical vibration
If this motion is transmitted to the place	
	sild, it will generate heat. When heating
the plastic it melts and two pieces can b	be welded together. The amount of heat
transferred is proportional to the weldin	g time. To get a proper joint the welding
time should not be too short neither too	long in this case the joint will be
rigid and fragilo	
rigiu and fragile.	
Due to influence of disturbances (changes	in line voltage, pneumatic pressure etc),
the quality of the joint changes of a con	stant welding time is used. The influence
will be oliminated if the sumplie t	searce wereining time is used. The initialitie
will be eliminated if the supplied energy	'is measured and the welding is terminated
when a certain amount of energy is transf	erred to the joint.
-	
A design has been done in accordance with	the princip mentioned above and the
thesis has been averal	the princip mentioned above and the
thesis has been proved.	
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LUND INSTITUTE OF TECHNOLOGY	Document name Master thesis	
DEPARTMENT OF AUTOMATIC CONTROL	Date of issue March 1981	
S 220 07 Lund 7 Sweden	Document number	
	CODEN: LUTFD2/(TFRT-5245)/1-86/(1981)	
Author(s)	Supervisor Karl Johan Betröm	
Anders Helmersson	Sponsoring organization	
9 		
Title and subtitle DUAL REGLERING – En optimal dual regulator för en integrator med konstant men okänd förstärkning. (DUAL CONTROL – An optimal dual regulator for`an integrator plant with constant but unknown gain)		
Abstract		
Nonlinear stochastic control theory is app with unknown gain. The optimal dual contro and interpreted intuitively. Some numerica Using simulated examples, a comparison is previously suggested suboptimal regulators	olied to a simple discrete integrator ol algorithm is evaluated numerically al problems arised are discussed. made of the performance of some s, and the optimal one.	
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DEPARTMENT OF AUTOMATIC CONTROL	Date of issue
Box 725	APRIL 1981
S 220 07 Lund 7 Sweden	Document number
Author(c)	CODEN:LUTFD2/(TFRT-5246)/0-045/(1981)
Honriotto Hoibull	J Wieslander and B Wittenmark
nentiette weibuli	Sponsoring organization
Some Programs for Frequency Analysis in	IDPAC.
Abstract	
This report deals with a part of the pro	gram package IDPAC that concerns
frequency analysis. The outlines of the	commands ASPEC BODE CSPEC EROP and
SPTRE, which are implemented in IDPAC and	commands Abillo, bobe, corec, roor, and
give an optimized transfor function function	an input frequence manager .
give an optimized transfer function from	an input frequency response, is
described.	
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To test th	e validit	y of the	models we ha	ve done an a	adaption to a r	eal is made	
In this wo system. Th user_area.	rk we bui e model c	ld up a s consists o	imple mathem f three part	atical model s: Distribut	of a district ing pipe, pump	heating , and	
Abstract							
	av tjarr	värmenät	(Simulation	of a distri	ct heating sys	tem)	
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DEPARTMENT Box 725 S 220:07 Lu Author(s) Jan-Åke Må Sten-Åke B Title and sub Simulering	OF AUTON und 7 nsson ergman title	1ATIC CONT Sweden	ROL	Date of issue April 198 Document nu CODEN: LU Supervisor Björn Wit Sponsoring o	l mber TFD2/(TFRT-5247 tenmark rganization	7)/1-080/(	1981)

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