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

1980 - 1982

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Activity Report 1980-1982

Abstract

The report surveys the activities at the Department of Automatic Control, Lund Institute of Technology, during the academic years 1980-81 and 1981-82. At the civilingenjör level (≈ MS) seven different courses are given on regular basis. About 800 students have participated during these two years. Also 43 MS-theses and two PhD-theses have been completed.

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

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TABLE OF CONTENTS

1. INTRODUCTION

The activities in the academic years 1980/81 and 1981/82 are reported here. On the teaching side a substantial effort has been devoted to planning for new teaching laboratories. This has included travel, discussions and extensive experimentation. The work is very time-consuming but we expect it to have a significant impact on future education. New courses on computer-controlled systems and real-time programming have also been developed. This is described in more detail in Section 2. The planning of teaching programs was given a real boost during a trip that the department made to our colleagues in The Netherlands, see Section 6.

During this period the major research efforts followed the previously established lines. The major methodological projects carried out during the period were adaptive control and computer aided design. The computer aided design project was terminated during the period. The major reason is that we have developed a set of useful tools and we believe that good feedback from many different users are needed to take the next step. Research in adaptive control has been continued with efforts devoted to robustness, multivariable control and dual control. This field is so rich that we expect to continue for a long time. Preliminary exploration of nonlinear control have also been persued in connection with Gutman's thesis. We expect this effort to be continued. With regards to application a new project control of wind turbine generators has been initiated. This work is done in close cooperation with Sydkraft. This is described in Section 3. Our old interest in control of activated sludge processes has also been reactivated.

The most drastic changes have been in computer related research. Together with the Department of Computer Engineering and with the support of STU we have started a center for industrial computer systems (CID). The idea is to take a more serious look at implementation issues and computer hardware. This new program is presented in Section 4. The program is expected to have impact on education as well as on future research directions. Our computational facilities have been expanded considerably with the installation of a VAX-11/780 computer, see Section 5.

We want to thank our sponsors, The Swedish Board of Technical Development (STU), The Swedish Institute of Applied Mathematics (ITM), The Research Institute of National Defence (FOA), The Swedish Council for Planning and Coordination of Research (FRN), The Swedish Board for Energy Source Development (NE), The Swedish Wastewater Works Association (VAV), and Sydkraft AB for their support to our projects.

2. EDUCATION

The courses given in the MS program are the same as in the previous years. The following number of students have passed during 1980-81 and 1981-82:

	80-81	81-82
Linear systems	281	225
Automatic control for chemical engineers	22	18
Principles of automatic control	4	6
Nonlinear and sampled data systems	23	25
Systems engineering	22	16
Computers in control systems I	28	24
Computers in control systems II	76	41

Fortythree students have made their MS-dissertations in Automatic Control. A list of the MS-theses is given in Appendix C. A list of the PhD courses given are found in Appendix D. Two PhD-theses have been completed during the period.

Several members of the department have taken an active part in the planning of the new curriculum in computer engineering. Although this consumes considerable effort we believe the activity to be worthwhile because of its long range strategic importance for the Institute of Technology.

New teaching laboratories

The need for upgrading our teaching laboratories has been recognized for some time. During this period we have made major exploratory efforts towards new laboratories. The basic ideas is to introduce computer controlled systems in the basic courses and to develop a collection of small teaching processes. We have tried and evaluated a number of commercial processes and we have experimented with designs of our own. It is expected that the effort will result in new labs in a few years time.

Computer-controlled systems

A major step towards a new course have been taken. A preliminary version of a new text has been tried.

Computers in control systems II

This course has been drastically revised. The revision was strongly influenced by the LICS project in the Center for Industrial Computer Systems (CID). A substantial project based on LSI-11 computers have been introduced in the course. In the project three different groups work on local control, man-machine interaction, and computer-computer

communication. The projects are implemented on different LSI-11 systems. In the final test the three projects are interfaced to make a functioning distributed system. Each subproject results in up to 1500 lines of source code. The project provides unique opportunities to get experience of implementation and testing of real-time programming. We expect to give more emphasis on implementation issues in the years to come.

Continued education

We have made a policy decision to be actively involved in continued education. The reasons are to obtain good feedback from practising engineers and stimulation of course development. We have set a goal of running four courses per year.

3. RESEARCH

Wind turbine generators

A mathematical simulation model for a large horizontal axis wind turbine system has been developed. The model is intended for simulation of the synchronization of the wind turbine generator against the utility grid and the operation of the wind turbine system under different wind conditions and with different control algorithms.

Particular attention has been given to the modularization. The model is divided into subsystems to make it easy to modify the model and adapt it to systems of similar type. The interactive simulation package SIMNON has been used.

The model has been used in a simulation study of WTS-3. WTS-3 is a 3 MW wind turbine system which has been built near the city of Trelleborg, in southern Sweden, by Karlskronavarvet AB, Sweden and Hamilton Standard, a division of United Technologies Inc., USA. A 4 MW plant (WTS-4) of the same design is built in Medicine Bow, Wyoming, USA.

WTS-3 is currently (summer 1982) taken into operation. As the physical system did not exist at the start of the simulation project, the only validation so far has been made by simulation comparisons from runs made by the WTS-3 designers. However, during the full-scale testing period 1982-1985, system identification and model validation will be done.

Currently the control problem is studied. The purpose is to discuss and evaluate different control strategies.

The project is done in cooperation with Sydkraft AB, Malmö, Sweden.

4. CENTER FOR INDUSTRIAL COMPUTER SYSTEMS

The Center for Industrial Computer Systems (Centrum för Industriella Datorsystem - CID) is a joint effort between the departments of Automatic Control and Computer Engineering. It is supported by the Swedish Board for Technical Development (STU).

One of the goals of the center is to establish hardware and software knowledge and experience for implementation of industrial computer systems, and to serve as a basis for advanced development projects with the industry.

The current major activities are in the fields of

- computer architecture and special purpose hardware
- hardware implementation of real-time computations
- real-time software for control applications

There are also other activities in the center with the purpose of broadening the knowledge base and increasing contacts with industry. These activities take the form of seminars, conferences, feasibility studies and master thesis projects. Seminars and conferences are listed in Appendix E.

Software tools for implementation of control systems

This project is carried out at the Department of Automatic Control. The purpose is to develop a system for documentation, implementation and testing of computerized control systems. It should be based on the concepts and notations used in automatic control theory and oriented towards the implementor and the controlled system.

The design aims at control systems for large industrial plants, presently controlled by, for example, DDC-packages, microprocessor based decentralized controllers and PC-systems. In many cases the control of each individual component poses no problem. The problem is to handle the large amount of information about all the controllers.

One aid when dealing with large amount of information is graphical representation. High resolution color screens are, in fact, available for process operators at this kind of plants. However, there are poor tools for the implementor of the control systems.

The structure of a plant and its control system has served as a basis for the design of the implementation system. A mapping of this basic structure to a graphical representation has been constructed. Decomposition of a system is represented by block diagrams. Hierarchical decomposition corresponds to zooming of a particular block

in the block diagram. At the lowest level there is a need to express algorithms as ordinary statements as well as documentation in the form of pure text.

A program prototype is developed in Pascal at a Vax-11/780 with a color graphics system with 512x512 resolution.

Some smaller subprojects have also been carried out:

- Design and implementation of a prototype language, called REGULA.
- Pascal for PC-systems, implementation of code generator (master thesis).
- Alphanumeric video terminal with zoom (master thesis).
- Implementation of a real time kernel for Pascal on LSI-11.

5. LABORATORY

The Vax computer

A Vax-11/780 computer was installed in September 1980. The configuration at that time was a very small one: 0.5 Mb of main memory, 2 x 28 Mb of disk space and 8 terminal ports. Since then it has been upgraded considerably, and the configuration at present (September 1982) is:

2.5 Mb of main memory
256 Mb Winchester disk (Ampex Capricorn)
2 x 28 Mb removable disk (DEC RK07)
32 terminal ports
Tape drive (Ampex)
Adapters for Multibus and Q-bus.

The Multibus contains equipment for computer image handling (2 Matrox RGB-Graph and 1 Matrox VAF-512). The Q-bus contains A/D and D/A converters. The operating system is VAX/VMS version V3.0. There is also a Eunice programming system, which enables simulation of a Unix programming environment.

Microcomputers

An Apple II microcomputer with diskette drives and process interface has been bought. It will be used to demonstrate simple computer control in the basic undergraduate courses, and also to investigate very simple self-tuning controllers.

We have also got a Falcon microprocessor (DEC). It will be used to investigate the possibility of making "packaged" adaptive controllers. The programs will be written in Omsi Pascal and a modified version of the Real Time Kernel (see reports TFRT-7230 and TFRT-7231) will be used.

Other equipment

A number of small processes for lab exercises has been bought or made during the period:

- A tank process for level control.
- A process for demonstration of mixing control with possibilities for transport delay and reflux.
- The "Coupled Drive Apparatus" from Tecquipment Ltd, for demonstration of tension and speed control of e.g. a roll of paper in a press or a paper machine.
- A number of standard PID regulators to control these and other processes.

6. TRAVELS

Travels by the staff are listed in Appendix G.

During April 12-17, 1982, eighteen members of the department made a study tour to Holland. The following departments were visited:

Eindhoven University of Technology, Eindhoven:
- Group Measurement and Control
- System and Control Engineering Group

Philips, Eindhoven:
- Philips Research Lab
- Product Division Science and Industry
- Lighting Demonstration Centre

Delft University of Technology, Delft:
- Laboratory for Mechanical Measurement and Control
- Department of Electrical Engineering
- Department of Biochemical Reactors

The purpose of the travel were to study the work of other similar research groups and to get new ideas for our research and education in Lund.

The travel is reported in TFRT-8037.

APPENDIX A - LIST OF PERSONNEL JULY 1980 TO JULY 1982

Professor

Karl Johan Åström

University lecturers (Universitetslektorer)

Gustaf Olsson
Björn Wittenmark

Research assistant (Forskarassistent)

Per Hagander (Docent)

Research engineers (Forskningsingenjörer)

Leif Andersson
Sten Bergman (PhD candidate)
Hilding Elmqvist (PhD)
Tommy Essebo (programmer)
Per-Olof Gutman (PhD, teaching assistant 80-81)
Tore Hägglund (PhD candidate, teaching assistant 80-81)
Matz Lenells (PhD candidate)
Carl Fredrik Mannerfelt (PhD, teaching assistant 80-81)
Sven Erik Mattsson (PhD candidate)
Ann-Britt Östberg
Lars Pernebo (PhD), until Aug 1981
Thomas Schönthal (programmer)
Anders Wikström

Teaching assistants (Assistenter)

Jan Peter Axelsson (PhD candidate)
Rolf Johansson (PhD candidate)
Bengt Mårtensson (PhD candidate)
Lars Nielsen (PhD candidate)
Lars Rundqwist (PhD candidate)
Karl-Erik Årzén (PhD candidate)

PERSONNEL

Laboratory engineer (Laboratorieingenjör)

Rolf Braun

Visiting scientists (Gästforskare)

Dr Zhou Zhaoying (Sept 1979 - Oct 1981)
Tsiaghua University, Peking, China

Dr Jin Shaoning (Sept 1979 - Aug 1981)
South China Institute of Technology, Canton, China

Professor Ennu Rüstern (Sept 1980 - Jan 1981)
Tallinn Technical University, Tallinn, USSR

Professor Oliver Jacobs (Febr 1-28, 1982)
Oxford University, England

Professor H Elliot (April 5-27, 1982)
University of Massachusetts, Amherst, USA

Professor Mont Hubbard (May 11 - June 4, 1982)
University of California, USA

Technical drawings (Tekniskt biträde)

Britt-Marie Carlsson

Secretaries (Sekreterare)

Eva Schildt
Eva Dagnegård (part time)

Typist (Skrivhjälp)

Agneta Tuszynski (part time)

APPENDIX B - PUBLISHED PAPERS AND CONFERENCE CONTRIBUTIONS

Andrews J F, Olsson G, Hill R: ASCL - An activated sludge process control language. University of Houston, Houston, Texas, Sept 1981.

Aström K J: Maximum likelihood and prediction error methods. Automatica 16 (1980) 551-574.

Aström K J: Why use adaptive techniques for steering large tankers? Int J Control 32 (1980) 689-708.

Aström K J: Self-tuning control of a fixed-bed chemical reactor system. Int J of Control 32 (1980) 221-256.

Aström K J: Self-tuning regulators - design principles and applications. In Narendra K S and Monopoli R V: Applications of Adaptive Control, Academic Press, New York, 1980.

Aström K J: Design principles for self-tuning regulators. In Unbehauen H (ed): Methods and applications in adaptive control, Springer, Berlin, 1980.

Aström K J, Hagander P, Sternby J: Zeros of sampled systems. The 19th IEEE Conference on Decision and Control, Albuquerque, Dec 10-12. IEEE (1980).

Aström K J: Direct methods for non-minimum phase systems. The 19th IEEE Conference on Decision and Control, Albuquerque, Dec 10-12. IEEE (1980).

Aström K J: Adaptive autopilots for ship steering. Proc Workshop on Applications of Adaptive Systems Theory, Yale University, May 1981.

Aström K J: Theory and applications of adaptive control. Proc 8th IFAC World Congress Kyoto, Japan, August 24-28, 1981, pp 737-748.

Aström K J, Elmqvist H: Perspective on interactive software for computer aided modeling and design of control systems. Proc 20th IEEE Conf Decision and Control, San Diego, California, Dec 16-18, 1981, pp 402-407.

Aström K J, Mayne D Q: A new algorithm for recursive estimation of controlled ARMA processes. Proc 6th IFAC Symposium on Identification and System Parameter Estimation, Arlington, Virginia, June 7-11, 1982, pp 122-126.

Aström K J: Adaptive control. In Encyclopedia of Science and Technology, Vol I, 5th edition, McGraw-Hill 1982, pp

PUBLISHED PAPERS

99-102.

Bergman S, Mattsson S E, Östberg A B: A modular simulation model for a wind turbine system. AIAA-81-2558. AIAA 2nd Terrestrial Energy Systems Conf, Dec 1-3, 1981, Colorado Springs, USA, pp 1-8.

Briggs R, Olsson G: On-line measurement, data processing and digital control. The Institute of Water Pollution Control, Symp Data Processing in the Water Industry, Bournemouth, England, 20-21 April 1982.

Egardt B: Stability analysis of continuous-time adaptive control schemes. SIAM J Control and Optimization 18 (1980) 540-558.

Egardt B: Unification of some discrete-time adaptive control schemes. IEEE Trans AC-25 (1980) 693-696.

Egardt B: Stability analysis of discrete-time adaptive control schemes. IEEE Trans AC-25 (1980) 710-716.

Frogner B, Olsson G, Doi K, Lin C: A method for optimizing BWR control rod patterns using the power shape monitoring system. Transactions of the American Nuclear Society, 39 (1981) 685-686.

Gutman P O: Stabilizing controllers for bilinear systems. Joint Automatic Control Conference, San Fransisco, Aug 13-15, 1980.

Gutman P O: Stabilizing controllers for bilinear systems. IEEE Trans AC-26 (1981) 917-922.

Gutman P O, Mannerfelt C F, Molander P: Contributions to the model reduction problem. IEEE Trans AC-27 (1982) 454-455.

Hagander P, Oleskog G, Knöös T, Persson R B R: Monte Carlo and flowsystems cellcycle simulation, a comparison. In M Rotenberg (ed): Biomathematics and Cell Kinetics, Elsevier, North Holland Biomedical press (1981).

Hennesy J, Elmqvist H: The design and implementation of parametric types in Pascal. Software, Practice and Experience 12 (1982) 169-184.

Källström C, Åström K J: Experience of system identification applied to ship steering. Automatica 17 (1981) 187-198.

Mattsson S E: Ada in control applications - A case study. FOA Report C20459-D8(E3), The Research Institute of National Defense (FOA), Stockholm, Sweden.

Molander P, Willems J C: Synthesis of state feedback control

laws with a specified gain and phase margin. IEEE Trans AC (1980).

Olsson G: Some new results on activated sludge control based on dissolved oxygen profiles. Joint Automatic control conference, San Francisco, USA, Aug 13-15, 1980.

Olsson G: Design and operation interactions in wastewater treatment, Proc of a task force "Real time water quality management", (Ed M.B. Beck), IIASA, CP-80-38, Dec 1980.

Olsson G: Control and automation in wastewater treatment - Advances, unsolved problems and challanges. Final address at the IAWPR International Workshop on Practical Experience of Control and Automation in Wastewater Treatment and Water Resources Management, Munich, June 1981. Published in Progress in Water Technology.

Olsson G and Andrews J F: Dissolved oxygen control in the activated sludge process. IAWPR International Workshop on Practical Experience of Control and Automation in Wastewater Treatment and Water Resources Management, Munich, June 1981.

Olsson G and Andrews J F: Estimation of loading changes for the nitrifying activated sludge process. Paper, IFAC 8th World Congress, Kyoto, Japan, Aug 1981.

Olsson G: Operational and control challenges in biological wastewater treatment. Paper presented at the Elmia Int Conf on Air and Water Conservation, Jönköping, Sweden, Sept 1981.

Olsson G, Cohen A I, Rao H: An approach to air-fuel ratio control for automobile engines using self-tuning regulators. Paper, IEEE 20th Decision and Control Conference, San Diego, California, Dec 1981.

Pernebo L: An algebraic theory for the design of controllers for linear multivariable systems - Part I: Structure matrices and feedforward design. IEEE Trans AC-26 (1981) 171-182.

Pernebo L: An algebraic theory for the design of controllers for linear multivariable systems - Part II: Feedback realizations and feedback design. IEEE Trans AC-26 (1981) 183-194.

Sivik B, Wittenmark B: Behov av mät- och reglerutrustning i svensk livsmedelsindustri (The need for measurement and control equipment in the Swedish food processing industry). Livsmedelsteknik Nr 9 (1981) 437-439.

PUBLISHED PAPERS

Sternby J: Extremum control systems - An area for adaptive control? Proc Joint Automatic Control Conference, San Francisco, USA, Aug 13-15, 1980.

Tranberg K G, Hagander P: Insulin kinetics after brief interportal and peripheral infusions of unlabelled insulin. In C Cobelli, R N Bergman (ed): Carbohydrate Metabolism, John Wiley & Sons 1981.

Tranberg K G, Hagander P, Thorell J: Disappearance of insulin in man: Variation with plasma insulin level. Acta Endocrinologica 97 391-397 (1981).

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DISSERTATIONS

TFRT-1021 Mannerfelt C F: Robust control design with simplified models. Aug 1981.

TFRT-1022 Gutman P O: Controllers for bilinear and constrained linear systems. March 1982.

FINAL REPORTS

TFRT-3160 Åström K J, Wieslander J: Computer aided design of control systems. Final report STU projects

73-3553, 75-3776, 77-3548. Jan 1981.

TFRT-3161 Elmqvist H: Språk för förverkligande av reglersystem (Languages for implementation of control systems). Dec 1981.

TFRT-3162 Åström K J, Mayne D Q: A new algorithm for recursive estimation of parameters in controlled arma processes. April 1981.

TFRT-3163 Åström K J: Förstudie för forskningsprojekt om datorstyrning i kraftindustrin (A program for research into computer control of power systems). FOU-projekt, May 1981.

TFRT-3164 Åström K J: Reglerteknik - En elementär introduktion. Kapitel 2, Den enkla reglerkretsen (Control engineering - An elementary introduction. Chapter 2, The simple feedback loop). Oct 1981

TFRT-3165 Åström K J: Reglerteknik - En elementär introduktion. Kapitel 4, Till-från reglering (Control engineering - An elementary introduction. Chapter 4, On-off control). Oct 1981

TFRT-3166 Åström K J: Reglerteknik - En elementär introduktion. Kapitel 5, PID reglering (Control engineering - An elementary introduction. Chapter 5, PID control). Jan 1982.

TFRT-3167 Åström K J: Ziegler-Nichols auto-tuners. May 1982.

ACTIVITY REPORTS

TFRT-4011 Hagander P: Activity report 1979-1980. Jan 1981.

MASTER THESES

TFRT-5235 Wennstad P: Adaptiva regulatorer (Adaptive regulators). June 1980.

TFRT-5236 Bäckestrand: Extremalsökande regulatorer (Extremal seaking regulators). Aug 1980.

TFRT-5237 Stalin C: Elektrohydrauliskt bromssystem (Electro-hydraulic breaking system). Aug 1980.

TFRT-5238 Månsson L: CONDIS - En vidareutveckling av simuleringspaketet Combinedsimulation (CONDIS - A development of the simulation package Combinedsimulation). April 1980.

REPORTS

TFRT-5239 Lidemyr S: 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). Sept 1980.

TFRT-5240 Hellaeus A: Experiment med självinställande PID-regulator (Experiment with self-tuning PID-controller). Aug 1980.

TFRT-5241 Freij A, Romare S: Fartygsstyrning vid sjögång (Automatic steering of ships in heavy seas). Oct 1980.

TFRT-5242 Swietlicki J, Wallenberg A: Analys av insulin-glukos dynamik (Analysis of insulin-glucose dynamics). Dec 1980.

TFRT-5243 Oleskog G: Cellcykelsimulering (Cell cycle simulation). March 1981.

TFRT-5244 Levin B: Eliminering av störningar vid försegling med ultraljud (Elimination of disturbances at sealing with ultrasound). March 1981.

TFRT-5245 Helmersson A: 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 Weibull H: Some programs for frequency analysis in IDPAC. April 1981.

TFRT-5247 Månsson J Å, Bergman S Å: Simulering av fjärrvärmenät (Simulation of a district heating system). April 1981.

TFRT-5248 Hed G, Thorselius K: Adaptivt bränsleflödesmätningssystem för motorfordon (Adaptive fuel flow measuring system for motor vehicles). July 1981.

TFRT-5249 Bjerke O: Dimensionering av en multivariabel styrregulator för en robot samt en undersökning av villkor för stabilitetsmarginaler för multivariabla system (Design of a multivariable elevator controller for a missile and an insight into conditions of robustness of multivariable systems). July 1981.

TFRT-5250 Hansson P: Implementering av självinställande PI-regulator (Implementation of self-tuning PI-controller). July 1981.

REPORTS

TFRT-5251 Andersson J: Implementering av DDC-6 reglersystem (Implementation of a DDC-6 control system). Aug 1981.

TFRT-5252 Emanuelsson C, Theander G: Optimal inställning av PID-regulatorer med hjälp av förlust-funktionsoptimering (Optimal tuning of PID-controllers using loss function minimization). Aug 1981.

TFRT-5253 Nilsson P-A: Lasthanteringsprogram för själv-lossande malmfartyg (Cargo-loading program for self-loading ore-vessels). Aug 1981.

TFRT-5254 Elfgren L-G: Temperaturreglering med själv-inställande PID-regulator (Temperature control with self-tuning PID-controllers). Sept 1981.

TFRT-5255 Löfstrand P-A: PID-regulatorer i en process-terminal (PID-regulators in a process terminal). June 1981.

TFRT-5256 Minör S, Permvall O: Pascal för PC-sykstem (Pascal for PC-systems). Sept 1981.

TFRT-5257 Wikström A: Evolutionärt stabila strategier (ESS) i en predator bytesdjurs modell (Evolutionary stable strategies (ESS) in a predator prey model). Sept 1981.

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TFRT-5259 Gunnarsson H: Recursive identification using a general model structure. Oct 1981.

TFRT-5260 Uneram M, Wegelid L: Självinställande servo implementerat med mikrodator (A microprocessor implementation of a self-tuning servo). Oct 1981.

TFRT-5261 Hagberg U: Modeller och prediktion av effektförbrukningen i fjärrvärmeverk (Model and prediction of heat load in a district heating system). Nov 1981.

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TFRT-5263 Hillbur A: Mikrodatorbaserad temperaturregulator för ystkar (Microcomputer based temperature controller). Nov 1981.

TFRT-5264 Bååth L, Malmqvist P-O: Självinställande regulatorer på mikrodator i högnivåspråk

REPORTS

(Self-tuning regulators on a micro-computer in high-level language). Nov 1981.

TFRT-5265 Stamoulis A, Moustakas T: Algoritmer för digitala PID-regulatorer (Algorithms for PID-controllers). Dec 1981.

TFRT-5266 Mårtensson B: Zeros of samples systems. Jan 1982.

TFRT-5267 Kalliakmanis K, Tsanis E: Experimentell undersökning av blandningsprocess (Investigation of a mixing process). Jan 1982.

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TFRT-5269 Heder N, Speidel T: Förstudie av programmet SLIRSIM (Prestudy av the program SLIRSIM). March 1982.

TFRT-5270 Andell L-Å: Självinställande PID-regulator för system med tidsfördröjning (A self-tuning PID-controller for systems with time delay). March 1982.

TFRT-5271 Sandin G, Wullt T: Experiment med datorstyrd kännande robot (Experiments with a computer controlled touch-sensing robot). Aug 1982.

TFRT-5272 Eriksson G, Molin B-A: Design of a digital motor speed controller. May 1982.

TFRT-5273 Persson M: Mätning av banhastighet med korrelationsteknik (Measurement of web speed using correlation methods). June 1982.

TFRT-5274 Rundqwist L: Mathematical modelling for simulation of an extruder. June 1982.

TFRT-5275 Bengtsson T: Realtidskärna för Motorolas MC 68000 mikroprocessor (Real-time kernel for Motorola MC 68000 micro processor). June 1982.

TFRT-5276 Persson T: Högupplösande färggrafik för operatörskommunikation (High-resolution colour graphics in control systems). June 1982.

TFRT-5277 Lilja M: Quantum mechanics and non-linear filtering. June 1982.

REPORTS

REPORTS OF MASTER THESES

TFRT-6011 Pernebo L: Master theses in automatic control 1979/80. Oct 1980.

TFRT-6012 Pernebo L: Master theses in automatic control 1980/81. Nov 1981.

INTERNAL REPORTS

TFRT-7195 Carlsson Y, Carping T, Nellgård L, Eiken J, Nilsson B, Larsson E, Odelius M, Wiberg P A: Projektarbeten i reglerteknik systemteknik, våren 1978. Sept 1980. (Projects in course 9E, spring 1978). Sept 1980.

TFRT-7196 Åström K J: Datorstyrda processreglersystem. Presentation för data- och elektronikkommitt n 9.1.1979 (Computer control. Presentation for the governmental committee on computers and electronics Jan 9, 1979). Sept 1980.

TFRT-7197 Åström K J: Syntes av servosystem. (Synthesis of servo systems). Sept 1980.

TFRT-7198 Åström K J: Three lectures on modeling, identification and adaptive control. Sept 1980.

TFRT-7199 Olsson G: Automatic control in wastewater treatment plants, invited plants. Sept 1980.

TFRT-7200 Wittenmark B, Bar-Shalom Y: Model validation from estimated closed loop performance. 5th IFAC on identification and system parameter estimation. Sept 1980.

TFRT-7201 Wittenmark B, Hagander P, Gustavsson I: STUPID - Implementation of a self-tuning PID-controller. June 1980.

TFRT-7202 Åström K J: Inledande laboration i samplade system. (Laboratory notes for course 9F). Sept 1980.

TFRT-7203 Åström K J: Design principles for self-tuning regulators. Sept 1980.

TFRT-7204 Åström K J: Overhead slides for eight lectures on stochastic control and its applications. Sept 1980.

TFRT-7205 Pernebo L: Numerical algorithms for polynomial matrix systems. Oct 1980.

REPORTS

TFRT-7206 Pernebo L: A command guide for a computer program for polynomial matrix systems. Oct 1980.

TFRT-7207 Gutman P O: How to run IDPAC on Lund University computing centre. Aug 1980.

TFRT-7208 Hägglund T: Use of instrumental variables in self-tuning regulators. Oct 1980.

TFRT-7209 Gustavsson I: Implementation of a self-tuning regulator for non-minimum phase systems on PDP 11/03. Oct 1980.

TFRT-7210 Gutman P O: Controllers for bilinear systems. Aug 1980.

TFRT-7211 Gutman P O, Mannerfelt C F, Molander P: On the model reduction problem. Dec 1980.

TFRT-7212 Mannerfelt C F: Nonlinear amplitude stabilization of a discrete time oscillator. Dec 1980.

TFRT-7213 Magnusson B, Löfgren M, Elmqvist H, Fernström I, Kruzera I, Schöntal T: REGULA - An interactive user oriented language for implementation of control systems. Febr 1981.

TFRT-7214 Åström K J: MORE STUPID. Sept 1981.

TFRT-7215 Nielsen L: Analysis of a pump servo system using sampled data identification and continuous time interpretation. Febr 1981.

TFRT-7216 Breidegard B, Hägglund T, Gutman P O, Nyqvist J: A multiprocessor DDC-package. Apr 1981.

TFRT-7217 Essebo T: Machine code generation for Simnon on VAX-11. May 1981.

TFRT-7218 de la Cour U, Gupta B, Källgren S, Larsson T, Lindholm B, Ulveland P: System för automatisk landning av flygplan. Projektarbete i systemteknik våren 1974. (A system for automatic landing of airplanes. Projects in course 9e, spring 1974). June 1981.

TFRT-7219 Flote A, Ingemansson U, Johansson G, Marat S, Obrant O, Oleskog G, Wolszczan J: Modellering och simulering av datorstyrd svarv. Projektarbete i systemteknik våren 1980 (Modelling and simulation of a numerically lathe. Projects in course 9e spring 1980). June 1981.

REPORTS

TFRT-7220 Andersson I, Bolmsjö G, Dimitric D, Johnsson S, Kristensson T, Laurell S, Löfstedt J, Morinder L, Schierwagen T, Wemmert B, Wong K S: Modellbygge med simulering på värmepumpsanläggning i Skurup. Projektarbete i systemteknik våren 1981 (Modelling and simulation of a heat pump system at Skurup. Projects in course 9e spring 1981). June 1981.

TFRT-7221 Bengtsson T, Bengtsson M, Bergström M, Hedar N, Lie M, Christiansen T, Moustakas T, Skeppe H, Lundgren B, Karavas D: Simulering av hjälpmatarvattensystemet till Oskarshamn 1. Projektarbete i systemteknik våren 1981 (Simulation of auxiliary feedwater system at the Oskarshamn nuclear power plant. Projects in course 9E spring 1981). June 1981.

TFRT-7222 Åström K J: Ship steering. A test example for robust regulator design. June 1981.

TFRT-7223 Zhao-Ying Z, Åström K J: Polynomial factorization using recursive formulas for complex integrals. June 1981.

TFRT-7224 Hägglund T: A PID tuner based on phase margin specification. Sept 1981.

TFRT-7225 Zhao-Ying Z, Åström K J: Regulator syntheses based on polynomial manipulation. June 1981.

TFRT-7226 Zhao-Ying Z, Åström K J: A microcomputer implementation of LQG self-tuner. July 1981.

TFRT-7227 Bergman S, Mattsson S E, Östberg A-B: A modular simulation model for a wind turbine system. Sept 1981.

TFRT-7228 Mattson S E: ADA in control applications - a case study. Sept 1981.

TFRT-7229 Åström K J, Zhao-Ying Z: Self-tuners with automatic adjustment of the sampling period for processes with time delays. Aug 1981.

TFRT-7230 Elmqvist H, Mattsson S E: Implementation of Basic primitives for concurrent programming in Pascal. Aug 1981.

TFRT-7231 Elmqvist Hilding, Mattsson S E: A real-time kernel for Pascal. Aug 1981.

TFRT-7232 Nielsen L, Wennerström H, Hagander P: Thermo dynamics and control of the oxidative phosphorylation in mitochondria. An investigation of the

oxidative phosphorylation in mitochondria. An investigation of the consequences of the chemiosmotic theory. Jan 1982.

TFRT-7233 Johansson R: Parametric models of linear multivariable systems for adaptive controllers. Febr 1982.

TFRT-7234 Tengvall F: Rendezvous primitives for intertask communication on VAX/VMS. March 1982.

TFRT-7235 Hultman B and Olsson G: Static analysis of a nitrifying activated sludge process. July 1980.

TFRT-7236 Olsson G, Fukuzaki T, Lin C, Doi K and Frogner B: Predictions of power and thermal margin changes for rod withdrawals in boiling water reactors. Jan 1981.

TFRT-7237 Andrews J F, Olsson G, Hill R: ASCL - An activated sludge process control language. Sept 1981.

TFRT-7238 Sternby J: Självinställande nivåreglering i massakokeri (Selftuning level control in a pulp factory). March 1982.

TFRT-7239 Mattsson S E: Development of a modular simulation model for a wind turbine system. March 1982.

TFRT-7240 Polak E, Aström K J, Mayne D Q: Interoptdyn SISO: A tutorial. March 1982.

TFRT-7241 Aström K J: Parameterization of special digital control algorithm. May 1982.

TFRT-7242 Hägglund T: Adaptive control with fault detection. June 1982.

TFRT-7243 Mannerfelt C F: A note on the Smith predictor. June 1982.

TFRT-7244 Aström K J, Helmersson A: Dual control of a low order system. June 1982.

TFRT-7245 Aström K J: Adaptiv reglering (Adaptive control). June 1982.

TRAVEL REPORTS

TFRT-8029 Aström K J: Besök på University of Singapore. (Visit to University of Singapore). Sept 1980.

REPORTS

TFRT-8030 Gutman P O: Studieresa till västsvenska företag, 1979. (Visit to industries in western Sweden 1979). Sept 1980.

TFRT-8031 Åström K J: Visit to China April 1980. Sept 1980.

TFRT-8032 Åström K J: Processreglering i kemiindustrin - Intryck från en kongress arrangerad av Engineering Foundation januari 1981. (Process control in the chemical industry - Impressions from a conference by Engineering Foundation, Januari 1981). June 1981.

TFRT-8033 Pernebo L: Workshop on feedback and synthesis of linear systems, Bielefeld, Germany. Nov 1981.

TFRT-8034 Nielsen L: Studieresa 9-23/6 1981 till forskningscentra inom bildbehandling i USA (Visit to image processing research centers in USA 9-23/6 1981). Feb 1982.

TFRT-8035 Åström K J: Plenary lecture at the 8th IFAC World Congress, August 24-28, 1981. May 1982.

TFRT-8036 Elmqvist H: Travel report USA 1981: Man-machine interaction. May 1982.

TFRT-8037 Arzén K-E: Studieresa till Holland 12-17/4 1982 (Visit to The Netherlands 12-17/4 1982). July 1982.

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)
Automatic control for chemical engineers (Reglerteknik MK)
Principles of automatic control (Reglerteknikens grunder)
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:

Adaptive control (K J Åström)
Identification (P Hagander)
Algebraic design methods (L Pernebo)
Linear systems (P Hagander)
Control of nuclear reactors (S Bergman)
Analog techniques for implementing regulators (K J Åström)
Numerical methods in control (P Hagander)

Seminars

1980

Aug 14, 19	Prof A Willsky (MIT): Issues in the implementation of control compensators.
Aug 20, 22, 26	Prof A Willsky (MIT): Abrupt changes in signals and systems.
Sept 3	M Grimble (Sheffield Polytechnic): Selection of Q and R weighting matrices using results from multivariable root loci.
Sept 5	P Dybjer (Lund): Formell specifikation av program och programmeringsspråk - ett hjälpmedel att övervinna mjukvarukrisen (Formal specification of program and programming language - a mean to overcome the software crisis).

COURSES & SEMINARS

Sept 8	J van Schuppen (Amsterdam): The stochastic filtering problem for point processes.
Sept 10	K J Aström: Piecewise deterministic functions.
Sept 16	T Bohlin (KTH), A Marlevi (LME): Synkronisering av okända telekommunikationsnät genom decentraliserad reglering av klockfrekvenser (Decentralized control of the oscillators in unknown communication networks).
Sept 22	Prof C Moler (Albuquerque): Matlab.
Oct 12	Prof W Schaufelberger (ETH Zurich): Experiences with project-oriented and group-teaching courses in a graduate control program.
Oct 13	Prof W Schaufelberger: Industrial applications of adaptive control in Switzerland.
Nov 4	G Bengtsson (ASEA): Framtidsvyer (Trends in control).
Nov 28	A Rault (France): Process control - Idcom.
Dec 9	L Dahlström (ASEA): Industriella tillämpningar av fiberoptik och seende datorer för industriell automation (Industrial application of fiberoptics and vision in industrial control computers).
Dec 22	B Leden (Mefos): Framtida värmeforskning (Future research in heat technics).

1981

Jan 12	T Westerlund (Åbo Akademi): Tillämpning av stokastisk reglerteori vid cementframställning (Application of stochastic control theory in cement productions).
Jan 14	R Syding (ASEA): Tillståndsdiagnostik (State diagnostics).
Jan 21	C Ovr n (ASEA): Nya givarprinciper - fiberoptiska givare (New sensor concepts - fiberoptic sensors).
Feb 25	G Martins (ASEA): Framtida användning av robotar (Future use of robots).
March 26	Prof J Zaborsky (Washington univ): Local feedback stabilization of large interconnected power systems in emergencies.

COURSES & SEMINARS

March 30	Visit by engineering students from Grenoble.
April 29	I Rydahl & B Sandin (Asea Atom): Designfilosofi vid reglering av kärnkraftverk (Design philosophy in the control of nuclear power plants).
May 8	B Tyreus (Bofors Nobel Kemi): Multivariable control - An industrial view.
Aug 11	Prof E Angel (Univ of Mexico): Image processing, an overview.
Aug 12	Prof E Angel: Image models.
Aug 13	Prof E Angel: Half tones and image coding.
Aug 14	Prof E Angel: Texture analysis and tissue characterization.
Sept 4	D J Bell (University of Manchester): Von Zeipel's perturbation procedure for optimal control.
Sept 9	J Taylor (General Electric): Nonlinear oscillations.
Sept 10	J Taylor: Covariance analysis of nonlinear systems.
Sept 15	Visit by prof Lin Zi-zhi and colleagues from Sheynang Institute of Automation, China.
Sept 30	C F Mannerfelt: Robusta regulatorer (Robust regulators).
Oct 6	P O Gutman: Linjärprogrammeringsregulatorn (The LP-regulator).
Oct 16	C F Mannerfelt: A simple self-tuner.
Oct 20	A Rault (Adersa/Gerbos): Fault detection.
Oct 27	H Elmqvist & T Essebo: LICS - ett datorhjälp-medel för implementering av reglersystem (LICS - A tool for implementation of control systems).
Oct 30	G Bengtsson (Asea): Avancerad reglerteori i praktiken (Advanced control in industrial practice).
Nov 4	K J Åström: The Ziegler-Nichols selftuner.
Nov 4	T Hägglund: The phase margine selftuner.

COURSES & SEMINARS

Nov 11 — S E Mattsson: ADA för implementering av reglersystem (Implementation of control laws in ADA).

Nov 12 — H Boman (Skandiakoncernen): Försök att tillämpa reglerteori inom försäkringsrörelsen (Insurance business as a control problem).

Nov 13 — K J Aström: Theory and application of adaptive control.

Nov 18 — S Bergman, S E Mattsson, A B Östberg: A modular simulation model for a wind turbine system.

Dec 3 — H Elmqvist: Programming environments - a travel in USA.

Dec 16 — H Elmqvist: Dymola - hur gör man? (Dymola - how to use it).

1982

Jan 8 — R Johansson: Flervariabla adaptiva regulatorer (Multivariable adaptive control).

Jan 15 — L Andersson: Hur skall en LOGIN-fil se ut? (What does a LOGIN-file look like?).

Jan 22 — G Olsson & K J Aström: Decision and Control Conference 1981.

Jan 27 — M Fjeld (SINTEF): Diskussion om adaptiv reglering (Discussion of adaptive control).

Feb 2 — Prof O L R Jacobs (Oxford University): On-line computer control of pH in an industrial process.

Feb 3 — Prof O L R Jacobs: Feedback control of post-operative pain.

Feb 5 — Prof O L R Jacobs: Estimation through scalar non-linear output.

Feb 9 — P O Gutman: A new design for constrained controllers for linear systems.

Feb 11 — Prof O L R Jacobs: On the significance of controller dynamics.

March 5 — Prof L Ljung (LiTH): Adaptiv reglering baserad på kriterieminimering (Adaptive control based on criteria minimization).

March 12 — J Holst (Imsor/LTH): Reglerteknik och Imsor (Automatic Control and Imsor).

COURSES & SEMINARS

March 18	Prof H Koivo (Tampere Univ): Tuning of multivariable PI-controllers for unknown linear systems.
April 6	C van Loan (Cornell Univ): Riccati equation solution.
April 28	Visit by P Hibbard from Carnegie-Mellon University.
April 28	Visit from Ericsson, Mölndal: Presentation av aktiviteter vid LME. Realtidsprogrammering. (Activities at LME. Real-time programming.)
May 18	Prof M Hubbard (Univ of California): Dynamics in biomechanical systems. Application to locomotion and sportmechanics.
May 19	Prof M Hubbard: Optimum vehicle suspension minimizing RMS rattlespace, sprung-mass acceleration and jerk.
May 19	K Sh Zigangirov (IPPI, Moscow): Some problems of information theory connected with control theory.
May 24	Prof M Hubbard: Estimation of feedstream concentrations in cement raw material blending.
May 24	H Elmqvist: Programsystem för implementering, dokumentation och testning av reglersystem (A program for implementation, documentation and testing of control systems).
June 1	J E Larsson, H Franzon: Spelprogram (Computer chess).
June 4	A Willsky (MIT): Reconstruction of 2D fields from line integrals based on the detection and estimation of objects.
June 14	T Wiberg (Umeå): Programmeringsmiljö (Programming environments).
June 18	Visit by S Kahne (Case Western Reserve Univ, Ohio). Discussions on collaboration NSF - STU.

External courses

Sept 23-25, 1980,
Workshop on numerical methods in automatic control:

1. A Laub (Univ of Southern Calif): Survey of computational methods in control theory.

2. V Klema (MIT, USA): Mathematical software for control and estimation theory.

3. M Denham (Kingston Polytechnic, UK): UK SRC control algorithm library.

4. D Boley & G H Golub (Stanford univ): Block Lanczos and control theory.

5. M Denham: The determination of large scale systems structures using principal component analysis.

6. P van Dooren (Philips res lab, Brussels): A generalized eigenvalue approach for solving riccati equations.

7. V Strejc (Czechoslovak Academy of Science, Prague): Square root filtering and UD-decomposition.

8. C B Moler (Univ of New Mexico): MATLAB - An interactive matrix laboratory.

9. F Cellier (ETH, Zurich): On the numerical integration of discontinuous ordinary differential equations - simulations and real-time applications.

10. C W Gear (Univ of Illinois): Oscillating problems and limit cycles (tentative title).

11. M Sorine (INRIA, France): Numerical solution of Riccati and Chandrasekhar equations arising in optimal control of distributed parameter systems.

12. N Nichols (Univ of Reading, UK): Application of numerical boundary value problems in optimal control.

13. S A Gustafsson (The Royal Inst of Technology, Stockholm): Numerical treatment of parabolic boundary-value control problem by means of semi-infinite programming.

14. R Gorez (Univ of Louvain, Belgium): Some features of Chandrasekhar equations and orthogonal transformation techniques in optimal control.

15. A Wierzbicki (IIASA, Austria): Trajectory optimization - theoretical background and practical motivations for infinite-dimensional objectives in dynamical optimization and control.

16. B Asselmeyer (Technische Hochschule, Darmstadt): Comparison of several optimization methods not requiring exact one-dimensional searches - Numerical experience.

17. E Polak, Univ of California Berkley, USA): Algorithms for control systems design involving singular value

inequalities.

18. E Spedicato (Univ of Bergamo, Italy): Use of slack variables in nonlinear programming.

19. P Zencke (Univ of Bonn): A self-starting algorithm for the identification of positive exponential decay components by minimization of the Chebyshev error.

20. A Ruhe (Univ of Umeå): Fitting emperical data by positive sums of exponentials.

21. V Kucera (Chechoslovak Academy of Science, Prague): Control systems design using polynomial equations. Numerical aspects.

22. L Pernebo: Numerical problems in multivariable synthesis using the polynomial approach.

23. J Edmunds (Cambridge Univ): A frequency response algorithm to calculate precompensators which optimise the closed loop response of a multivariable system.

24. K Zeiske (Ruhr Univ Bochum): Routh-criterion for obtaining the roots of polynomials.

25. J Wieslander (Stora Kopparberg AB): A sequence of programs for control systems analysis and design.

26. A Barraud (Laboratoire D'Automatique de Grenoble): Autopac a robust software for automatic control purposes.

27. H Elmqvist: A language for dynamical models based on general equations.

28. C Suleyman and A Barraud (Laboratoire D'Automatique de Grenoble): ISER-CSO an interactive system for education and research in control.

29. R Gorez (Univ of Louvain, Belgium): PAAS and SIMUL, conversational programs for educational purposes in control systems analysis.

30. H C Lammers and A Kraak (Delft Univ of Technology): STUPID - an in-line computer-aided control/design package.

Nov 5-7, 1980,
Course in control theory for ASEA. K J Aström, B Wittenmark and P Hagander.
Contents:

1. Presentation.

2. Linear continuous time systems.

3. Sampled systems.

4. Stochastic systems.

5. Future trends in control.

6. Laboratory - Simnon.

7. Perspective - Modelbuilding, identification, adaptive control.

March 16 - May 18, 1982,
Course in Simnon for teachers at Lund Institute of Technology. B Wittenmark, P O Gutman, S E Mattsson, G Olsson.
Contents:

1. Simulation of dynamic systems - an overview.

2. Simnon - how to do.

3. A case study - simulation of a wind power plant.

4. Experiences, problems and solution. Course evaluation.

5. Exercises.

March 22-26, 1982,
Review course in control theory for the power industry. K J Åström, G Olsson, S Bergman, M Lenells, L Andersson, P O Gutman, C F Mannerfelt, B Wittenmark, P Hagander.
Contents:

1. Simple regulators and introductory computer programming.

2. Conventional control systems.

3. Process models and simulation.

4. Identification, specifications and advanced control forms.

5. Trends and computer control.

6. Programming and simulation exercises.

May 4-6, 1982,
Course in simulation of dynamical systems for engineers in industry. B Wittenmark, R Johansson, C F Mannerfelt, P O Gutman, S E Mattsson, G Olsson, H Elmqvist.

Contents:

1. Simulation of dynamical systems, principles and methods.
2. Simnon - an interactive simulation program.
3. Examples of the use of simulation.
4. Simnon - how to do.
5. Case study - simulation of a wind power plant.
6. Simulation languages - an overview.
7. Dymola - a structured model language for continuous systems.
8. Computer exercises.

May 25-27, 1982,
Course in digital control for engineers in industry.
B Wittenmark, G Olsson, P O Gutman, M Lenells, T Hägglund, P Hagander, C F Mannerfelt, H Elmqvist.
Contents:

1. Computers as controllers.
2. Sampling.
3. Analysis of discrete-time systems.
4. The design problem. Translation of continuous-time controllers to digital form.
5. Controllers based on state-space models.
6. Controllers based on external models.
7. Adaptive control.
8. The real time programming problem.
9. A direct digital control program.
10. Laboratory exercises

June 2-4, 1982,
Repetition of Course in digital control for engineers in industry, same contents as above.

APPENDIX E - SEMINARS ARRANGED BY CID

Seminars arranged by Center for Industrial Computer Systems (CID, Centrum för Industriella Datorsystem) are summarized here. Read about CID in Section 4.

1980

Sept 15 — S Fogelström (Teleplan, Solna): De nya 16-bitars mikrodatorerna (The new micro processors with 16 bits).

Sept 22 — H Lunell (LiTH): Pascal - ett välstrukturerat programspråk för mikrodatorer (Pascal - A well structured programming language for micro processors).

Sept 29 — H Elmqvist (LTH): Översikt över hjälpmedel för implementering av reglersystem (Tools for implementation of control systems).

Oct 6 — G Sigfridsson & C Ahlerup (Satt-Elektronlund, Malmö): PC-system (Programmable controllers).

Oct 13 — H Elmqvist & S E Mattsson (LTH): Programmering av parallella aktiviteter (Concurrent programming).

Oct 20 — C Cöster (Kockumation, Malmö): In- och utmatning till datorer med mänskligt tal (Computer input and output with human speech).

Oct 27 — J Agerberg (FOA) & S E Mattsson: Ada - det nya realtidsspråket (Ada - The new real time programming language).

Nov 3 — A Rajnak (CTH): Smådatorer i mätsystem (Measurement systems with small computers).

Nov 10 — A Jacobsson & T Hagström (Saab-Scania): Framtagande av mikrodatorbaserade enloops-regulatorer (Development of a micro processor based one-loop controller).

Nov 17 — M Cedervall (LTH): Programmerbara sekvensnät och bit-slice teknik (Programmable logic and bit-slice technique).

Nov 24 — K Hassel (Teleplan, Solna): Felsökning i mikrodatorsystem (Debugging of micro computer systems).

Dec 1 — B Svensson & U Carlsson (Sattco, Solna):

CID SEMINARS

Förarbetade kundkretsar (Semi custom designed LSI-circuits).

1981

March 9 — J Olofsson (MoDo Chemetics): Realtids-Basic - Ett interaktivt språk för processtyrning (Real-time Basic - An interactive language for process control).

March 16 — B A Bergvall & K Andersson (Husqvarna AB): Introduktion av mikrodatorer i en traditionellt helmekanisk produkt (Introduction of micro processors in a traditionally completely mechanical product).

March 23 — R Bernemyr (Televerkets Centralförvaltning): Digital kommunikation genom optiska fibrer (Digital communication using optical fibres).

March 30 — H Bäckman (Datahuset, Täby) and B Åkerlind (Nordisk Elektronik AB, Stockholm): Kort-datorsystem (Modular micro computer systems).

Apr 6 — J E Lundström (ASEA): Färgbildspresentation i processdatorsystem (Color graphics in process control systems).

Apr 13 — A Eckerström (Televerkets Centralförvaltning): Datornät och datorkommunikation (Computer networks and computer communication).

May 25 — Seminars on 'personal computers for technical applications':

1. K Johansson (Frontec): Hårdvara i smådatorer (Hardware for personal computers).

2. S Nilsson (Teleplan): Mjukvara i smådatorer (Software for personal computers).

3. L Philipsson (Computer Engineering, LTH): Forskning och utveckling (Research and trends).

4. R Brodin (Hobbydata): Tillbehör för smådatorer (Accessoires for personal computers).

5. S O Carlberg (Luxor TV AB): Tillämpningar (Applications).

6. Discussions, exhibition.

CID SEMINARS

1982

April 19-21 Prof H Elliott: Seminars on 'Image segmentation algorithms for engineering problems in computer vision':

1. Overview and introduction.

2. Boundary oriented image segmentation.

3. Region oriented image segmentation.

April 19-22 Prof H Elliott (Colorado State Univ): Seminars about 'Discrete multivariable adaptive control':

1. The pole-placement approach.

2. Discrete multivariable adaptive control II.

3. Discrete multivariable adaptive control III.

April 26 Seminars about 'scientific personal computers':

1. L Philipson (Computer Engineering, LTH): Inledning och bakgrund (Introduction and background).

2. P Hibbard (Carnegie-Mellon University): SPICE - An experiment in personal computing.

3. K J Åström: Vetenskapliga persondatorer vid amerikanska universitet - intryck från en studieresa våren 1982 (Scientific personal computers at universities in the USA - impressions from a visit, spring 1982).

4. K Skog (University of Tromsö): Dokumentproduktion and fontverktyg (Document production and font tools).

5. L Kahn (STU): Vetenskapliga persondatorer för ovetenskapligt arbete - användning av persondatorer i kontorsmiljö (Scientific personal computers for nonscientific work - use in office environments).

6. H Elmqvist: Persondatorer med extremt snabb färggrafik och speciella grafiska processorer - presentation av ett projekt vid Stanford University (Scientific personal computers with extremely fast color graphics and special

graphic processors - presentation of a project at Stanford University).

7. L Philipson and M Taube (Computer Engineering LTH): Interaktiv konstruktion av högintegrerade kretsar, exempel på konvertering av programvara till vetenskaplig persondator (Interactive construction of LSI-circuits, example of conversion of software for scientific personal computers).

8. Panel: Trends for scientific personal computers.

May 10-11 Seminar series about decentralised process computer systems: Fault-tolerant distributed computer control systems including colour screen control panels and higher level programming systems. Prof Dr M Syrbe, Dr H Steusloff, Dipl-ing D Heger (Fraunhofer-Institut fur Informations- und Datenverarbeitung).

1. Requirements and technology trends promoting control computer systems architecture.

2. CAE (Computer Aided Engineering) of control computer systems.

3. Basic principles of program design.

4. Languages for real-time programming, Pearl.

5. Pearl, multicomputer-pearl.

6. Supporting systems programs, operating systems, test systems.

7. Basic principles and modelling of man-machine communication.

8. EAF: An advanced input/output color screen display system.

9. Basic principles of local area networks (LAN) - (System types, performance analysis).

10. LAN in the RDC-system (distributed computer control system of IITB). Further extensions to open networks (THYNET).

11. Basic principles and trends towards modular self-testing systems.

12. RDC-devices and EAF-devices, the hardware of two realized systems.

13. Results of 5 RDC-systems, considering fault tolerance and performance during 3 years.

14. Application systems: application of RDC, EAF and multicomputer pearl on soaking pit furnaces, industrial data communication system, Robots.

15. Results of the application of multi-computer Pearl over the life cycle of the programs.

16. Linked method base system and real-time database for process automation.

APPENDIX F - LECTURES BY THE STAFF

1980

Aug 14	Olsson G: Some new results on activated sludge control based on dissolved oxygen profiles. Paper presented at the Joint Automatic Control Conference, San Francisco, USA.
Aug 15	Sternby J: Extremum control system - An area for adaptive control? Joint Automatic Control Conference, San Francisco, USA.
Sept 4	Åström K J: Styrsystem inom processindustrin - Framtidsutsikter (Control systems in the process industry - an outlook). Mo och Domsjö, Örnsköldsvik, Sweden.
Sept 4	Åström K J: Reglerteknikens utveckling (The progress of automatic control). Mo och Domsjö, Örnsköldsvik, Sweden.
Sept 30	Åström K J: Robustness of a design method based on an assignment of poles and zeros, VDE/VDI, Working group on advanced control algorithms in industry. Interlaaken, Zurich, Zwitzerland.
Oct 7	Åström K J: Datorstyrd processreglering. Computer process control. Statsföretag, Stockholm, Sweden.
Oct 10	Olsson G: Wastewater treatment control, modeling and identification in wastewater treatment. 6 lectures at EMA Inc, St Paul, Minnesota, USA.
Oct 15	Åström K J: Validation of control systems models. Task Force Meeting on Model Validity Credibility, IIASA, Vienna, Austria.
Oct 24	Olsson G: Some advances in control of wastewater treatment system control. Dept of Civil Engineering, Univ of Houston, Houston, Texas, USA.
Nov 21	Olsson G: Process control in activated sludge systems - experiences from Sweden. Department of Sanitary Engineering, Univ of California, Berkeley, USA
Nov-Dec	Olsson G: Self-tuning regulators, principles and applications. 5 lectures at Systems Control Inc, Palo Alto, California, USA.

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Dec 5 Wittenmark B: Design principles for digital controllers and their application to self-tuning controllers. Univ of Cennecticut, Storrs, USA.

Dec 9 Wittenmark B: Design principles of self-tuning regulators. Some applications of adaptive control. Workshop on stochastic adaptive control at the 19th IEEE Conf Decision and Control, Albuquerque, New Mexico, USA.

Dec 11 Åström K J: Direct methods for non-minimum phase systems. 19th IEEE Conf Decision and Control, Albuquerque, USA.

Dec 11 Åström K J: Zeros of sampled systems. 19th IEEE Conf Decision and Control, Albuquerque, USA.

Dec 12 Åström K J: Theory of sampled systems. 19th IEEE Conf Decision and Control, Albuquerque, USA.

Dec 15 Åström K J: What happens to the zeros of a system when it is sampled. Univ of California, Berkeley.

Dec 15 Wittenmark B: Design principles for and applications of self-tuning regulators. Systems Control Inc, Palo Alto, USA.

Dec 16 Åström K J: Perspective on interactive software for computer aided modeling and design of control systems. 20th IEEE Conference on Decision and Control, San Diego, USA.

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Jan 16 Åström K J: Adaptive regulators for steering of ships. Univ of Gainsville, Florida.

Jan 21 Åström K J: Sensitivity of control systems design to modeling errors. Engineering foundation workshop on process control in a chemical industry, Florida.

Jan 29 Åström K J: Computer aided design. Honeywell Research division, Minneapolis, USA.

Feb 23 Olsson G: Computer applications in the wastewater treatment industry. Dept of Electrical Engineering, Univ of Houston, Texas, USA.

Feb 25 Olsson G: Modeling, estimation and control of activated sludge plants. Wastewater Technology Centre, Canada Centre for Inland Waters,

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Burlington, Ontario, Canada.

Feb 26 — Olsson G: Software and hardware for on-line computers - applications in the wastewater industry. Greeley and Hansen Engineers, Chicago, Illinois, USA.

March 4 — Hagander P: Monte Carlo and flowsystems cellcycle simulation, a comparison. International workshop on biomathematics and cell kinetics, Asilomar, California, USA.

March 5 — Olsson G: Computer control in treatment processes. California section of Water Pollution Control Federation, Richmond, California, USA.

March 9 — Hagander P: Mathematical analysis of cancer cell dynamics. Univ of Colorado, School of Medicine, Dept of Biometrics, Denver, Colorado, USA.

March 10 — Åström K J: Adaptiv reglering (Adaptive control). Helsingfors, Finland.

March 19 — Wittenmark B: Adaptive and self-tuning control systems, NTH, Trondheim, Norway.

Apr 2-3 — Olsson G: Dynamical modeling, estimation and control of activated sludge systems. Weyerhaeuser Technical Centre, Weyerhaeuser Company, Tacoma, Washington, USA.

Apr 23 — Åström K J: Funderingar kring reglerteknikens teori och praktik (Thoughts on theory and practice in automatic control). Åbo academy, Åbo, Finland.

May 13 — Wittenmark B: Självinställande regulatorer (Self-tuning regulators). Asea, Ludvika, Sweden.

May 13 — Åström K J: Adaptive control. Lecture at the Optimization Days, Montreal, Canada.

May 19 — Åström K J: The parameterization problem in adaptive control. Workshop on System Geometry, System Identification and Parameter Estimation, Henderson House, Mass, USA.

May 20 — Åström K J: Status of computer aided control system design for modeling and identification. GE-RPI-NSF Workshop on Control Design, Schenectady, NY, USA.

May 21 — Gutman P O: Non-linear regulators. Dept of Industrial Electronics, Luleå, Sweden.

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May 27	Åström K J: Adaptive autopilots for ship steering. 2nd Yale Workshop on Applications of Adaptive Control, Yale, New Haven.
June 1 - - July 10	Åström K J: 12 lectures on Adaptive Control. ETH, Zurich, Switzerland.
June 3	Hagander P: Analys och simulering av cellcykelkinetik (Analysis and simulation of cellcycle kinetics). Dept of Automatic Control, University of Uppsala, Sweden.
June 22	Olsson G: Dissolved oxygen control in the activated sludge process. Paper presented at the Int Association on Water Pollution Research (IAWPR). Int workshop on practical experiences of control and automation in wastewater treatment and water resources management, Munich, West Germany.
June 25	Olsson G: Control and automation in wastewater treatment - advances, challenges and disappointments. Invited final workshop address, IAWPR workshop, Munich, West Germany.
June 30	Åström K J: Thoughts on theory and practice of automatic control. Swiss Society of Automation, Switzerland.
Aug 18	Olsson G: Control and estimation methods - Applications to wastewater treatment control. Systems Development Laboratory, Hitachi, Kawasaki City, Japan.
Aug 27	Olsson G: Estimation of loading changes for the nitrifying activated sludge process. Paper presented at the 8th IFAC World Congress, Kyoto, Japan.
Aug 27	Åström K J: Theory and applications of adaptive control. Plenary lecture 8th IFAC World Congress, Kyoto, Japan.
Sept 2	Åström K J: Linear quadratic Gaussian control. Arab School of Science and Technology, Bloudan, Syria.
Sept 5	Åström K J: Adaptive control. Arab School of Science and Technology, Bloudan, Syria.
Sept 24	Olsson G: Operational and control challenges in biological wastewater treatment. Elmia Int Conf on Air and Water Conservation, Jönköping, Sweden.

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Oct 5 — Wittenmark B: Signalbehandling och regleralgoritmer (Sampled data systems and digital controllers). STF course Mikrodatorbaserade processreglersystem (Microcomputer based process control), Linköping, Sweden.

Nov 16 — Mattsson S E: Ada i reglersystem - en tillämpningsstudie (Ada in control applications - A case study). The Swedish Institute of National Defense (FOA), Stockholm, Sweden.

Nov 16 — Elmqvist H: A programming environment for implementation of control systems. IBM Research Laboratory, San José, USA.

Nov 18 — Elmqvist H: A programming environment for implementation of control systems. Xerox Palo Alto Research Center (PARC), Palo Alto, USA.

Nov 24 — Elmqvist H: Dymola - A structured model language for continuous systems and a programming environment for implementation of control systems. Rensselaer Polytechnic Institute, Troy, USA.

Dec 8 — Olsson G: Applications of computer control systems to wastewater treatment. Department of Environmental Science and Engineering, Rice University, Houston, Texas.

Dec 13 — Wittenmark B: Processtyrning med datorer (Process control using computers). In the conference 'Datasystem för Produktions- och Processtyrning' arranged by Svenska Dataföreningen, Kungälv, Sweden.

Dec 18 — Åström K J: Perspective on interactive software for computer aided modeling and design of control systems. 20th IEEE Conf Decision and Control, San Diego, California, USA.

Dec 18 — Olsson G: An approach to air-fuel ratio control for automobile engines using self-tuning regulators. 20th IEEE Conf Decision and Control, San Diego, California, USA.

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March 9 — Olsson G: Dynamics and control in biological wastewater treatment. Dept of Chemical Engineering, Institute of Technology, Lyngby, Denmark.

March 9 — Olsson G: Air-fuel ratio control in internal

combustion engines. Dept of Chemical Engineering, Institute of Technology, Lyngby, Denmark.

April 19 Wittenmark B: Signalbehandling och regleralgoritmer (Sampled data systems and digital controllers). STF course Mikrodatorbaserade processreglersystem (Microcomputer based process control), Linköping, Sweden.

APPENDIX G - TRAVELS

Karl Johan Åström participated in the VDE/VDI Working Group on robust control in Interlaken in Sept 1980. He participated in the Decision and Control Conference in Albuquerque in December. In connection with this he also visited University of California, Berkeley. Åström participated in the second conference on Chemical Process Control in Sea Island, Georgia, in Jan 1981. In connection with this he also visited University of Florida and the Research Department of Honeywell. He was a visiting professor at ETH in Zurich in June and July, 1981. He gave there a graduate course on adaptive control.

In August Åström participated in the 8th IFAC World Congress in Kyoto, where he gave a plenary lecture on Adaptive Control. He was also elected to the IFAC Council. In September 1981 he gave lectures on stochastic control theory and adaptive control at the Arab Summer School in Bloudan, Syria. In December he participated in the 20th IEEE Conference on Decision and Control in San Diego, where he presented papers on computer aided engineering and adaptive control. In February 1982 he visited Rennes to be examiner of the PhD dissertation of Dr Fuchs. In May 1982 he visited University of Washington, S:t Lois, to give a lecture series on adaptive control.

Hilding Elmqvist made a visit to West Germany during four days in June 1981. He visited the following institutions in Karlsruhe: Frankhofer Institut für Informations und Datenverarbeitung (Steusloff), University (Informatik, Goos) and Kernforschungszentrum. He also visited University of München (Institut für Nachrichtentechnique, Färber) and University of Stuttgart (Institut fur Regelungstechnique, Lauber).

Elmqvist visited USA in November 1981. He first attended the ACM Annual Conference in Los Angeles. The following universities and industries were then visited: California Institute of Technology, University of Utah, IBM Research Lab in San José, Stanford University, Xerox PARC in De Anza, San José, Computer Corporation of America in Boston, MIT, Rensselaer Polytechnic Institute in Troy, and Carnegie Mellon University.

Per Hagander participated in the Fifth Annual Meeting of the Cell Kinetics Society, Asilomar, March 1-3, 1981 and presented a paper at the Workshop on Biomathematics and Cell Kinetics Asilomar, March 4-6. He also visited USC, Caltech, UCLA, Univ of Colorado and MIT.

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On March 22-24, 1982, Hagander participated in the Conference on Matrix Pencils in Piteå, Sweden.

Sven Erik Mattsson visited USA together with Sten Bergman (Sydkraft AB) from Nov 28 to Dec 11, 1981. They participated in and presented a paper at the AIAA 2nd Terrestrial Energy Systems Conference, Dec 1-3, 1981, Colorado Springs, Colorado. In California they visited Stanford University, Stanford, Systems Control Inc, Palo Alto, and Electric Power Research Institute (EPRI), Palo Alto.

Gustaf Olsson spent the academic year 1980-1981 as a visiting senior scientist at Systems Control Inc, Palo Alto, California. He gave several guest lectures and seminars in the USA during the year. He also cooperated with the Univ of Houston on a research project on wastewater treatment control, and visited the Weyerhaeuser Company, Tacoma, Washington, in September 1980 and April 1981 for discussions and seminars on wastewater treatment control. In August 1980 he presented a paper at the Joint Automatic Control Conference, San Francisco. He participated in the annual ISA conference in Houston, Texas, in October 1980. In December at the IEEE 19th CDC conference in Albuquerque, New Mexico, he chaired a session on Parameter estimation. In January 1981 he became the chairman of standing committee for international activities within the IEEE Control Systems Society. He participated in a workshop on Computer Aided Design, arranged by the General Electric Co and the Rensellaer Polytechnic Institute, in Schenectady, New York, in May 1981. In June he presented a paper and also delivered the final conference address at the IAWPR International Workshop on Practical Experience of Control and Automation in Wastewater Treatment and Water Resources Management, Munich, West Germany.

During the time July 15 - August 12, 1981, Gustaf Olsson returned to the USA to complete his work at Systems Control, Palo Alto, California. He then spent two weeks in Japan as a "research fellow", invited by the Department of Sanitary Engieering, Kyoto University. He participated in the 8th IFAC World Congress in Kyoto, presented one paper and chaired a session. In December 1981 he spent two weeks in the USA and participated in the IEEE Control and Decision Conference in San Diego, California, where he presented a paper. He also organized and chaired a session on Software for Computer Aided Design of Control Systems. He visited Canada Centre for Inland Waters, Burlington, Ontario as well as the Weyerhaeuser Company, Tacoma, Washington and the Rice University, Houston, Texas.

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Björn Wittenmark visited Univ of Connecticut in Dec 1980 where he gave seminars. At the 19th CDC in Albuquerque, New Mexico, he gave lectures at the workshop a Stochastic Adaptive Control. During the stay in USA he also visited Systems Control Inc in Palo Alto and Stanford University. On March 19-20, 1981, he visited NTH in Trondheim.

Wittenmark visited University of Salford, UMIST, Manchester, and Tec Quipment Ltd, Nottingham, during November 23-26, 1981, for discussions of laboratory equipment. June 1-12, 1982, he visited USA to discuss Computer Engineering education at Carnegie Mellon University, Rensselaer Polytechnique Institute and General Electric Corp. He also participated in the 6th IFAC Symposium on Identification and System Parameter Estimation in Washington.