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ACTIVITY REPORT
1979 - 1980

PER HAGANDER

LTH

Department of Automatic Control Lund Institute of Technology

A C T I V I T Y   R E P O R T

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Per Hagander

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Title and subtitle

Activity Report 1979 – 1980

Abstract   A4   A5

The report surveys the activities at the Department of Automatic Control, Lund Institute of Technology, during the academic year 1979-80. At the civilingenjör level (≈ MS) seven different courses are given on regular basis. About 400 students have participated during the year. Also 13 MS-theses and 1 PhD-thesis have been completed.

The major areas of research have been adaptive control, robustness, system identification, and computer aided design of control systems.

Key words   A4   A5

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TABLE OF CONTENTS

1. INTRODUCTION

The activities in the academic year 1979/80 are reported
here. During the year one project was finished, computer
aided design, and a new one started, software for
implementation of control systems. The latter is described
in some detail, while for the other projects it is referred
to previous Annual Reports and to the reports listed in the
Appendices.

Only a limited number of copies of the reports are available
through the Department. It is, however, possible to borrow
the reports through the University Library in Lund. The
address is:

University Library 2
Box 1010
S-221 03 Lund, Sweden

2. EDUCATION

Two new undergraduate courses have been given: Principles of automatic control and Computers in control systems II.

Principles_of_automatic_control

This is a new course that has been given for chemical engineers. For the moment the course is taken by students specializing in food engineering. The other chemical engineering students are taking the course Automatic control for chemical engineers. The intention is that the new course is going to be the basic course for all chemical engineers. Those specializing in chemical equipment and processes should then have the possibility to get a deeper knowledge in automatic control. The emphases of the new course are to introduce the concepts of dynamic systems, mathematical models, feedback, and simple controllers. The intention is to give the students a feeling for what can be done with automatic control.

Undergraduate_course_in_real_time_computing

The course Computers in control systems I has been given since 1974. It contains both the hardware and software and is given also for chemical and mechanical engineers. Starting in 1979 a new elective course, Computers in control systems II, has been given for about 55 students per year with a solid background in electronics and computers. This course has an emphasis on software and especially concurrent programming. Pascal is used as the basic language, and exercises are done on a LSI-11 system. The course is very much influenced by the book Brinch-Hansen: Operating system principles. Data structures and linked lists are introduced and the problems of concurrency are described together with the tools for synchronization, such as critical regions, semaphores, and monitors.

Practical programming exercises successively prepare for quite an extensive project work.

The project corresponds to about 1 week full time work and is done in a group of four students. The task has been to construct a DDC program package. The basic structure of the package is given. The desired operator commands and control algorithms are defined. The students have to construct suitable data structures and write operator communication as well as control algorithms. The DDC program package is tried out on laboratory processes.

3. RESEARCH

The major research areas have been described in previous activity reports. The project Computer aided design of control systems was completed during the year. A feasibility study on a new project "Languages for implementation of control system" was started. This project is described below.

Software for implemention of control systems

Since it becomes more and more common to use computers as components in control systems, it is important to have powerful software tools. The opinion generally held is that the tools commonly used today are inefficient and difficult to use and do not give a reliable product. Moreover it is commonly understood that it is necessary to use abstract languages when writing concurrent programs.

In 1978 it was recognized at the department that it was necessary to get experiences from these new languages for concurrent programming. At that time only Concurrent Pascal was available. It was decided to try to implement Concurrent Pascal on LSI-11. It turned out to be possible and gave us a profound insight in the problem.

Together with the National Defence Research Institute (FOA) the department participated in Ada Test and Evaluation, Phase III. This cooperation with FOA will be continued in a project to study the quantitative and qualitative properties of Ada when implementing control systems and to compare these with for example Concurrent Pascal, Portal, Modula-2 and Pascal/D80. The study will be carried through as a project to develope the software for a control system. The system to be controlled is a 3 MW horizontal axis wind energy conversion system, that will be built by Karlskronavarvet AB in cooperation with Hamilton Standard.

The feasibility study "Languages for implementation of control systems" has been performed during the year. The presently used aids for implementation of control systems have been studied, such as real-time operating systems, DDC-packages, programmable controllers, real-time Basic, modern languages for concurrent programming and micro processor based controllers with fixed programs. Special attention has been devoted to study the different concepts and how they relate to each other.

A simple language for description of control systems has been developed as a pilot project. It is highly interactive. The control algorithms can be edited on a text screen. The replacement of a control algorithm then takes place between two interpretations (the algorithms are stored in an

intermediate form, similar to P-code, and interpreted).

Another pilot project was the construction of a small operating system (kernel) to be used together with Pascal. It gives the possibility to make procedures behave as concurrent processes. The kernel also handles semaphores and interrupts.

4. LABORATORY

New laboratory computer system

The PDP 15 computer system at the department has been in use since 1970. A total of 47 500 CPU hours was logged on the computer on June 30, 1980. The department has got investment funding for a replacement system. A thourough evaluation was done, and as a result a VAX11/780 was ordered. The system will be delivered in the fall of 1980. It is going to be used in the research for interactive computing, hierarchical control together with the existing LSI-11 systems, and for real time control tasks.

APPENDIX A - LIST OF PERSONNEL

Professor

    Karl Johan Aström

University lecturers (Universitetslektorer)

    Gustaf Olsson
    Björn Wittenmark

Research assistant (Forskarassistent)

    Per Hagander (Docent)

Research engineers (Forskningsingenjörer)

    Leif Andersson
    Bo Egardt (PhD; in USA 1980)
    Hilding Elmqvist (PhD)
    Tommy Essebo (programmer)
    Ivar Gustavsson (PhD) until Dec 1980
    Per Molander (PhD 1979)
    Ann-Britt Nilsson (on leave 1980)
    Lars Pernebo (PhD)
    Thomas Schönthal (programmer)
    Jan Sternby (PhD) until April 1980
    Johan Wieslander (PhD) until Febr 1980

Teaching assistants (Assistenter)

    Per-Olof Gutman (PhD candidate)
    Tore Hägglund (PhD candidate)
    Rolf Johansson (PhD candidate)
    Matz Lenells (PhD candidate)
    Carl Fredrik Mannerfelt (PhD candidate)
    Sven Erik Mattsson (PhD candidate)
    Lars Nielsen (PhD candidate)

Laboratory engineer (Laboratorieingenjör)

    Rolf Braun

Visiting scientists (Gästforskare)

    Jean Nyquist (Sept 79 - June 80)
    University of Michigan, Ann Arbor, Michigan, USA

    Zhou Zhaoying (from Sept 1979)
    Tsiaghua University, Peking, China

    Jin Shaoning (from Sept 1979)
    South China Institute of Technology, Canton, China

Technical drawings (Tekniskt biträde)

    Britt-Marie Carlsson

Secretaries (Sekreterare)

    Eva Schildt
    Eva Dagnegård (half time)

Typist (Skrivhjälp)

    Bert Sjögren

APPENDIX B - PUBLISHED PAPERS AND CONFERENCE CONTRIBUTIONS

Aström K J: Self-tuning regulators - design principles and applications. Proc. Workshop on Applications of Adaptive Control, Yale University, Aug 1979 (invited survey paper).

Aström K J: Maximum likelihood and prediction error. Preprints 5th IFAC Symposium on Identification and System Parameter Estimation, Darmstadt, Germany, Sept 1979.

Aström K J: Design pricniples for self-tuning regulators. Preprints Int Symposium on Adaptive Control, Ruhr University, Bochum, Germany, March 1980.

Aström K J: Design of fixed gain and adaptive ship steering autopilots based on the Nomoto model. Preprints Symposium on Ship Steering Automatic Control, Genoa, Italy, May 1980.

Aström K J: Piece-wise deterministic signals. In O D Anderson (Ed): Time Series, North-Holland, 1980.

Aström K J: Robustness of a design method based on assignment of poles and zeros. IEEE Trans AC-25 (1980) 588-590.

Aström K J: A robust sampled regulator for stable systems with monotone step responses. Automatica 16 (1980) 313-315.

Aström K J: Adaptive control. Encyclopedia of Science and Technology, 5th Edition, McGraw-Hill Book Company, New York, 1980.

Aström K J, Wittenmark B: Self-tuning controllers based on pole-zero placement. IEE Proceedings, PLD, 127 (1980) 120-30.

Bergman S, Gustavsson I: Analysis of pump servo systems in boiling water reactors using recursive identification. Preprints 5th IFAC Symposium on Identification and System Parameter Estimation, Darmstadt, Germany, Sept 1979.

Egardt B: Unification of some continuous-time adaptive control schemes. IEEE Trans AC-24 (1979) 588-592.

Elmqvist H: Dymola - A structured model language for large continuous systems. Summer computer simulation conference, Toronto, Canada, July 1979.

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Elmqvist H: Some new convenient features of simulation
    languages. Sorrento workshop for international
    standardization of simulation languages, Sorrento,
    Italy, Sept 1979.

Elmqvist H: Manipulation of continuous models based on
    equations to assignment statements. IBACS
    Congress/Simulation of Systems, Sorrento, Italy, Sept
    1979.

Hagander P: Simulation and flow systems analysis of the cell
    cycle. Mathematical Biosciences 48 (1980) 241-265.

Havlicek A, Cermak J, Gustavsson I: Dynamic identification
    of the cooling system in a fluidized bed combustor.
    Chemical Engineering Journal 20 (1980) 95-106.

Källström C G, Aström K J: Experiences of system
    identification applied to ship steering dynamics.
    Preprints 5th IFAC Symposium on Identification and
    System Parameter Estimation, Darmstadt, Germany, Sept
    1979.

Lindholm T, Thysell H, Qvarnström A, Nylén U, Hagander P,
    Ohlsson L-G, Heinegard D, and Gullberg C-A: Continuous
    glucose measuring and control in dialysis patients.
    European Society for Artificial Organs, Geneva,
    Switzerland, Sept 1979.

Mattsson S E: Implementation of Concurrent Pascal on LSI-11.
    Software - Practice and Experience 10 (1980) 205-217.

Olsson G: Modeling and control of the activated sludge
    process. ACS Symp Series No 124 "Computer Applications
    to Chemical Engineering" (1980) 368-382.

Olsson G: Automatic control in wastewater treatment plants.
    Trib Cebedeau No 436, 33 (1980) 121-130.

Olsson G: State of the art in sewage treatment plant
    control. AIChE Symp Series No 159, 72 (1980) 52-76.

Oppelstrup J, Lennells M: Några frirandsproblem (Some free
    boundary problems), in Swedish. ITM Working report No
    50, Feb 1980.

Pernebo L, Silverman L M: Balanced systems and model
    reduction. 18th IEEE Conference on Decision and
    Control, Fort Launderdale, Florida, USA, Dec 12-14,
    1979.

Tranberg K-G, Hagander P: Insulin kinetics after brief
    intra-portal and peripheral infusions of unlabelled
    insulin. Symposium on Carbohydrate Metabolism:
    Quantitative Physiology and Mathematical Modeling,
    Padova, Italy, Sept 4-6, 1979.

Qvarnström A, Nylén U, Schersten B, Hagander P, Lindholm T, Thysell H, Heinegard D, Ohlsson L-G, Håkansson H, Gullberg C-A: A new equipment for continuous blood glucose measuring without blood loss. 10th Congress of IDF, Workshop on Artificial Betacell, Héviz, Hungary, Sept 19-20, 1979.

Scherstén B, Hagander P, Nylén U, Qvarnström, Gullberg C-A: Clinical experience of a new equipment for continuous glucose measuring. 10th Congress of IDF, Workshop on Artificial Betacell, Héviz, Hungary, Sept 19-20, 1979.

Sternby J: Performance limits in adaptive control. IEEE Trans AC-24 (1979) 645-647.

Sternby J: Adaptive control of extremum systems. Int Symposium on adaptive control, Bochum, Germany, March 1980.

Wittenmark B, Bar-Shalom Y: Model validation from estimated closed loop performance. 5th IFAC Symposium on System Parameter Estimation, Darmstadt, Germany, Sep 1979.

Wittenmark B, Aström K J: Simple self-tuning controllers. Int Symposium on Adaptive Control, Bochum, Germany, March 1980.

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APPENDIX C - REPORTS

Any of the listed publications may be borrowed through
your library service or from the University Library in
Lund:

UB2
Box 1010
S-221 03 Lund, Sweden

The reports in 1000- and 3000-series may be ordered from

Department of Automatic Control
Lund Institute of Technology
Box 725
S-220 07 Lund 7, Sweden

There is a copying and handling charge of between $6.00
and $25.00 for each document. Invoice will be sent
together with the ordered report(s).

Please be certain to include both the report number and
the title.

DISSERTATIONS

TFRT-1020   Molander P: Stabilisation of uncertain systems.
              Aug 1979.

FINAL REPORTS

TFRT-3154   Aström K J, Bell R D: A 10th order linear drum
              boiler turbine model. Sep 1979.

TFRT-3155   Aström, Källström C G: Determination of linear
              and nonlinear ship steering dynamics using
              system identification. Sep 1979.

TFRT-3156   Wieslander J: Interactive programs - General
              guide. Feb 1980.

TFRT-3157   Wieslander J: Idpac commands - User's guide.
              Feb 1980.

TFRT-3158   Wieslander J: Modpac commands - User's guide.
              Feb 1980.

TFRT-3159   Wieslander J: Synpac commands - User's guide.
              Feb 1980

ACTIVITY REPORTS

TFRT-4010   Wittenmark B, Hagander P: Activity report
             1977-1978, 1978-1979. May 1980.

MASTER THESES

TFRT-5222   Kongstad P: Automatisk inställning av
             PID-regulatorer baserad på optimering och
             identifiering (Automatic tuning of
             PID-controllers using optimization and
             identification). Aug 1979.

TFRT-5223   Wiberg P A: Vibrationer i presspartiet i en
             pappersmaskin (Press nip vibrations in paper
             machines). Aug 1979.

TFRT-5224   Brännström K, Melcher H: Reglering av
             strängspruta (Control of a rubber extruder). Aug
             1979.

TFRT-5225   Tiljander S-G: Undersökning av två
             självinställande regulatorer för servoproblemet
             (Investigation of two self-tuning regulators for
             the servoproblem). Sept 1979.

TFRT-5226   von Knorring O, Lindsten L-G: Enkla regulatorer
             (Single controllers). July 1979.

TFRT-5227   Nilsson, Ch H: Insulin-glukos reglering
             (Insulin-glucose control). Oct 1979.

TFRT-5228   Nielsen L: Reglering av ATP-syntesen i
             mitokondrier (Control of the ATP-synthesis in
             mitochondria). Oct 1979.

TFRT-5229   Svensson G, Ahs M: Modellering och simulering av
             matarvattenförvärmningssystem (Modelling and
             simulation of feedwater preheating system). Nov
             1979.

TFRT-5230   Ullén K: Styrning av motorprovbädd (Control of a
             diesel engine test bed). April 1980.

TFRT-5231   Hedin B: Identifiering av dynamiska modeller för
             temperaturen i ett kontorslandskap
             (Identification of dynamic models for the
             temperature in an office landscape). May 1980.

TFRT-5232   Bjartmarsson K: Simulering av en kemisk reaktor
             (Simulation of a chemical reactor). May 1980.

TFRT-5233   Nilsson M, Olofsson P: Likströmsmotordrivet
             kraftreglersystem (DC-motor driven force control
             system). June 1980.

TFRT-5234   Olsson R: Modellering och simulering av synkrongeneratordynamik (Modelling and simulation of synchronous generator dynamics). June 1980.

REPORTS OF MASTER THESES

TFRT-6010   Wittenmark B: Master theses in Automatic Control 78/79. Jan 1980.

INTERNAL REPORTS

TFRT-7166   Gustavsson I: Processidentifiering – overhead- bilder (Process identification – transparencies). Aug 1979.

TFRT-7167   Mattsson S E: Concurrent Pascal user's guide. Aug 1979.

TFRT-7168   Mattsson S E: Implementation of Concurrent Pascal on LSI-11. Aug 1979.

TFRT-7169   Gustavsson I: övningar för Idpac (Exercises for Idpac). Aug 1979.

TFRT-7170   Gustavsson I: Några Macro's för Idpac (Some Macro's for Idpac). Aug 1979.

TFRT-7171   Aström K J: Piece-wise deterministic signals. Aug 1979.

TFRT-7172   Aström K J: New implicit adaptive pole-zero- -placement algorithms for nonminimum-phase systems. Aug 1979.

TFRT-7173   Aström K J: A robust sampled regulator for stable processes with monotone step responses. Sept 1979.

TFRT-7174   Olsson G: Modeling and control of the activated sludge process. Aug 1979.

TFRT-7175   Elmqvist, H: Dymola – A structured model language for large continuous systems. Sept 1979.

TFRT-7176   Olsson G, Wieslander J: Evaluation of process computers. Dec 1969 (old report).

TFRT-7177   Aström K J: Self-tuning regulators – Design principles and applications. Sept 1979.

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TFRT-7178   Aström K J: Reflections on theory and practice
             of automatic control. Sept 1979.

TFRT-7179   Wittenmark B: Self-tuning PID-controllers based
             on pole placement. Oct 1979.

TFRT-7180   Aström K J, Wittenmark B: Self-tuning
             controllers based on pole-zero placement. Nov
             1979.

TFRT-7181   Egardt B, Elmqvist H: Paged - A page oriented
             editor. Dec 1979.

TFRT-7182   Hägglund T: A linear quadratic control of a drum
             boiler turbine. Feb 1980.

TFRT-7183   Aström K J: Adaptive control. Dec 1979.

TFRT-7184   Aström K J: Simple self-tuners I. Dec 1979.

TFRT-7185   Wittenmark B: Reglerproblem inom livsmedels-
             industrin (Control problems in the
             food-processing industries). Jan 1980.

TFRT-7186   Essebo T: Character and string handling in
             Intrac. File handling in program package. Feb
             1980.

TFRT-7187   Schönthal T: Implementation procedures for
             Intrac. Feb 1980.

TFRT-7188   Schönthal T: Implementation procedures for
             Idpac. Feb 1980.

TFRT-7189   Schönthal T: Implementation procedures, plot
             routines. Feb 1980.

TFRT-7190   Sternby J: Adaptive control of extremum systems.
             March 1980.

TFRT-7191   Wittenmark B, Aström K J: Simple self-tuning
             controllers. March 1980.

TFRT-7192   Molander P: Current topics in stability theory.
             June 1980.

TFRT-7193   Olsson G: LDC Modell 80? Datakraft vid Lunds
             datacentral och Lunds universitet under 80-talet
             (LDC model 80? Computing power at the Lund
             university computing centre and Lund university
             during the 80's). April 1980.

TFRT-7194   Essebo T, Johansson R, Lenells M, Nielsen L: A
             facility for executing concurrent processes in
             Pascal. June 1980.

TRAVEL REPORTS

TFRT-8024   Elmqvist H: Visit to Stanford University,
             California, Aug 1978 - Aug 1979. Dec 1979.

TFRT-8025   Elmqvist H: Travel report from a standardization
             workshop and a congress in Sorrento, Italy,
             September 1979. Dec 1979.

TFRT-8026   Wittenmark B: Reseberättelse LEESA 3-7 mars 1980
             (Travel report LEESA March 3-7, 1980). June
             1980.

TFRT-8027   Olsson G: Datakraft vid några europeiska och
             amerikanska universitet - Rapport från
             studieresor hösten 1979 (Computing power at some
             European and American Universities - Report from
             travels Fall 1979). May 1980.

TFRT-8028   Hagander P: Conferences on insulin-glucose,
             Padova-Vienna, September 1-14, 1979. June 1980.

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APPENDIX D - COURSES AND SEMINARS AT THE DEPARTMENT

Undergraduate courses, graduate courses, seminars as well as
external courses, given at the department during the year,
are summarized here. They are given both by the staff at the
department and by invited lecturers.

Undergraduate courses

Linear systems (Reglerteknik AK)
Principles of automatic control (Reglerteknikens grunder)
Automatic Control theory for chemical engineers (Regler-
    teknik MK)
Nonlinear and sampled data systems (Reglerteknik FK)
Systems engineering (Systemteknik)
Computers in control systems I (Datorer i reglerteknik I)
Computers in control systems II (Datorer i reglerteknik II)

PhD Courses

The following courses have been given:

Optimal control   (P Hagander)
Linear system theory   (B Wittenmark)
Stochastic control theory   (B Wittenmark, P Hagander)
Biomedical systems   (P Hagander)
Modern languages for process control (L Andersson,
    H Elmqvist, S E Mattsson)
Current topics in stability theory (P Molander)

Seminars

1979

Sep 5   E Irving (France): Improving power network
             stability with adaptive generator control.

Sep 6   Prof A Pearson (Brown Univ): System
             identification and signal estimation via a
             finite time equation error method.

Sep 7   A Pearson: Finite horizon time regulators for
             linear systems.

Sep 19   P Gawthrope (Oxford): Self-tuning control.

Sep 19   Prof J C Willems (Groningen): Almost
             (A,B)-invariant subspace.

Sep 20   J C Willems: Dissipative dynamical systems.

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Oct 4	Prof P Caines (Harvard Univ): Non-stationary linear systems identification from cross-sectional data.
Oct 5	P Caines: Recent results in adaptive control.
Oct 5	H Austin Spaing (General Electric): Discussion on multivariable control.
Oct 9	T L Steding (Systems Control): A unified approach to operations scheduling in electric power systems.
Oct 10,11, and 12	B Egardt and P Gawthrope: Stability and converg- ence. Adaptive regulators I, II, and III.
Oct 19	S A Dahlqvist (KTH, Stockholm): Application of self-tuning regulators to the control of a pilot distillation column.
Oct 16	L Olbjer (Mathematical Statistics, Lund): Convergence proof for STR.
Oct 25	B Wittenmark: Self-tuning PID-regulators.
Nov 9	K J Aström: More about simple selftuners.
Nov 23	P Young (Univ Engineering Dept, Cambridge): Generalised equation error minimisation and robust estimation.
Nov 24	P Young: Second generation self-adaptive autostabilisation of airborne vehicles.
Nov 30	Reglerteknik inom livsmedelsindustrin (Control problems in the food-processing industries). Kontaktdag.

1980

Jan 15	I Svensson (SMT Pullmax): Datorstyrning av verktygsmaskiner (Computer machine tool control).
Feb 8	H Skoog (ASEA): Industrirobotar och deras styrning (Industrial robots and their control).
March 18	B Wittenmark: Simple self-tuning controllers.
March 18	J Sternby: Adaptive control of extremum systems.
May 13	G Cook (Univ of Virginia): Minimum noise aircraft landing trajectory.

May 28   L Radoune (Rabat, Marocko): Automatic control in
                Rabat.

May 30   A Sundström and G Olsson: Datakraft vid LU inför
                80-talet (Computing power at Lund University
                during the 80's).

June 9   H Elmqvist: En Pascal konferens (A Pascal
                conference).

External_courses

I. Computers and society (Datakraften i samhället). Basic
course in computer science for journalists, financed by the
Swedish Council for Planning and Coordination of Research
(Forskningsrådsnämnden). January 28-29, 1980. Coordinator
P-O Gutman. Contents:

1. P-O Gutman: Computer architecture.

2. H Elmqvist: The principles of programming.

3. J Sternby: The basics of automatic control.

4. J Wieslander: Automatic control and computers in industry
   today and in the future.

5. P Ragnarsson (Malmö Museum of Technology): Perspective on
   the impact of computers on society.

6. Exercises: Hardware (PDP-8). The programming language
   Basic (PDP-11). Computer control of water temperature
   (PDP-11).

II. Simulation of dynamical systems. May 5-6, 1980.
Contents:

1. K J Åström: Simulation - principles, methods, models.

2. H Elmqvist: Simnon - an interactive simulation program.

3. S Bergman (Sydkraft AB, Malmö): Modelling, simulation and
   identification of a measurement system in a nuclear power
   plant.

4. C G Källström (Statens Skeppsprovningsanstalt, Göteborg):
   Simulation of steering of large tankers.

5. G Olsson: Simulation of wastewater treatment plants.

6. J Oppelstrup (Swedish Institute of Applied Mathematics,
   Stockholm): Numerical methods for ordinary differential
   equations.

7. H Elmqvist: Simulation languages - survey.

8. H Elmqvist: Dymola - a structured model language for
   continuous systems.

9. Exercises using digital computer.

APPENDIX E - LECTURES BY THE STAFF

1979

July 16   Elmqvist H: Dymola - A structured model language
            for large continuous systems. Summer Computer
            Simulation Conference, Toronto, Canada.

Aug 1-6   Pernebo L: Algebraic control theory for linear
            multivariable systems. A series of four lectures
            at Price University, Houston, Texas, USA.

Aug 23   Aström K J: Self-tuning regulators - design
            principles and applications. Int Workshop on
            Applications of Adaptive Control, Yale
            University, New Haven, Conn, USA.

Aug 27   Aström K J: Adaptive control. Foxboro,
            Massachusetts, USA.

Aug 27   Aström K J: Applications of adaptive control. Du
            Pont, Wilmington, Delaware, USA.

Sep 6   Pernebo L: Some questions in multivariable
            control. Yale University, New Haven,
            Connecticut, USA.

Sep 7   Aström K J: Datorstyrd processreglering
            (Computer control). Swedish Academy of
            Engineering Sciences, IVA, Avd VII, Lund,
            Sweden.

Sep 10   Aström K J: Datorstyrd processreglering
            (Computer control). Statsföretags
            Elektroniksymposium, Stockholm, Sweden.

Sep 13   Olsson G: Modeling and control of the activated
            sludge process. Invited paper, American Chemical
            Soc, Washington DC, USA.

Sep 18   Olsson G: Some new results on dissolved oxygen
            profile control. Metropolitan Sanitary District
            of Greater Chicago, Chicago, USA.

Sep 20   Pernebo L: Algebraic design theory for linear
            multivariable systems. University of Toronto,
            Toronto, Ontario, Canada.

Sep 21   Hagander P: Modeller för cellcykelkinetik och
            deras tillämpning på tumörterapi (Models for the
            cell cycle kinetics and their application in
            tumor therapy), Dept of Radiophysics, Lund,
            Sweden.

Sep 24   Elmqvist H: Manipulation of continuous models
              based on equations to assignment statements.
              IMACS Congress, Sorrento, Italy.

Sep 24   Aström K J: Maximum likelihood and prediction
              error methods. 5th IFAC Symp on Identification
              and System Parameter Estimation, Darmstadt,
              Germany.

Sep 25   Aström K J and Källström C G: Experiences of
              system identification applied to ship steering
              dynamics. 5th IFAC Symp on Identification and
              System Parameter Estimation, Darmstadt, Germany.

Sep 25   Wittenmark B: Model validation from estimated
              closed loop performance. IFAC Symp on
              Identification and System Parameter Estimation,
              Darmstadt, Germany.

Oct 9   Mattsson S E: The type concept of Ada. An
              informative meeting on Ada arranged by FOA
              (National Defense Research Institute),
              Stockholm, Sweden. (Repeated Oct 15.)

Nov 10   Aström K J: Användning av algebra för
              dimensionering av servosystem (Algebra in the
              design of servosystems). Svenska
              Matematikersamfundet, Lund, Sweden.

Nov 30   Elmqvist H: Parametriserade typer i Pascal
              (Parametric types in Pascal). Dept of
              Mathematics, Linköping University, Sweden.

Dec 4   Wittenmark B: Self-tuning PID-controllers based
              on pole placement. Brown University, Providence,
              USA.

Dec 6   Wittenmark B: Self-tuning PID-controllers based
              on pole placement. University of Connecticut,
              Storrs, USA.

Dec 11   Hagander P: Stokastiska flödessystem och
              cellcykler (Stochastic flow systems and cell
              cycles), Department of Electrical Engineering,
              Linköping, Sweden.

Dec 17   Elmqvist H: Parametriserade typer i Pascal samt
              in- och utmatning i programmeringsspråk
              (Parametric types in Pascal and input-output in
              programming languages). Dept of Computer
              Science, Lund Institute of Technology, Sweden.

1980

Jan 29   Olsson G: Mätning, styrning och reglering av
                reningsverk (Measurement and control in
                wastewater treatment systems). Environmental
                Centre, Royal Institute of Technology,
                Stockholm, Sweden.

March 4   Wittenmark B: Comparison of recursive
                identification methods. LEESA, Rabat, Marocko.

March 5   Wittenmark B: Self-tuning algorithms for control
                prediction and smoothing. LEESA, Rabat, Marocko.

March 6-7   Elmqvist H: 1. Syntax driven input and output.
                2. Parametric types in Pascal. 3. Research and
                development at Automatic Control in Lund. Three
                lectures at Landis & Gyr, Zug, Switzerland.

March 10-14   Aström K J: Modelbildung - Identification -
                Adaptive Systeme (Three lectures on modeling,
                identification and adaptive control). Tagung
                über Regelungstheorie, Mathematisches
                Forschungsinstitut, Oberwolfach, Germany.

March 12   Olsson G: Design and operation interactions in
                wastewater treatment. Task force meeting on real
                time water quality management, IIASA, Laxenburg,
                Austria.

March 20   Aström K J: Design principles for self-tuning
                regulators. Int Symp on Adaptive Control,
                Bochum, Germany.

March 20   Wittenmark B: Simple self-tuning controllers.
                Int Symp on Adaptive Control, Bochum, Germany.

March 20   Sternby J: Adaptive control of extremum systems.
                Int Symp on Adaptive Control, Bochum, Germany.

March 27   Aström K J: Applications of adaptive control.
                Eurotherm Ltd, Worthing, England.

April 1   Pernebo L: Algebraisk systemteori (Algebraic
                system theory) and Vad jag gjorde i USA (What I
                did in the United States). ASEA Research Lab,
                Västerås, Sweden.

April 2   Aström K J: Adaptive ship steering. University
                of Singapore, Malaysia.

April 7-16   Aström K J: Stochastic control theory (eight
                lectures). Institute of Systems Science and
                Mathematics, Academia Sinica, Peking, China.

April 16	Wittenmark B: System modelling and identification. IIMAS, Mexico City, Mexico.
April 17	Aström K J: Institute of Systems Science and Mathematics, Academia Sinia, Peking, China.
April 17	Wittenmark B: Comparison of recursive identification methods. IIMAS, Mexico City, Mexico.
April 18	Elmqvist H: Computerized process control. Symposium arranged during a visit by a delegation from Christian Albrechts University in Kiel, Lund Institute of Technology, Sweden.
April 18	Wittenmark B: Adaptive control - an overview. IIMAS, Mexico City, Mexico.
April 20	Aström K J: Identification and control of ship steering dynamics. Shanghai Ship Design and Research Institute, Shanghai, China.
April 21	Aström K J: Research on automatic control in Sweden. Shanghai Jiao Tong University, Shanghai, China.
April 21	Aström K J: Theory and applications of adaptive control. Shanghai Society of Automation, Shanghai, China.
April 21	Wittenmark B: Self-tuning algorithms for control prediction and smoothing. IIMAS, Mexico City, Mexico.
April 23	Wittenmark B: Self-tuning PID-controllers based on pole placement. IIMAS, Mexico City, Mexico.
April 24	Wittenmark B: Applications of self-tuning regulators. IIMAS, Mexico City, Mexico.
April 26	Aström K J: Datorstyrd processreglering (Computer control). Symposium om datorerna och samhällsutvecklingen, Bonnersvik, Sweden.
April 29	Molander P: Systemanalys i Sverige (Systems analysis in Sweden). Linköping University, Linköping, Sweden.
April 30	Aström K J: A comparison of self-tuning regulators and model reference adaptive systems. Laboratoire d'automatique, Ecole Nationale Supérieure d'Ingenieurs Electriciens de Grenoble, Grenoble, France.

May 22   Olsson G: Identification, model building and
            control of activated sludge processes. Nordic
            Symposium on State of the Art in Wastewater
            Treatment Systems, Lund, Sweden.

May 29   Molander P: Robusta regulatorer (Robust
            regulators). Linköping University, Linköping,
            Sweden.

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APPENDIX F - TRAVELS

Karl Johan Aström visited USA in August 1979 to participate in Yale Symposium on Adaptive Control. Participated in 5th IFAC Symposium on Identification and Parameter Estimation in Darmstadt in September. From Sept 1979 to March 1980 Aström was on leave to work at Telsand AB on digital control of a blown film extruder. This project was a FOSAM activity. In January Aström visited the Mathematics Dept at Groningen University, Netherlands, as a member of an international review committee. On Feb 1 to 3 Aström visited IIASA to participate in a meeting with the advisery committee to the system and decision sciences area. March 20-21 he participated in the International Symposium on Adaptive Control in Bochum. In April 1980 Aström was invited to lecture at the Institute of System Sciences in Peking, China. He also visited Shanghai.

Hilding Elmqvist returned in August 1979 from a one year visit to Stanford University. He presented a paper at the Summer Computer Simulation Conference in Toronto, July 1979. During a visit to Italy in Sept 1979 he participated in the 'Sorrento workshop for international standardization of simulation languages' and presented a paper at the IMACS congress. In March 1980 he was invited to Landis & Gyr, Zug, Switzerland, and gave three lectures. He then also visited the Eidgenössische Technische Hochschule and Brown Boveri, Zürich. He also participated in a symposium and a conference on Pascal and Ada in Gothenburg in June 1980.

Per Hagander participated in the conference "Carbohydrate Metabolism: Quantitative Physiology and Mathematical Modeling" in Padova Sept 4-6, 1979, and he then also visited the LADSEB-CNR laboratory. During Sept 10-14 he participated in the 10th International Diabetes Federation Congress in Vienna.

Sven Erik Mattsson attended the Ada Training Workshop on July 23-27, 1979, at the National Physical Laboratory in London. The course was lead by Jean Ichbiah from CII Honeywell-Bull.

Per Molander visited France on March 18-19, 1980, to attend the conference 'Analyse de systemes', organized by Centre National de Recherche Scientifique, Lyon, France.

Gustaf Olsson has been working full time on a special task on computer planning for the Lund University from July 1, 1979, to March 31, 1980. As part of this commission he visited several European and American university computer centres and departments Sept 2-27, 1979. During this trip he participated in a symposium on 'Computer applications to chemical engineering process design and simulation',

American Chemical Society, Washington DC, Sept 9-14. He also participated in the Univac User's Association meeting in Madrid, Nov 5-10. He made an additional trip to the USA between Dec 4 and 19 and visited computing centres as well as the IEEE conference on decision and control in Fort Lauderdale, Florida. He was invited to join a task force meeting on 'Real time water quality management' at IIASA, Laxenburg, Austria, March 12-14, 1980.

Lars_Pernebo visited the USA from Sept 12, 1978, to Sept 28, 1979. After July 1, 1979, he visited the following places: Rice University, Houston, July 30 - Aug 10, Massachusetts Institute of Technology, Boston, Aug 27-31, Yale University, New Haven, Sept 5-7, Brown University, Providence, Sept 10-12, General Electric Research Lab, Schenectady, Sept 14, University of Toronto, Toronto, Sept 17-21.

Jan_Sternby participated in the International Symposium on Adaptive Control in Bochum, Germany, on March 20-21 and also presented a paper.

Björn_Wittenmark participated in and presented a paper at the IFAC Symposium on Identification and System Parameter Estimation. During December 1-16, 1979, he visited Harvard University, Brown University, and University of Connecticut, where he gave seminars and discussed with colleagues. During the 18th CDC in Ft Lauderdale he organized and lead a session on applications of adaptive control. March 3-7, 1980, he visited LEESA in Rabat, Marocko, and discussed possibilities to set up an exhange program with the Department in Lund. March 20-21 he participated at an Internation Symposium on Adaptive Control and also presented a paper. During April 14-26 he was invited to lecture at IIMAS at the University of Mexico in Mexico City, Mexico.