Activity Report: Automatic Control 2011

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Automatic Control 2011

Activity Report

Automatic Control 2011

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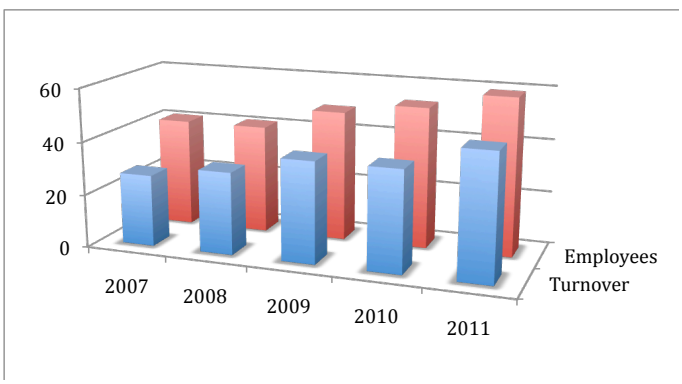
Content

1. Introduction

This report describes the main activities at the Department of Automatic Control at Lund University during the period January 1 to December 31 2011– an exciting period with continued expansion and many interesting events.

The department continued to grow in size. The budget for 2011 was 47 MSEK and we are now 59 persons working at the department (guests not included). The figures for the last 5 years are seen in the table below. More about the financial figures is found in the chapter General Information.



Today (year 2011) the department has 5 full time professors, 3 senior professors, 2 associate professors and 2 assistant professors, 5 research engineers, 5 secretaries, 31 PhD students, including one industrial PhD student, and 6 post-docs. Some of these numbers include part-time positions. During the year one new PhD student was admitted to the department. Moreover, Monika Rasmusson joined the department as administrator, and Giacomo Como and Johan Åkesson were hired as assistant professors. During the year Charlotta Johnsson was also appointed to ”Docent”.

Two PhD theses, by Erik Johannesson and Per-Ola Larsson, were published during 2011. Erik is now working at McKinsey and Per-Ola at Modelon. The total number of PhDs graduating from the department is now up to 88. There were also four licentiate theses presented: by Marzia Cescon, Magnus Linderoth, Vanessa Romero Segovia and Anna Lindholm.

Five new research proposals were accepted with funding from Swedish agencies and EU.

The ICT-Psi project funded by SSF is a cooperation with KTH around control and infrastructure design of the power network . Two robotics projects were also initiated: PRAISE and SME-robotics. Two new projects were also obtained from the Swedish Research Council, to Giacomo Como and Karl Erik Årzen.

The EU FP7 STREP project ACTORS was successfully terminated exceeding plans and given excellent evaluation grades.

Duing 2011 we gave 15 courses to 928 students and 37 students presented their master's thesis at the department. We also arranged 7 PhD courses. More about this in the chapters Education and Research.

Our Linnaeus Center LCCC (Lund Center for Control of Complex Engineering Systems) continued to expand and is now up to full speed. The center organized a focus period on "Dynamics, Control and Pricing in Power Systems" in May2-May27 which brought together researchers in the fields of control, power systems and economics. During December a three day workshop on "Control of Computing Systems" was arranged. It was co-organized with the FP7 NoE ArtistDesign project. The LCCC advisory board meeting was held during two days in connection with the IFAC world congress.

The traditional Swedish-Chinese control meeting was held in May in Lund. This was the 5th occasion with 27 invited speakers and about 40 participants.

The department also took part in organizing the ELLIIT workshop in Lund in October. The ELLIIT network organization is a cooperation between 9 different departments from Lund, Linköping, Bleking and Halmstad universities. The workshop attracted about 150 persons and consisted of keynote speakers, project presentations and a poster session. As a result of the ELLIIT project an increasing amount of research projects are now performed in cooperation with colleagues in Linköping.

A further highlight during the year was that the textbook Feedback Systems: An Introduction for Scientists and Engineers, by Åström and Murray, received the IFAC Control Engineering Textbook Prize. The motivation reads "This textbook presents an innovative and enticing approach to feedback control of dynamic systems, which is accessible to students from diverse backgrounds….".

Bo Bernhardsson and Eva Westin

2. Education

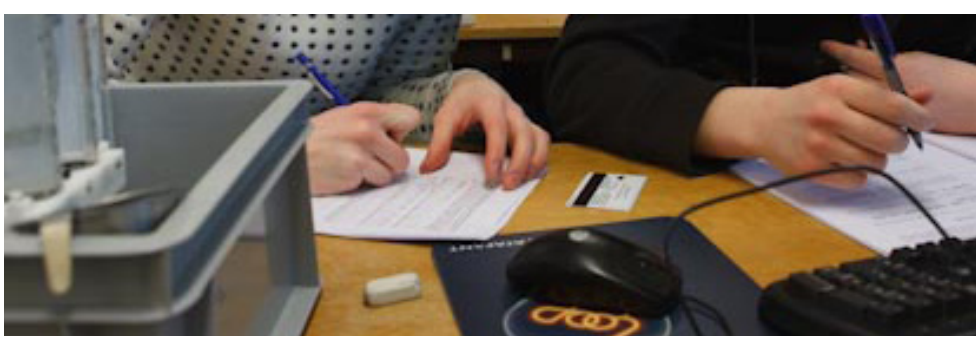
2.1 Basic Level

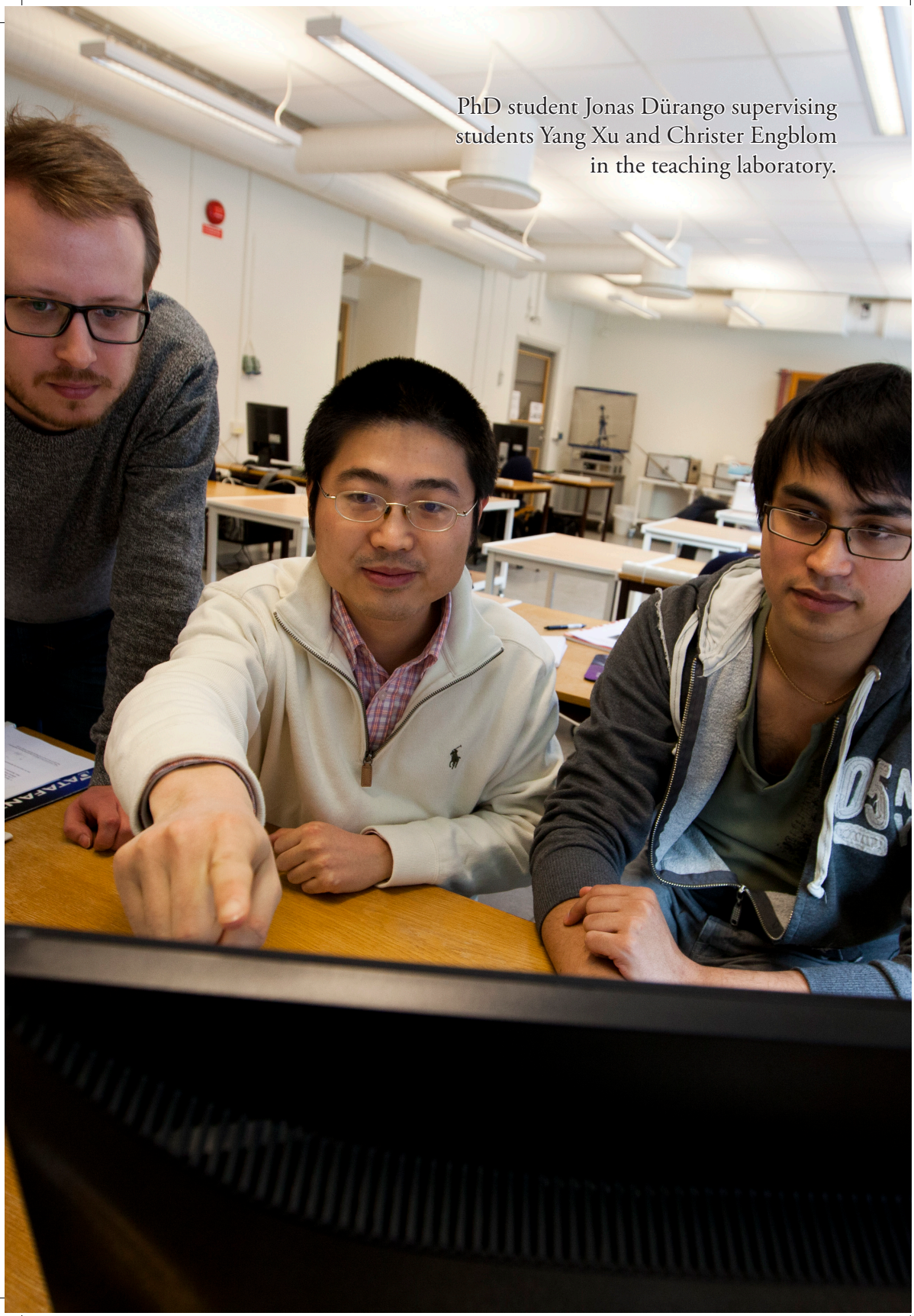
The engineering education follows the central European systems with a five year program leading up to the university degree "civilingenjör" (civ.ing.), with the international title MSc. Automatic control courses are taught as part of the engineering curriculum in Engineering Physics (F), Electrical Engineering (E), Computer Engineering (D), Mechanical Engineering (M), Information and Communication Engineering (C), Environmental Engineering (W), Engineering Mathematics (Pi), Industrial Management and Engineering (I), Biotechnology (B), Engineering Nanoscience (N) and Chemical Engineering (K).

During 2011 the department has been involved in courses given together with Lund University School of Economics and Management. Within this interdisciplinary cooperation called Technology Management, 16 future engineers have completed a master's thesis in pair with a future economist. These students have also completed different courses on the subject.

This year, 952 students passed our courses and 37 students completed their master's thesis projects. A list of the master's theses is given in the Annex. The number of registered students correspond to 135 fullyear equivalents during the year. The numbers for 2010 were 850, 45 and 123 respectively.

In the table below, our courses are listed along with the number of students who passed each course. Each course in the engineering program has its own homepage, documentation, manuals, old exams etc. We also have information sheets about the engineering courses, the master's theses and the doctorate program. You'll find the links at **www.control.lth.se/education/**





PhD student Jonas Dürango supervising students Yang Xu and Christer Engblom in the teaching laboratory.

2.2 PhD Studies

The PhD education consists of four years of studies: 120hp of courses and 120hp of thesis work. Since most students have 20% of teaching duties, the nominal time for the PhD education is 5 years. In the Swedish system there is also a possibility to do a half-time thesis called a ”Licentiate”.

Four licentiate theses were presented during 2011, by Marzia Cescon, Magnus Linderoth, Vanessa Romero Segovia and Anna Lindholm (see abstracts below in 2.3).

Two doctoral theses were also defended during the year by Erik Johannesson and Per-Ola Larsson (see abstracts below in 2.4).

We have admitted Mahdi Ghazaei as PhD student during 2011.

The following PhD Courses were given in 2011:

* Optimization with Casadi, Joel Andersson and Johan Åkesson
* Network dynamics, Giacomo Como
* Robust Control, Maxim Kristalny
* Machine Learning, vt 2, Thomas Schön
* Statistical Sensor Fusion, Fredrik Gustafsson
* Stochastic Control, Björn Wittenmark
* SLAM, continuation from 2010, Group study

2.3 Licentiate Dissertations

The licentiate theses, of which the abstracts are presented below, are available in their entirety at www.control.lth.se/publications

Linear Modeling and Prediction in Diabetes Physiology
Marzia Cescon

Diabetes Mellitus is a chronic disease characterized by the inability of the organism to autonomously regulate the blood glucose level due to insulin deficiency or resistance, leading to serious health damages. The therapy is essentially based on insulin injections and depends strongly on patient daily decisions, being mainly based upon empirical experience and rules of thumb. The development of a prediction engine capable of personalized on-the-spot decision making concerning the most adequate choice of insulin delivery, meal intake and exercise would therefore be a valuable initiative towards an improved management of the desease. This thesis presents work on data-driven glucose metabolism modeling and short-term, that is, up to 120 minutes, blood-glucose prediction in Type 1 Diabetes Mellitus (T1DM) subjects. In order to address model-based control for blood glucose regulation, low-order, individualized, data-driven, stable, physiological relevant models were identified from a population of 9 T1DM patients data. Model structures include: autoregressive moving average with exogenous inputs (ARMAX) models and state-space models. ARMAX multi-step-ahead predictors were estimated by means of least-squares estimation; next regularization of the autoregressive coefficients was introduced. ARMAX-based predictors and zero-order hold were computed to allow comparison. Finally, preliminary results on subspace-based multi-step-ahead multivariate predictors is presented.

Robotic Work-Space Sensing and Control
Magnus Linderoth

Industrial robots are traditionally programmed using only the internal joint position sensors, in a sense leaving the robot blind and numb. Using external sensors, such as cameras and force sensors, allows the robot to detect the existence and position of objects in an unstructured environment, and to handle contact situations not possible using only position control. This thesis presents work on how external sensors can be used in robot control. A vision-based robotic ball-catcher was implemented, showing how high-speed

computer vision can be used for robot control with hard time constraints. Special attention is payed to tracking of a flying ball with an arbitrary number of cameras, how to initialize the tracker when no information about the initial state is available, and how to dynamically update the robot trajectory when the end point of the trajectory is modified due to new measurements. In another application example, force control was used to perform robotic assembly. It is shown how force sensing can be used to handle uncertain positions of objects in the workspace and detect different contact situations.

Adaptive CPU Resource Management for Multicore Platforms
Vanessa Romero Segovia

The topic of this thesis is adaptive CPU resource management for multicore platforms. The work was done as a part of the resource manager component of the adaptive resource management framework implemented in the European ACTORS project. The framework dynamically allocates CPU resources for the applications. The key element of the framework is the resource manager that combines feedforward and feedback algorithms together with reservation techniques. The reservation techniques are supported by a new Linux scheduler through hard constant bandwidth server reservations. The resource requirements of the applications are provided through service level tables. Dynamic bandwidth allocation is performed by the resource manager which adapts applications to changes in resource availability, and adapts the resource allocation to changes in application requirements. The dynamic bandwidth allocation allows to obtain real application models through the tuning and update of the initial service level tables.

Utility Disturbance Management in the Process Industry
Anna Lindholm

Use of utilities, such as steam and cooling water, is very common at industrial sites. Utilities are often shared between several production areas, and a disturbance in the supply of a utility is therefore likely to affect a large part of the production site, and cause great loss of revenue. In order to minimize the loss of revenue due to disturbances in utilities, the optimal supply of utilities to different areas has to be determined. It is not evident how utility resources should be divided, as both buffer tank levels, the connections between areas and profitability of different areas must be considered. This thesis presents a general method for reducing the loss of revenue due to distur-

bances in utilities, the Utility Disturbance Management method (UDM). The method concerns identifying disturbances in utilities, estimating the loss of revenue due to such disturbances, and finding strategies for reducing the loss. A model of the production site is needed to complete all steps of the method. In this thesis, some modeling approaches are suggested, and on/off production modeling with and without buffer tanks is described in detail. The UDM method is applied to an industrial site at Perstorp using these two modeling approaches.

2.4 Doctoral Dissertations

The doctoral theses, of which the abstracts are presented below, are available in their entirety at www.control.lth.se/publications

Control and Communication with Signal-to-Noise Ratio Constraints
Erik Johannesson

This thesis is about two problems in the intersection of communication and control theory. Their common feature is that they involve communication over an additive white noise channel with a signal-to-noise ratio (SNR) constraint. The first problem concerns the transmission of a real-valued signal from a partially observed Markov source. The distortion criterion is the mean squared error and the transmission is subject to a delay constraint, which introduces the need for real-time coding. The problem is first considered for scalar-valued signals when the channel has no feedback and then, in turn, generalized to each of the cases with non-white channel noise, vector-valued signals or channel feedback. It is shown that jointly optimal encoders and decoders within the linear time-invariant (LTI) class can be obtained by solving a convex optimization problem and performing a spectral factorization. The functional to minimize is the sum of the well-known cost in a corresponding Wiener filtering problem and a new term that is induced by the channel noise. The second problem, which can be viewed as a generalization of the first problem, concerns a networked control system where an LTI plant, subject to a stochastic disturbance, is to be controlled over the channel. The controller is based on output feedback and consists of an encoder/observer that measures the plant output and transmits over the channel, and a decoder/controller that receives the channel output and issues the control signal. The objective is to stabilize the plant, satisfy the SNR constraint and minimize the variance of the disturbance response. The problem is studied for channels without and with feedback. In both cases, it is shown that optimal controllers within the LTI class can be obtained by solving a convex optimization problem and performing a spectral factorization. Previously known

conditions on the SNR for stabilizability follow directly from the constraints of these optimization problems.

Optimization of Low-Level Controllers and High-Level Polymer Grade Changes

Per-Ola Larsson

Two design problems at different levels in the control hierarchy are considered; optimization of robust low-level controllers with constrained control signal activity and optimization of economical high-level polyethylene grade changes.

As for the first design problem, a constraint on control signal activity due to measurement noise is presented and used when optimizing and comparing PI/PID controllers with measurement filters of different orders. The results show increased performance when roll-off is present in the feedback loop and that similarities exist between PID and high-order Youla-parametrized controllers.

Robustness margins separating the dead-time uncertainty from other process uncertainties are presented. Methods to compute the margins, posed as optimization problems based on Nyquist diagram interpretations, are given.

PID and predictive PI (PPI) controllers with measurement filters are optimized and compared using the presented control signal activity constraint and robustness margins. The two controllers show similar performance on industrially representative processes, with a few exceptions where the PID controller outperforms the PPI controller.

Concerning the second design problem mentioned above, a cost function for optimization of economical polyethylene grade changes is proposed. It considers inflow costs, on- and off-grade polymer production revenues and polymer quality variable intervals to define on-grade production as well as economical incentives for on-target production.

Using the JModelica.org platform, several stationary operating points and dynamic grade changes are optimized with regards to economy. The optimizations are based on Modelica models of both a gas-phase polyethylene reactor and the polyethylene plant PE3 at Borealis AB. The results show that economically optimal grade changes can be divided into three phases with distinguishing features, and that the synchronization of control flows and the usage of recycle area off-gas flows are important.

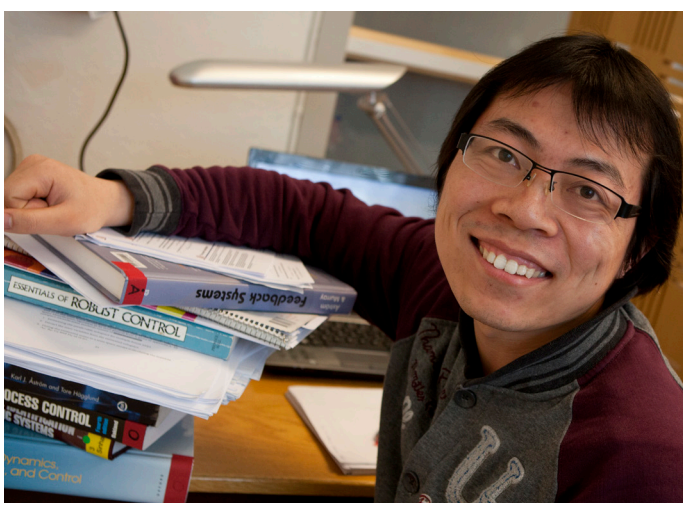
A Modelica library for the plant PE3 at Borealis AB, including three reactors and three distillation columns, is presented.

2.5 Focus on PhDs

Visiting Automatic Control in Lund

I received my Bachelor's Degree in automation from Zhejiang University in Hangzhou in 2008 and since then became a PhD Student there with Prof. Zhihuan Song as my supervisor. My research interests are modeling, control, monitoring and identification for process industries. I'm working on detection and diagnosis of model plant mismatch in control loop with applications in metal processing.

Visiting Lund is one of the luckiest and most important experiences in my life. I was trying to find an opportunity to cooperate with the top researchers when I met Dr. Alexander Horch from ABB. I knew the Department of Automatic Control in Lund is one of the strongest in control for long, but I had no connections yet. Fortunately he promised to recommend me to Prof. Tore Hägglund. Then fund is another essential factor for the visit. Erasmus Mundus Europe Asia (EMEA) program covers some exchange studies to Lund University. None of the long listed subprojects, however, are from this department. I was a little bit frustrated but decided to create a subproject for myself. I contacted Tore about a potential visit by the fund from EMEA and then met Daria and Erik to know more about each side in Hangzhou. They welcomed my visit and I wanted to be here more then ever. Next I wrote to the EMEA committee to save this great opportunity and they agreed to add another subproject for me to compete. After a four months' selection, I was granted the fund and admission to Lund University!



I will keep enjoying the stay in Lund and continue my doctoral study after leaving here in June 2012. I'm expected to finish my thesis defense and find a job a year later. Definitely I will miss Lund and hope to come back!

Hong Wang

3. Research 2011

The Department of Automatic Control has been very successful regarding research during 2011. The department currently has four excellence centers, i.e. longterm strategic research projects and major research areas. The research spans from application-oriented projects to theory-oriented projects.

3.1 Excellence Centers

LCCC – Lund Center for Control of Complex Engineering Systems

LCCC is a Linnaeus Center at Lund University funded by the Swedish Research Council. The ten principal investigators are from the Department of Automatic Control and the Department of Electrical and Information Technology.

Process Industrial Centre at Lund University

Swedish process industry and the Foundation of Strategic Research has founded a Process Industry Centre at Lund University. PIC-LU is a collaboration between the departments of Chemical Engineering and Automatic Control at the Faculty of Engineering.

ELLIIT Strategic Research Center

ELLIIT is a network organization for Information and Communication Technology (ICT) research at the universities in Linköping, Lund, Halmstad and Blekinge, which has been created to support and enhance an internationally acknowledged research environment in these areas. The objective is scientific excellence in combination with industrial relevance and impact. It is organized within the Swedish government's strategic research support initiative.

Competence Center Combustion Processes (KCFP)

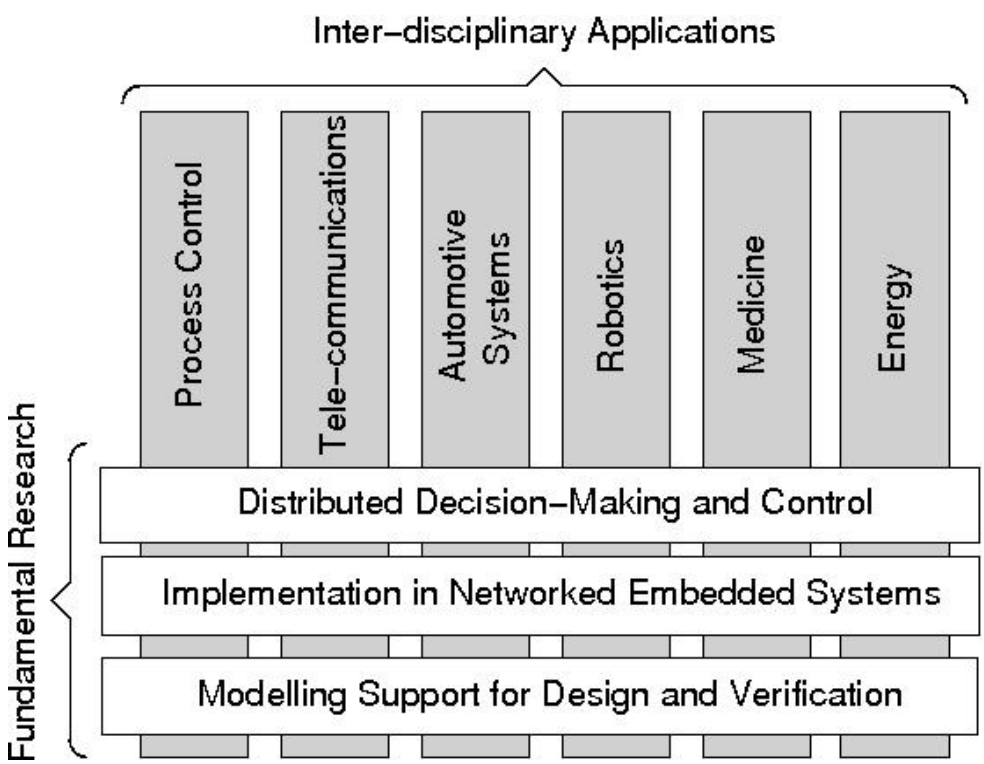
The Competence Center on Combustion Processes at Lund University focuses on research on combustion processes in domain between conventional HCCI (Homogeneous Charge Compression Ignition) and classical Otto and Diesel engines.

LCCC – Lund Center for Control of Complex Engineering Systems

LCCC is a Linnaeus Center at Lund University funded by the Swedish Research Council. The ten principal investigators are from the Department of Automatic Control and the Department of Electrical and Information Technology.

LCCC official website: http://www.lccc.lth.se/

Our vision is to make fundamental contributions to a general theory and methodology for design and operation of complex systems. This includes scalable methods and tools for modeling, analysis and control synthesis, as well as reliable implementations using networked embedded systems.



Focus Period on Dynamics, Control and Pricing in Power Networks, May 2011

Our power network is under rapid transformation due to economic incentives and integration of renewable resources. Technoloy for control and communication is at the heart of this development, but there is also a strong coupling to economics and market forces. The objective of this focus period is to create an environment where leading researchers in power systems, control engineering and economics can meet and work under optimal circumstances. Our aim is to create an environment for cross-fertilization and new ideas.

Speakers: Göran Andersson, ETH Zürich; Aranya Chakrabortty, North Carolina State University; Joe H. Chow, Rensselaer Polytechnic Institute; Antonio Conejo, Universidad de Castilla - La Mancha; Ian A Hiskens, University of Michigan; Gabriela Hug, Carnegie Mellon University; Karl H Johansson, KTH Stockholm; Marija D. Ilic, Carnegie Mellon University; Kurt Jörnsten, Norges Handelshøyskole; Javad Lavaei, Caltech; Stephen Low, Caltech; Yuri Makarov, Pacific Northwest National Laboratory; Sean Meyn, Univ of Illinois; Fernando Paganini, Universidad ORT Uruguay; Antonis Papachristodoulou, Oxford University; Kameshwar Poolla, UC Berkeley; Jacob Østergaard, Technical University of Denmark; Anders Rantzer, Lund University; Olof Samuelsson, Lund University; Henrik Sandberg, KTH Stockholm; Jacquelien Scherpen, University of Groningen; Lennart Söder, KTH Stockholm; Pravin Varaiya, UC Berkeley

Workshop on Control of Computing systems, December 2011

Performance and resource management in computing systems is increasingly important in everything from server systems in data centers to embedded systems. During recent years the use of feedback control techniques has attracted an increased attention both in academia and industry as a means for for realizing this.
The objective of this workshop is to gather leading researchers in the field from both the control amd the computing communities. Our aim is to create an environment for cross-fertilization and new ideas. In addition to the three day workshop the two following days are set aside for further discussion, seminars etc at the Department of Automatic Control, Lund University.

Speakers: Tarek Abdelzaher, University of Illinois, Urbana-Champaign; Karl-Erik Årzén, Lund University; Luca Benini, University of Bologna; Enrico Bini, Scuola Superiore St'Anna; Anton Cervin, Lund University; Yixin Diao, IBM; Johan Eker, Ericsson Research; Erik Elmroth, Umeå University; Gerhard Fohler, TU Kaiserslautern; Jim Håkansson, Ericsson; Karl Henrik Johansson, Royal Institute of Technology, Stockholm; Niklas Karlsson, Advertising.com Group; Jeffery Kephart, IBM; Maria Kihl & Anders Robertsson, Lund University; Mike Lemmon, University of Notre Dame; Jie Liu, Microsoft; Martina Maggio, Polytechnico di Milano; Luigi Palopoli, University of Trento; Zebo Peng, Linköping University; Eric Rutten, INRIA; Bruno Sinopoli, Carnegie Mellon University; Rolf Stadler, Royal Institute of Technology, Stockholm; Toshimitsu Ushio, Osaka University; Bo Wahlberg, Royal Institute of Technology, Stockholm; Zhikui Wang, HP Labs - Multi-scale thermal control and optimization problems in data centers; Björn Wittenmark, Lund University; Xiaoyun Zhu, VMWare

ELLIIT - Excellence Center at Linköping - Lund on Information Technology

Researchers: Karl-Erik Årzén, Bo Bernhardsson, Anton Cervin, Anders Rantzer, Jerker Nordh, Anders Mannesson, Anders Robertsson, Rolf Johansson, Isolde Dressler, Yang Xu, Karl Berntorp in collaboration with reserachers at the Departments of Computer Science, Electrical and Information Technology, and Mathematics, Lund University, and Linköping University, Halmstad University, and Blekinge University.

Funding: VINNOVA/VR (National Strategic Research Area)
ELLIIT official homepage: http://www.elliit.liu.se/

ELLIIT is a network organization for Information and Communication Technology (ICT) research at Linköping, Lund, Halmstad and Blekinge, which has been created to support and enhance an internationally acknowledged research environment in these areas. The objective is scientific excellence in combination with industrial relevance and impact. It is organized within the Swedish government's strategic research support initiative.

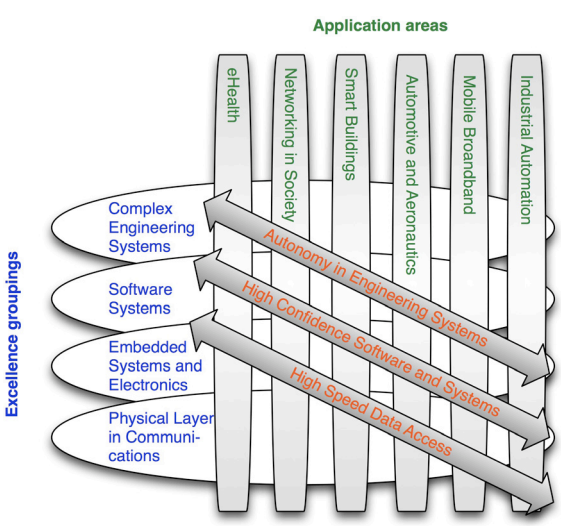
ELLIIT is a joint research program in Information and Communication Technology between four university sites: Linköping University, Lund University, Blekinge Institute of Technology and Halmstad University.

The research is organized based on four excellence groupings among the four sites: Complex Engineering System, Software Systems, Embedded Systems and Electronics and Physical Layer in Communications.

Three main themes dominate the research: Autonomy in Engineering Systems, High Confidence Software and Systems and High Speed Data Access.

Six application areas are also treated:

1. Industrial Automation
2. Mobile Broadband
3. Automotive and Aeronautics
4. Smart Buildings
5. Networking in Society
6. eHealth



Process Industrial Centre at Lund University

Researchers: Johan Åkesson, Tore Hägglund, Martin Hast, Charlotta Johnsson, Ola Johnsson, Per-Ola Larsson, Anna Lindholm, Kristian Soltesz

With support from the Swedish Foundation for Strategic Research (SSF), a new centre, PIC-LU, has been established in collaboration with the department of Chemical Engineering.
PIC-LU official hompage: www.pic.lu.se

All research activities are organised into integrated projects. Each project has one project leader and one to three PhD students. The project leaders, the PhD students, and possible Master Thesis students, make up PIC-LU academy. Each project studies a specific application in close collaboration with one or two industrial partners. The involved persons from the industrial partner companies make up PIC-LU industry. The project leaders, together with the centre leader and the vice centre leader, form the PIC-LU centre management group which meets once a week for informal discussions. The centre leader is responsible for the day-to-day operations of the centre and has, together with vice centre leader, the responsibility to integrate the centre into the departments. The PIC-LU board has the overall responsibility of the centre. The board consists of members from both academia and industry with a chairman from industry.

The research program is organized in five integrated projects and focused on the three topics; flexibility, controllability and availability. The projects have a strong interaction both between the projects and with industrial partners. Current industrial partners are Borealis, K. A. Rasmussen, Novo Nordisk, Novozymes, Modelon, Perstorp, and Pfizer.

Short project descriptions:

1. Optimal grade changes, is a collaboration between the two departments and Borealis, mainly focused on flexibility. It is a two PhD student project with a part time senior researcher and it started in the beginning of 2009. The industrial partner Modelon will join the project in 2011.
2. Utility disturbance management, is collaboration between Automatic Control and Perstorp, and availability is the research theme. It is a one PhD student project with some additional senior research time and it started in the second half of 2009.
3. Quality by design and control, is a collaboration between Novo Nordisk, Pfizer and Chemical Engineering with the main theme controllability. The project started already in July 2008 and is a two and a half PhD student project.

4. Flexible design, is a collaboration between Chemical Engineering and K.A.Rasmussen and started in 2010, based on industrial funding. The theme is flexibility and is a one PhD student project with additional research resources.

5. Fed-batch control, is a collaboration with Automatic Control, Chemical Engineering and Novozymes. The project, which is a one PhD student project, started in the second half of 2010 and has controllability as research theme.

KCFP, Competence Center Combustion Processes

Researchers: Rolf Johansson and Anders Widd in cooperation with
Patrick Borgqvist, Assoc. Prof. Per Tunestål and Prof. Bengt Johansson,
Div. Combustion Engines, Lund University.

Competence Center Combustion Processes at Lund University focuses on research of combustion processes between conventional HCCI (Homogeneous Charge Compression Ignition) and classical Otto and Diesel engines.

The research within KCFP is organized in projects. Each project has a project leader, a reference group and one ore more PhD students. There are three main projects within KCFP:

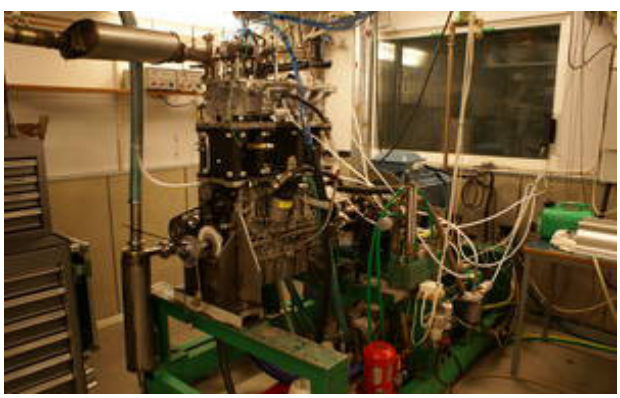
* Partially Premixed Combustion (PPC) project
* Generic Diesel Combustion (GenDies) project
* Gas Engine project

These projects are financed directly by KCFP and controlled by the KCFP board. The PPC project has six sub projects:

* Heavy Duty
* Light Duty
* Control
* Fuel
* Model
* Laser

In addition to these projects the following associated projects with other sources of funding are within the area of interest for KCFP:

* D60
* MPPC
* Microwave Ignition
* CCC
* Closed-loop diesel
* Diesel engine control for low environmental impact
* Pneumatic hybrid
* HCCI index



3.2 Modeling and Control of Complex Systems

Theory and computer tools are developed to deal with fundamental complexity issues appearing in for example vehicles, power systems and communications.

AEOLUS - Distributed Control of Large-Scale Offshore Wind Farms

Researchers: Daria Madjidian, Ahmed H. El-Shaer, Maxim Kristalny, Anders Rantzer in collaboration with project partners from Aalborg University, Industrial Systems and Control Ltd in Glasgow, University of Zagreb, Energy Research Centre of the Netherlands and Vestas Wind Systems A/S.

The project is funded by EU/IST/FP7. Duration May 2008 – April 2011.

Aeolus is an European research project funded by the European Commission under the IST framework programme 7 for Information and Communication Technology, ICT. The main goal of Aeolus is to research and develop models that allow real-time predictions of flows and incorporate measurements from a set of spatially distributed sensor devices. In Aeolus we will use the flow information as a basis for new control paradigms that acknowledge the uncertainty in the modelling and dynamically manage the flow resource in order to optimise specific control objectives.

November 14, 2008 Aeolus together with LCCC organized a Wind Power Meeting in Lund.

AEOLUS official website: www.ict-aeolus.eu

CHAT - Control of Heterogeneus Automation Systems

Researchers: Pontus Giselsson, Erik Johannesson, Mikael Lindberg, José Maestre, Karl Mårtensson, Anders Rantzer, Karl-Erik Årzén in collaboration with project partners from University of Pisa, Siemens AG, University of Trento, University College London, Elsag Datamat, Sofidel and University of Salento.

The project is funded by EU/IST/FP7.
Duration September 2008 – August 2011.

CHAT official website: www.chat.eu

Scalability, reconfigurability, and security are three aspects of paramount importance in developing efficient, predictable, and safe control architectures for large-scale networked industrial automation. At present, the state of control systems technology is such that the supervision and control of larger and more complex plants cannot be achieved without considerable costs in terms of hard infrastructure and software development.

CHAT is a research project exploring the research and engineering challenges inherent in the development of algorithms, protocols and procedures for next generation distributed control systems, in order to drastically reducing infrastructure, maintenance and reconfiguration costs.

Involvement

The Department of Automatic Control is involved in developing price mechanisms for distributed control as well as consensus and distributed estimation algorithms. Currently the focus is on using such methods for mobile robot task allocation. We have also provided simulation environments, extended to incorporate industrial network standards to our partners (FlexRay and PROFINET in Truetime).

Control with Communication Constraints

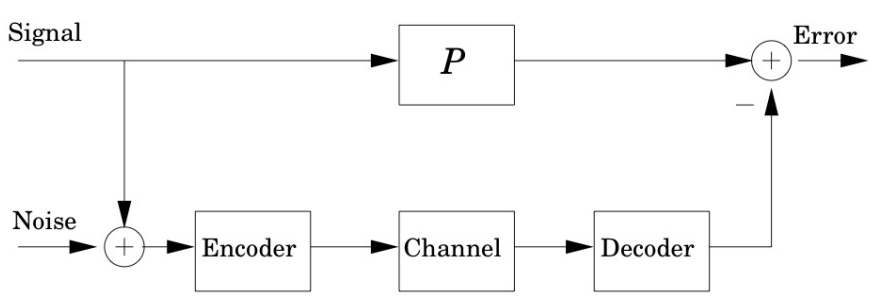
Researchers: Erik Johannesson, Anders Rantzer,
Bo Bernhardsson, Andrey Ghulchak

Funded by the Swedish Research Council.

Classical control theory assumes perfect communication, without limitations, between different parts of the control system and the process. A current trend in control systems is, however, for the systems to become more distributed and more dependent on communication over different types of networks. This makes it necessary to study the implications of the resulting communication constraints. In the control community this has spurred interest in the research of the interplay between communication and control. The results have mainly concerned fundamental limitations of control performance that arise from communication constraints.

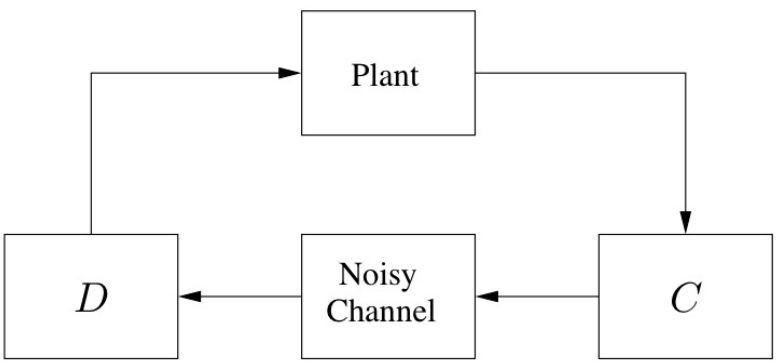
In this project, the goal is to design optimal controllers and estimators for some specific problems with limited communication. We model the communication constraints by analog communication channels with limited SNR (signal to noise ratio). These channels give an incentive to perform coding and decoding of the transmitted signal, in addition to the usual filtering and computation of control signals. The problem of designing the controller, coder and decoder simultaneously is a distributed control problem, which can be solved using tools from convex optimization. Currently, we are focusing on two specific problem structures, which represent an estimation problem and a control problem respectively.

Estimation over Channel with SNR Constraint



The objective is to design the coder and the decoder so that the estimation error is minimized. This can be interpreted as a real-time coding problem (if P is replaced by a time delay) with input noise. Another interpretation is that this concerns the design of a disturbance feedforward compensator, where the sensor and the actuator are geographically separated.

Control over Channel with SNR Constraint



In this problem, the objective is to design an observer/coder C and decoder/controller D that stabilize the plant and minimizes the effect caused by a plant disturbance (not shown).

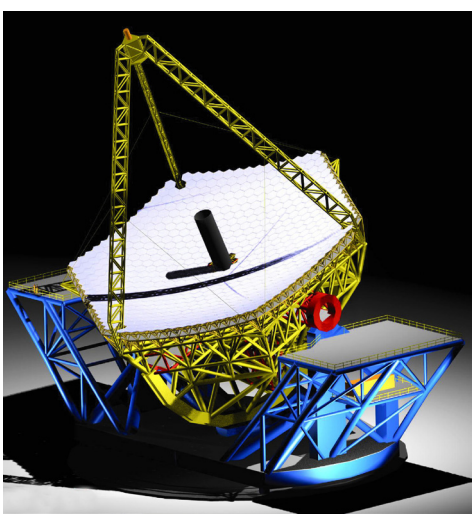
Modeling and Validation of Complex Systems

Researchers: Anders Rantzer, Kin Cheong Sou
and Aivar Sootla.

Funded by the Swedish Research Council and Toyota Motor Corporation.

Large complex mathematical models are regularly used for simulation and prediction. However, in control design it is a common practice to work with as simple process models as possible. This makes it easier to analyze and evaluate the model, or to use it as a component for efficient system-wise evaluation. On the other hand, models are typically dependent on some adjustable parameters, which allow system design. Therefore, the capability of simplifying parameter dependent models is important from an efficient design point of view. One objective of this project is to develop methods for parameterized model reduction, where a single parameter dependent reduced model is an accurate simplification of the original complex model for all the parameter values of interest. In this project, a semidefinite programming based parameterized model reduction method is being developed.

Another aspect of this project is to develop model reduction tools that take into account the properties and restrictions of large scale distributed networked systems. Model reduction schemes guaranteeing overall system stability is being developed. In addition, structure preserving model reduction and network topology simplification methods are also being investigated.



As an academic case study of the developed reduction tools a model of deformable telescope mirror is considered. The initial full order model is obtained using finite-element modeling approach, which yields a high order system. The telescope model was developed within the Euro50 modeling project (see, http://www.astro.lu.se/~torben/euro50/).

Language Support for Dynamic Optimization

Researchers: Johan Åkesson, Karl-Erik Årzén
and Görel Hedin (Comp. Sci.)

Overview

Efficient development and operation of control systems is essential in industry today. Optimization is increasingly used as a standard tool to improve operation, both in on-line and off-line applications. Examples are calculation of operating points, grade change trajectories and production schedules that maximize production while minimizing raw material, energy and other resources. Similar issues arise in the design of embedded control systems for e.g., the automotive, avionics, and mobile telecom areas, where efficient utilization of computing, communication, and/or battery resources is required in order to meet market demands. This can also often be formulated as optimization problems.

Due to the ever increasing complexity of plants, a model-driven approach is required. At the heart of this project is a language-based approach for developing a high-level description framework targeted at unified modeling of physical systems and associated optimization problems. This also includes development of prototype software, which transforms a high-level description into a canonical mathematical model representation. This canonical representation may then be used as a basis for code generation for the above mentioned applications. The main topic of the project is the formulation of large-scale optimization problems. Associated with this topic is also code generation for numerical solvers.

Optimica

A key issue is the definition of syntax and semantics of the Modelica extension, Optimica. Optimica provides the user with language constructs that enable formulation of a wide range of optimization problems, such as parameter estimation, optimal control and state estimation based on Modelica models.

At the core of Optimica are the basic optimization elements such as cost functions and constraints. It is also possible to specify bounds on variables in the Modelica model as well as to mark variables and parameters as optimization quantities, i.e., to express what to optimize over. While this type of information represents a canonical optimization formulation, the user is often required to supply additional information, related to the numerical method which is used to solve the problem. In this category we have

e.g., specification of transcription method, discretization of control variables and initial guesses. Optimica also enables convenient specification of these quantities.

The first version of Optimica was published in 2007. Current research focuses on extending Optimica to support specification of Model Predictive Controllers (MPC), mixed-integer programs and multistage problems.

Software Tools - the JModelica.org platform

One of the results of the research project is an open source project entitled JModelica.org. JModelica.org is an extensible Modelica-based open source platform for optimization, simulation and analysis of complex dynamic systems. The main objective of the project is to create an industrially viable open source platform for optimization of Modelica models, while offering a flexible platform serving as a virtual lab for algorithm development and research. As such, JModelica.org is intended to provide a platform for technology transfer where industrially relevant problems can inspire new research and where state of the art algorithms can be propagated form academia into industrial use. JModelica.org is currently managed by the Lund-based company Modelon AB and continues to evolve in close collaboration with several departments at Lund University, including Automatic Control, Mathematics and Computer Science.

JModelica.org features compilers supporting code generation of Modelica models to C, a C API for evaluating model equations and their derivatives and optimization algorithms. The compilers and the model C API has also been interfaced with Python in order to enable scripting and custom application development. In order to support formulation of dynamic optimization of Modelica models, JModelica.org supports the Optimica extension. Solution of dynamic optimization problems is supported by an implementation of a simultaneous collocation algorithm based on the NLP solver IPOPT.

Applications and related projects

JModelica.org, and prototypes thereof, have been used in a number of industrial size applications. These include start-up optimization of a plate reactor, lap time optimization for racing cars and optimal robot control. In a recent project, JModelica.org is used to compute optimal grade change profiles in collaboration with plastics manufacturer Borealis. For details, see the corresponding research home page. The project is also related research on parallel methods for dynamic optimization.

Parallel Methods for Dynamic Optimization

Researchers: Johan Åkesson, Carl Laird
(Texas A&M University, TX, USA)

Optimization is used extensively in many contexts in control engineering. Applications include design optimization to develop optimal processes, set-point optimization to minimize raw material and energy consumption, and on-line optimal control strategies such as Model Predictive Control (MPC). As systems are becoming increasingly complex, the need for efficient computational methods is put into focus.

The proposed research project is motivated by Moore's law, which states that the maximum number of transistors that be fit into an Integrated Circuit to a reasonable cost is doubled every other year. For decades, Moore's law has been closely related to important performance measures, for example the computational power of processors found in desktop computers. During the last 3-4 years this situation has changed, however. While the number of transistors on an Integrated Circuit continues to increase rapidly, many software applications does not run at correspondingly higher execution speeds. The explanation is that modern processors are equipped with multiple cores. Also, the clock frequency, which directly affect execution speed, is increasing only moderately. Many applications are capable of utilizing only one core, and cannot benefit from the availability of multi-core architectures.

In order to utilize more than one core, new methods and/or application of known methods in new contexts are needed. Such methods are typically specific for different application areas. In the field of dynamic optimization, development of parallel and distributed methods is essential in order to efficiently meet the challenges outlined above. In principle, there are two different scenarios that require attention. In the first scenario, the main challenge is the complexity of the problem. In this case, decomposition and parallelization is important in order to obtain manageable subproblems to distribute amongst the available cores. In the second scenario, the complexity of the problem may be moderate, but the computation time is critical. For example, MPC falls into this category. In this case, parallel algorithms are needed in order to fully explore the computational power of multi-core architectures and thereby reduce computation times.

Active Control of Compressor Systems Based on New Methods of Nonlinear Dynamic Feedback Stabilization

Researchers: Rolf Johansson, Anders Robertsson, Alina Rubanova in cooperation with Prof. Anton Shiriaev, Umeå University & NTNU, Trondheim

Funding: Swedish Research Council 2007-2009, Ref. 2006-5243; VR 2007-2009, VR 2009-3178)

This project deals with a number of facts related to the output feedback stabilization of the Moore-Greitzer compressor model. We show that quadratic feedback stabilization of the surge subsystem of the three-state Moore-Greitzer compressor model, which ensures an absence of additional equilibria in the augmented with stall dynamics closed loop system, implies convergence of all solutions to the unique equilibrium at the origin. Then some steps in developing such output feedback controller for surge subsystem are discussed, and a family of controllers is presented. Based on our new theoretical results on integrability, stability, nonlinear dynamic output feedback control, we wish to pursue active control application to compressor systems and experimental verification.

Adaptive Control in Flying Vehicles

Researchers: Anders Pettersson, Rolf Johansson, Anders Robertsson,
Karl Johan Åström

The goal of this project is to address the question whether adaptive control can be used in products that SAAB are developing today or in the future.

There are two fundamentally different ways of controlling systems with dynamics that change over time: adaptive or robust control. The industrial baseline for flying applications today is to use robust control, which caters for the effect of parametric uncertainties, but this baseline comes with an associated loss of performance. On the other hand, with an adaptive controller it is possible to boost the performance of the closed-loop system, but then the inherent robustness may be insufficient.

Questions to be addressed:

Can better performance be achieved for a fully/partly adaptive controller compared to a robust controller, especially with uncertain dynamics in the plant and its subsystems?

When in product development cycle, can adaptive steering be used? In what applications can adaptive techniques be used? Subsystems such as actuators perhaps, as well as at the top level?
For the use of adaptive control in these systems, aspects such as product safety, control law clearance and certification should be taken into account.

L I S A.

Line Information System Architecture

Researchers: Charlotta Johnsson in collaboration with partners from Chalmers, KTH, Siemens, Rockwell Automation, Leax, Scania and Volvo Car

This project is funded byVINNOVA FFI Sustainable Production Engineering.

Duration: 2011-2013

Future sustainable competitive production systems need to be productive and flexible, as well as environmentally friendly and safe for the personnel. There are today few system solutions that assist production management with a coherent information model and a modular system architecture that facilitates for data gathering regarding products and processes throughout the entire plant. To solve this problem the aim of this project is to develop a line information system architecture – LISA that can be used in industrial production systems in general and in automotive discrete manufacturing specifically.

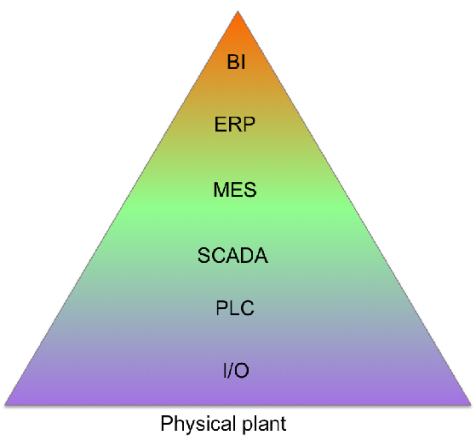


Figure : Functional levels of software products and information systems.

Involvement: The department of Automatic Control is involved in the LISA-workpackage that assures development of new relevant standards, in order to guarantee that the automotive manufacturer's perspective is taken into account. The workpackage makes it possible to obtain feedback and interaction between the industries involved in LISA and corresponding standard committees. Examples of relevant standards currently developed are: IEC 62264 and ISO 22400.

Cooperative Cyber-Physical Systems

Researchers: Karl-Erik Årzen

Funding: ELLIIT
Performed in cooperation with Linköping University

Cooperative Localization and Mapping for UAVs and UGVs - Indoor localization and mapping with UGVs has been an active research area and has lead to very useful theoretical and pragmatic results. Indoor localization and mapping with micro-UAV's is a relatively new area with less mature results. The same can be said in regard to cooperative localization and mapping with several UAVs, or with combinations of UGVs and UAVs. The focus of this sub-project will be to develop cutting edge theory and usable systems for collaborative indoor localization and mapping.

Advanced Navigation and Localisation

Researchers: Anders Mannesson, Jerker Nordh, Karl Berntorp, Bo Bernhardsson

Funding: ELLIIT
Performed in cooperation with departments of EIT and
Mathematics in Lund and with Linköping University

Navigation - Navigation, localization and map making are interesting research areas with many interesting applications. Indoor navigation is much more challenging compared to outdoor navigation since there is usually no GPS coverage, electronic compasses do not work that well, and the radio environment is complicated. Visual localization with respect to landmarks has the potential to overcome many of these problems, but needs considerable development to be robust and to be able to scale to large image collections. In this sub-project we will work on several aspects of navigation, localization and map making and investigate the use of combining several different sensor modalities such as multiple cameras, inertial sensors (accelerometers and gyroscopes), Ultra-wideband (UWB) measurements, field strength measurements). The research at AC is focusing on a platform for radio-aided positioning using virtual antenna arrays. Algorithms for tightly coupled radio channel estimation and IMU positioning have been developed. Also new algorithms for simultaneous localisation and mapping (SLAM) using particle smoothers have been studied and different versions of occupancy grids especially developed to fit particle smoothing have been developed.

Large-scale Optimization for Systems Analysis

Researcher: Anders Rantzer

Funding: ELLIIT
Performed in cooperation with Linköping University

Many control applications involve dynamics of a complexity that cannot be handled in standard optimization algorithms. This situation is common for example in process industry, in electricity networks, and in many other areas. Typically the controllers are tuned or designed locally with local objectives in mind. This is of course seldom optimal from a global perspective and can even cause instabilities. In this project we study how to assess global robustness and stability using tailor-made algorithms with limited information exchange. This is specifically relevant when parallel processors are used to reduce computational time. This has specific applications for robustness analysis of models coming from spatial discretization of partial differential equations, e.g. robustness analysis of flexible structures. A similar approach can also sometimes be used when the models of the local objects are private, and the owners of the models do not want to share detailed information about the models. We are focusing our efforts in robustness analysis of dynamical systems which are interconnected. In particular, we study interconnected systems that can be described with a chordal graph.

Enabling End-User-Centered Energy Management Systems

Researchers: Bo Bernhardsson, Anders Rantzer

Funding: ELLIIT
Performed in cooperation with Linköping University

Today there exists a large number of different solutions for small-scale energy production using, e.g., solar and wind energy. Such environmentally friendly solutions have not yet been fully integrated at the end consumer. A key component for minimizing the need for external power supply is to introduce energy storage devices in the system, for example a dedicated battery system or a plug-in hybrid/electrical vehicle. A main vision is then that an end user easily can plug in local energy producing, storage, and consuming devices, and reliably obtain optimal external energy consumption. The project studies adaptive management of the different energy sources which involves design of new power electronics, overall control, and supervision. This includes energy storage dimensioning based on predicted wind/solar availability and predicted consumption.

ICT platform for sustainable infrastructures

Researchers: Anders Rantzer, Bo Bernhardsson,
Georgios Chasparis, partners at IEA and KTH.

Funding: Swedish Foundation for Strategic Research

Resource-efficient infrastructures are critical for sustainable societies that want to maintain and improve today's standard of living. National and international climate goals imply large increases in renewable electricity production. This variable generation together with the increasing international trading of electricity affects the power flows in the electricity networks, which needs to be managed by system operators on local, regional and national levels. This development is in addition to the continuously increasing demand on reliable electricity supply. Traditionally this double challenge would be met by the building of new power lines. This is a simple and effective solution, but due to public reluctance to new power lines and the lengthy permission process alternatives are sought for. One general alternative is the use of automation for optimizing the use of the available network capacity. This concept - currently referred to as Smart Grids - involves investment in and installation of ICT equipment rather than physical capacity. While having been applied locally before, the situation now calls for application on a system-wide scale. Similar trends can be observed in other infrastructures.

This project aims to to design the decision-layer of an ICT platform for controlling large-scale infrastructures to operate reliably, economically, and with minimum resource waste. Special attention is given to functionality for detecting, clearing and recovering from critical operating conditions. A key component is the ARISTO real-time power system simulator, which will be used as demonstrator to illustrate the results.

DET NORDISKA ÖVERFÖRINGSNÄTET
The transmission grid in the Nordic countries

3.3 Control and Real-Time Computing

In the Control and Real-Time Computing area and work is performed in two main directions:

* **Implementation of control systems on resource-constrained implementation platforms, e.g., small embedded processors or networked controllers with limited communication bandwidth. This also includes event-based control.**
* **Applications of control to computing and communication systems. This includes control of server systems and adaptive resource management of embedded systems.**

LUCAS - Lund Center for Applied Software Research

Researchers: Karl-Erik Årzén, Rolf Johansson, Anders Robertsson, Anton Cervin, and Anders Blomdell in collaboration with Dept. of Computer Science, Lund University

The Center for Applied Software Research (LUCAS) is a collaboration between the software-oriented parts of the Departments of Automatic Control and Computer Science at LTH. In total around 15 faculty members and 20 PhD students are involved in LUCAS. The focus of LUCAS is industrially-oriented and motivated software research. This includes research on software engineering, software technology, and software applications. Special focus is put on real-time systems, in particular embedded systems, networked systems, and control systems.

LUCAS started in 1999 and its status has changed over the years. Currently its main role is to act as an umbrella organization. The main activity is the annual LUCAS workshop.

LUCAS official homepage: http://www.lth.se/programvaruportalen/

Event-Based Control

Researchers: Anton Cervin, Toivo Henningsson,
Erik Johannesson, Bo Bernhardsson and
Karl Johan Åström

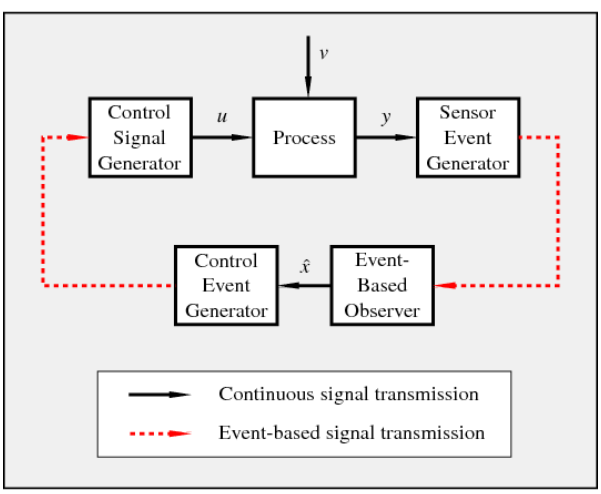
Funding: Swedish Research Council, LCCC

The vast majority of all feedback controllers today are implemented using digital computers, relying on periodic sampling, computation, and actuation. For linear systems, sampled-data control theory provides powerful tools for direct digital design, while implementations of nonlinear control designs tend to rely on discretization combined with fast periodic sampling. In recent years, there has been a growing research interest in event-based control, in particular in connection to distributed and networked control systems. The basic idea is to communicate, compute, or control only when something significant has occurred in the system. The motivation for abandoning the time-triggered paradigm is to better cope with various constraints or bottlenecks in the system, such as sensors with limited resolution, limited communication or computation bandwidth, energy constraints, or constraints on the number of actuations.

In this project we are currently developing theory and design methodology for suboptimal event-based state feedback and comparing the achievable performance to the linear time-invariant case.

We are also developing theory and design methodology for suboptimal event-based observers and comparing the achievable performance to the linear time-invariant case.

The project is investigating scheduling policies for multiple event-based controllers or observers on a shared local network.



Integrated Scheduling and Synthesis of Networked Embedded Event-Based Control Systems

Researchers: Anton Cervin, Karl-Erik Årzén, in collaboration with the Embedded Systems Lab at Linköping University.

Funding: ELLIIT and LCCC

Modern embedded control systems comprise periodic and sporadic software tasks that control several physical processes and execute on platforms with multiple computation and communication components. The project will focus on the complex system timing induced by resource sharing among the tasks, which is one of the main characterizations of the control quality. This control quality, which is affected negatively by long and varying computation and communication delays in the control loop, will be considered during system-level scheduling and optimization, as well as during controller synthesis by delay-compensation techniques.

Many control systems have time-varying resource demands, implying that scheduling policies and control strategies must be adapted at runtime to provide high control quality and efficient resource usage. Such variations are inherent in event-based control, which is an emerging technology in resource-constrained systems, but also occur depending on the states of the controlled processes or as a result of process disturbances and mode changes. The project will therefore also consider runtime optimization techniques to address such variations.

The project aims to push the state of the art of integrated control and computer systems design in several directions. We shall develop design methods for control-quality optimization of embedded control applications running on distributed execution platforms, which, for example, are very common in the automotive systems domain. Our subsequent aim is to develop design-time and runtime optimization methods that trade off control quality with the varying resource requirements present in multi-mode and event-based control systems. The long-term objective of the project is to develop an optimization and resource-management framework to be used for the design and implementation of future resource- constrained and adaptive embedded control systems.

ArtistDesign - Design of Embedded Systems

Researchers: Toivo Henningsson, Mikael Lindberg, Vanessa Romero Segovia, Anton Cervin, Anders Robertsson, and Karl-Erik Årzén in collaboration with the other 31 core partners of the EU IST FP7 ArtistDesign Network of Excellence.

Funding: EU IST FP7 NoE. Duration 2008-2011.

ArtistDesign is an EU/IST FP7 network of excellence on design of embedded systems. It is a follow-up project to the FP6 NoE Artist2. The objective of ArtistDesign is to strengthen European research in Embedded Systems Design, and promote the emergence of this new multi-disciplinary area. ArtistDesign gathers together the best European teams from the composing disciplines, and will work to forge a scientific community.

Internally ARTIST2 is divided into four thematic clusters (Modeling and Validation; SW Synthesis, Code Generation and Timing Analysis; Operating Systems and Networks, and Hardware Platforms and MPSoC Design) and one tranversal integration cluster. Lund is a member of the Operating Systems and Networks cluster. Karl-Erik Årzén is also the leader of the Design for Adaptivity activity within the integration cluster.

ArtistDesign official homepage: http://www.artist-embedded.org/artist/

Performance Modelling and Control of Server Systems

Researchers: Anders Robertsson, Karl-Erik Årzén, Karl Johan Åström
and Björn Wittenmark in collaboration with Maria Kihl and Payam
Amani at Dept. of Electrical and Information
Technology, LTH, Lund University

Funding: LCCC and the Swedish Research Council.

In the last couple of years "Communication and Control" has gained large attention and a lot of new research has focused on control of and over networks. However, the admission control problem, which is important for the utilization and the robustness of the network still remains as an rather unexplored area. Here, we believe the interaction of queuing theory and nonlinear control play a major role. The research is aimed at advancing the state of the art in control oriented modeling and control design of server systems by combining the scientific expertise from the telecommunication and the control communities. Important components in this research field are queuing theory, system identification, real-time systems and non-linear control theory. These fields have since long been well established research areas. However, the integration of this research with application to control of server systems gives raise to fundamental and challenging questions on how to e.g., combine and analyse discrete-event and continuous time flow models. The problems are of large theoretical as well as practical relevance in control of computing systems.

The main objectives of the research are:

* To use system identification and control theoretic methods to find good stochastic models and reliable state estimators for traffic and server systems
* Analyse the fundamental mechanisms in the combination of discrete-event based server systems and real-time control algorithms.
* To develop an experimental platform for experimental evaluation of control mechanisms

Parallel Architectures for Sampling Based Nonlinear Filters

Researchers: Anders Mannesson, Bo Bernhardsson

Funding: ELLIIT
Performed in cooperation with Linköping University

All research activities are organised into integrated projects. Each project has one project leader and one to three PhD students. The project leaders, the PhD students, and possible Master Thesis students, make up PIC-LU academy. Each project studies a specific application in close collaboration with one or two industrial partners. The involved persons from the industrial partner companies make up PIC-LU industry. The project leaders, together with the centre leader and the vice centre leader, form the PIC-LU centre management group which meets once a week for informal discussions. The centre leader is responsible for the day-to-day operations of the centre and has, together with vice centre leader, the responsibility to integrate the centre into the departments. The PIC-LU board has the overall responsibility of the centre. The board consists of members from both academia and industry with a chairman from industry.

The research program is organized in five integrated projects and focused on the three topics; flexibility, controllability and availability. The projects have a strong interaction both between the projects and with industrial partners. Current industrial partners are Borealis, K. A. Rasmussen, Novo Nordisk, Novozymes, Modelon, Perstorp, and Pfizer.

Short project descriptions:

1. Optimal grade changes, is a collaboration between the two departments and Borealis, mainly focused on flexibility. It is a two PhD student project with a part time senior researcher and it started in the beginning of 2009. The industrial partner Modelon will join the project in 2011.
2. Utility disturbance management, is collaboration between Automatic Control and Perstorp, and availability is the research theme. It is a one PhD student project with some additional senior research time and it started in the second half of 2009.
3. Quality by design and control, is a collaboration between Novo Nordisk, Pfizer and Chemical Engineering with the main theme controllability. The project started already in July 2008 and is a two and a half PhD student project.

3.4 Process Control

The department has always had an active collaboration with the process industry as well as suppliers of process control instrumentation. Most of the research projects are formed together with the process industry, and several of them are performed with active participation by staff from industry. Many of the research results are also transfered to instrument and system suppliers, and implemented and used in process industry.

PID Control

Researchers: Karl Johan Åström, Tore Hägglund and Per-Ola Larsson

This project has been in progress since the beginning of the eighties, and resulted in industrial products as well as several PhD theses. Three monographs on PID control that are based on experiences obtained in the project have also been published. The last is ”Advanced PID Control”, published in 2005. It is also translated to Spanish 2009: ”Control PID avanzado”. The research is currently focused on the following topics:

A simple dead-time compensator

Measurements often have small amount of noise since sensors are not perfect. This will be reflected in the control signal behaviour in e.g. high variance or large inter-sample jumps if considering a discrete time setting. Previous work on PI and PID controllers often focus on proportional-, integral- and derivative gains at design but the filter action is added afterwords such that a resonable sensitivity to noise is given. However, the filter changes phase and gain of the controller and the initial tuning may not give satisfying results. In this project, we have developed a software optimization routine in Matlab that calculates controller settings (PI and PID) and filter settings simultaneously that minimizes the Integrated Absolute Error (IAE) with robustness and meausrement noise sensitivity constraints. The filter may be chosen to have order 1-4. For filters of orders higher than 1, all time constants are equal and the damping must be lower than 0.7, i.e., no amplification of measurements.

Filter order selection for PI and PID controllers

A simple dead-time compensating controller is the Predictive PI controller, which is a simplified Smith predictor with only three parameters to tune. The motivation for the project is that this controller structure may be as easy to tune as a PI(D) controller using the developed software for PI and PID controllers (see above). The performance, measured by IAE, of the new controller has been compared to the performance of PID controllers when robustness and control signal constraints are set. The controllers are

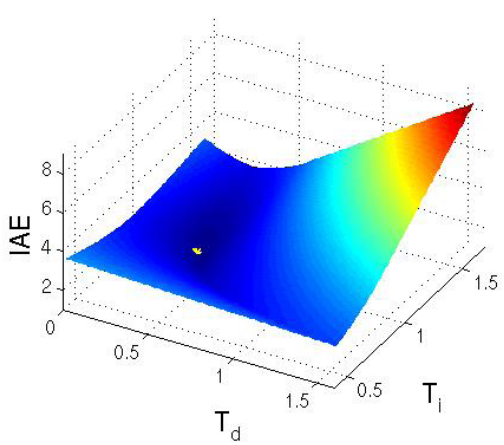
simultaneously designed together with measurement filters. Results show that the Predictive PI controller has similar performance as the PID controller for many processes representative for the process control community. However, for some processes the PID controller outperforms the Predictive PI controller.

Relation between control signal properties and robustness measures

In a realistic setting, fast response to load upsets are restricted by e.g. limitations on actuator devices, noise characteristics of measured signals, and process variations. Thus, this should be incorporated in the design of a controller. An analysis concering the optimization constraint in the PID design in this project and in the project ``Decentralized Structures for Industrial Control" has been performed. It has shown that analytical expressions relating the M_S and M_T circles and the control signal magnitude and activity exist to a certain extent. Large robustness margins give small control signal activities and the opposite holds for small robustness margins. Thus, the proposed PID parameter optimization do take required control signal properties into consideration.

Software tools for design of PID controllers

A new, interactive and easily modifiable software tool for robust PID design has been developed at the department. The tool has been programmed in Matlab and the goal is to find the controller that minimizes the IAE value during a load disturbance, while applying robustness constraints in terms of M-circles. The figure on this page shows a plot from the program, depicting the IAE cost as a function of the integral time and the derivative time in a PID controller. The minimum is shown by the yellow mark in the figure. The software is free to download. The Matlab files contained in the zip-file will make it possible to design a robust, optimal PID (or PI) controller. The software has been tested on Matlab 7 and may need some changes if it is not run under that version.



Surface plot from the PID design tool

Interacting learning modules for PID control

We are also developing interactive learning modules for PID control. The modules are designed to speed up learning and to enhance understanding of the behaviour of loops with PID controllers. The modules are implemented in SysQuake, and the work is done in collaboration with professor Sebastián Dormido at UNED, Madrid, and José Luis Guzmán at Universidad de Almería.

Utility Disturbance Management

Researchers: Anna Lindholm, Charlotta Johnsson
The research is part of the Process Industrial Centre at Lund University, PIC-LU, and is performed in close collaboration with Perstorp.

In the chemical process industry, companies must continuously improve their operational efficiency and profitability to remain competitive. This means it is of great importance to minimize losses in revenues due to e.g. disturbances in operation. Plant-wide disturbances cause considerable revenue losses at industrial sites. Some of these plant-wide disturbances are caused by utilities, such as steam or cooling water, which are used at most industrial sites. At a disturbance in the supply of a utility, the production in all areas that use the utility is affected. Furthermore, areas are often connected by the product flow at the site, which makes the consequences of utility disturbances hard to predict.

In this project, the main objective is to develop generic methods for improving management of disturbances in the supply of utilities. This work is performed at the site/area level of a company, which means that control of the production in the areas of the site, rather than the control of individual production units, is considered.

A generic method for minimizing the effects of disturbances in utilities has been developed, which requires a model of the site. Different modeling approaches have been suggested and the objective has been to start with simple and quickly obtained models, and step by step move towards more elaborate models. For each modeling approach that has been studied, the method has been applied to site Stenungsund at Perstorp.

Site Stenungsund is located on the Swedish west coast, about 50 km north of Gothenburg, and produces mainly aldehydes, organic acids, alcohols, and plasticizers.

The current research in the project concerns development of site models to be used for optimization of the supply of utilities to different areas to minimize the revenue loss due to utility disturbances. The modeling involves both modeling of how a utility disturbance affects the production in one production area, and modeling of how utilities are shared between areas at a site.

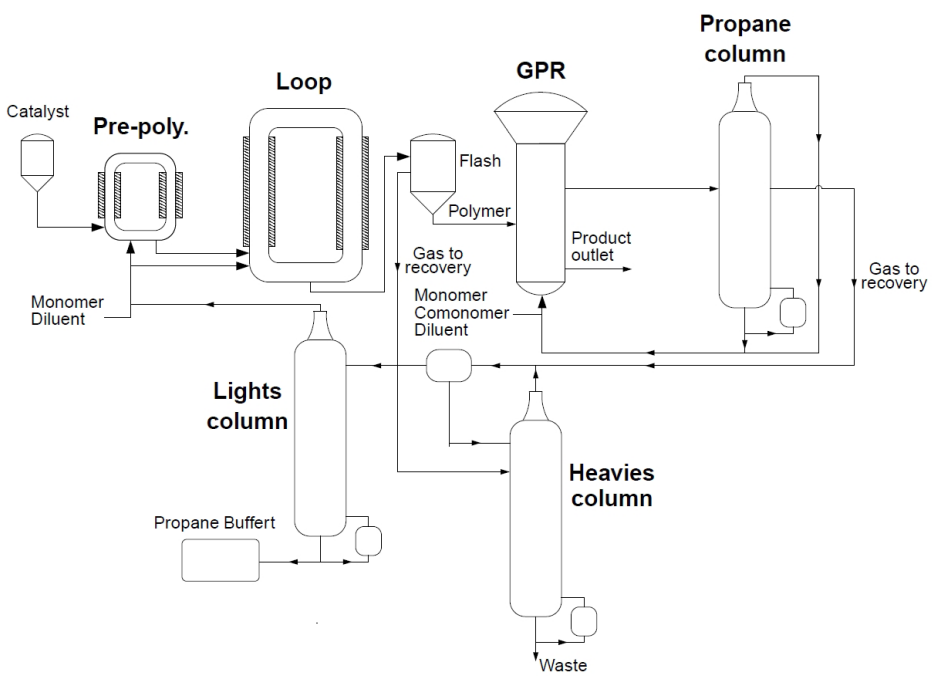
Modeling and Optimization of Grade Changes for Polyethylene Reactors

Researchers: Per-Ola Larsson, Niklas Andersson (Chem. Eng), Johan Åkesson, Tore Hägglund, Bernt Nilsson (Chem. Eng)

In collaboration with Borealis AB.

In this project, which is a collaboration with Borealis AB, we are considering grade changes for a chain of three polyethylene reactors and a gas recycle system consisting of three distillation columns. In chemical industry today, the market is changing rapidly both in raw material pricing but also in product demand. To have the ability to perform fast, safe and economical grade changes and thus adapting to the market is highly advantageous.

One part of the project is to develop physical models of the three polyethylene reactors and recycle system at Borealis' Stenungsund site, see Figure 1. Using both well known physical laws and empirical relations, together with models derived for a non-linear MPC controller used at site today, a model library in the Modelica languange has been constructed. The library includes both reactor and distillation column models and framework models for optimization and validation.



The second part of this project is optimization of grade changes using the models in the library. In the optimization, which is non-convex, both limitations of the reactors and columns, but also economics, safety, time, and parameters defining the desired grade needs to be considered. Using JModelica.org, which is a framework for dynamic optimization of Modelica models, grade change optimization problems can be solved. JModelica.org incorporates Optimica, which extends the Modelica language with constructs to encode optimization problems.

During 2009, the core of the library has been built. A first optimization of a grade change for a single reactor has been performed successfully and submitted for publication. Model calibration using measurements has been initiated at the Chemical Engineering Department using a computer cluster.

The work performed during 2010 mainly includes three parts. First, optimization of grade change with all three reactors has been performed with success and submitted for publications. Secondly, modeling of the recycle part, i.e., the distillation columns, has begun with support from measurement data from Borealis AB. Grade change optimization with both reactors and recycle system is under ongoing work. Thirdly, static model calibration using measurement data has been performed successfully at the Chemical Engineering Department.

During 2011, optimizations with all three reactors and recycle system have been performed using both quadratic cost functions, but also, more importantly, cost functions that considers plant economy. The latter cost functions take into consideration the grade definition, sell price of the polymer as well as the cost of raw material. The results from the optimizations have shown that economically optimal grade transitions can be divided into three phases with distinguishing features.

In November, Per-Ola Larsson finished his Ph.D. thesis entitled ”Optimization of Low-Level Controllers and High-Level Polymer Grade Changes”, which includes the above results.

Decentralized Control Structures

Researchers: Martin Hast and Tore Hägglund

There is an unfortunate gap between the centralized computational approaches of multi-variable control theory and the common practice to design local control loops disregarding couplings and interaction. Today it appears that both approaches has reached a point of refinement where the gap can be reduced from both sides. This project aims to revise and improve the basic modules for decentralized control, and to develop new. The ideas to be investigated in this project are relevant not only for process control but is also of interest for general classes of multi-variable systems.

TITO control

We will develop a new module building on experiences from PID control: a TITO controller, i.e. a controller with two inputs and two outputs. To be accepted in process control, the TITO controller must be fully automatic without any parameters to be set by the user. It means that an automatic tuning procedure has to be developed. Anti-windup can e.g. be handled conveniently.

In this project, we have established collaboration with University of Córdoba in Spain. An alternative decoupling structure, inverted decoupling, has been investigated. This structure has several important advantages compared with conventional decouplers, especially when it comes to implementation of the TITO controller. Using inverted decoupling, it is possible to implement the decoupling using standard blocks in most DCS systems just by adding feedforward signals to the two PID controllers. Industrial collaboration has also been initiated in the project.

Feedforward from load disturbances

Feedforward is a powerful method to improve the performance of feedback loops. Feedforward can be made both from setpoint and measurable load disturbances. In this project, the goal is to improve both structures and design methods for feeforward control from load disturbances.

The basic idea for design of feedforward compensators is simple. The ideal compensator is formed as the dynamics between the load disturbance and the process output, divided by the dynamics between the control signal and the process output, with reversed sign. However this ideal compensator is seldom realizable. Therefore, there is a need for design methods. There are surprisingly few such methods presented in the literature, and the methods do normally not take the feedback control into account in the design.

In a first phase, new simple tuning rules for feedforward compensators have been derived. The design objective is to minimize IAE without getting any overshoot in step load disturbance responses. This work has been done in collaboration with University of Almeria in Spain.

Using a structure that decouples feedback and feedforward action, optimal design rules that minimizes ISE has been developed. The used structure simplifies tuning of the feedforward controller by allowing the controller to be tuned with respect to the open-loop system while maintaining its properties and performance when used in a closed-loop setting

Performance Monitoring and Diagnosis

Researcher: Tore Hägglund

Stiction and backlash in control valves are the major problem at the loop level in process control plants. There are two aspects of the problem. First of all, the nonlinearities deteriorate the control performance. Secondly, the loops facing these problems often remain undiscovered by the personnel in process control plants. These are the motives for research in the area of automatic performance monitoring and diagnosis.

Backlash estimation

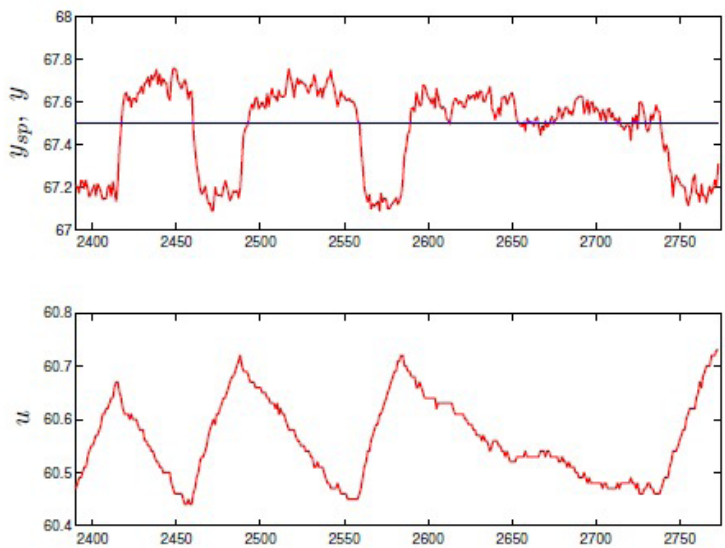
A new method for detection and estimation of backlash in control loops has been developed. The detection procedure is based on normal operating data. It is not assumed that the output from the backlash is measured. The procedure is automatic in the sense that no information has to be provided from the user to run the procedure. Since an estimate of the dead band caused by the backlash is provided by the procedure, the procedure gives all information needed to compensate for the backlash. The procedure has been tested in industry and a MS project has been performed in collaboration with ABB to prepare for implementation in an industrial DCS system. The method is patented.

Valve Stiction Diagnosis

Valves with a high level of static friction (stiction) generates stick-slip motion that causes the control loops to oscillate. There are several efficient methods for automatic oscillation detection available. There may, however, be several causes of oscillations in

control loops. Besides sticky valves, bad controller tuning and external load disturbances may cause oscillations. Therefore, there is an interest in procedures for automatic diagnosis of oscillations.

In this project, a method for automatic diagnosis of stiction in control valves has been derived. The diagnosis is performed using a shape analysis of the wave form of the oscillations that appear in the process output. In case of stick-slip motion, a rectangular form is obtained, whereas external load disturbances and bad controller tuning gives a sinusoidal wave form. The procedure is automatic in the sense that no process information is assumed except the one that is already available in the controllers. The procedure can be used both on line and off line. It has been tested on industrial data with good results.



Stick-slip motion in a recirculation flow loop in a distillation column

Fed-Batch Control
Optimizing fermentation control for B. licheniformis

Researchers: Ola Johnsson, Charlotta Johnsson, and Tore Hägglund

This project is performed in collaboration with Novozymes AS and Department of Chemical Engineering within the PICLU centre.

The project will focus on developing, improving and optimizing fermentation control strategies for the B. licheniformis fed batch processes. This process can produce vast amounts of protein but is sensitive to overdosing and process disturbances which lead to process variations and possibly crashed fermentations. There is thus a strong motivation for developing more robust control strategies for this process. The project aim is to develop a general method for finding optimal control strategies for various B. licheniformis production strains.

In addition to developing and evaluating bioprocess control strategies which can improve robustness and yield of specific B. licheniformis processes, it is also of interest that the developed methods are general enough to allow for implementation on various enzyme-producing processes utilising different B. licheniformis strains. This will require the identification of key physiological variables in the strains and an understanding of the interaction between these properties and the way the process is controlled.

More information is given on www.pic.lu.se

3.5 Robotics

Robotics offer both theoretical and practical challenges. Our main research are in motion and compliance control, force control, control system architectures and different sensor fusion problems.

Productive Robotics @ LTH

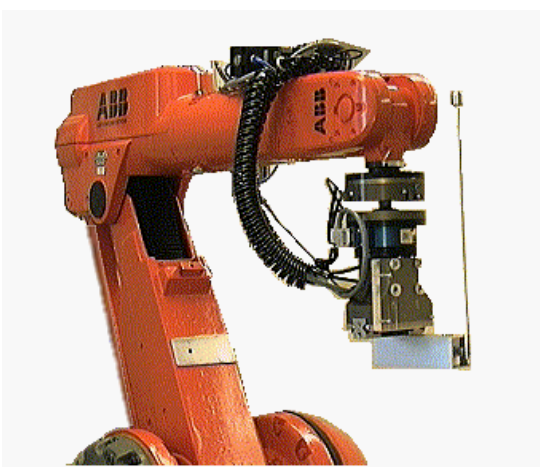
Research responsibles: Klas Nilsson (Dept. of Computer Science), Rolf Johansson (Dept. of Automatic Control), Anders Robertsson (Dept. of Automatic Control), Kalle Åström (Dept. of Mathematics) and Mats Alaküla (Dept. of Industrial Engineering and Automation)

Several research interests are represented in Robotics Lab:
* Open Control Software Architectures
* Exteroceptive Robots
* Force Control
* Robot Vision
* Sensor Fusion
* Adaptive and Iterative Learning Control
* Task-level Programming

Robot control systems and other manufacturing equipment are traditionally closed. This circumstance has hampered system integration of manipulators, sensors and other equipment. As a result, such system integration has often been made at an unsuitably high hierarchical level.

The purpose of past and present projects is to show how to organize open robot control systems and to verify these ideas by means of experimental verification.

As a part of this research, we have developed several experimental open robot control systems. The systems are built around industrially available robots that have been reconfigured for experimental purposes.



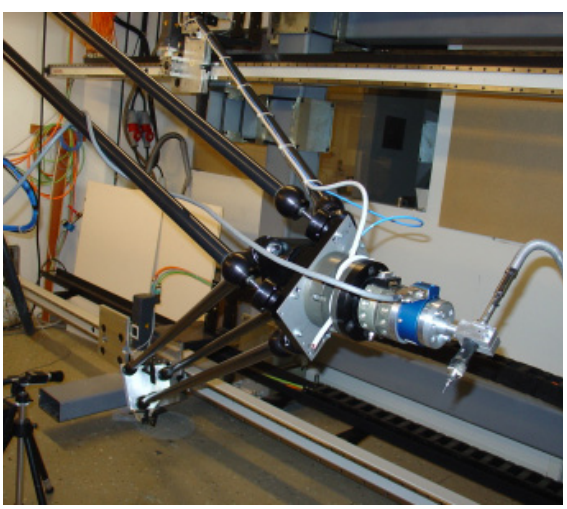
The developed specific robot interfaces and the integration of the robots into a complete system forms a unique environment for testing and development of algorithms for improvement of performance, sensor integration, programming automation and autonomous operation.

Robotics Research

Researchers: Rolf Johansson, Anders Robertsson, Isolde Dressler, Magnus Linderoth, Andreas Stolt, Olof Sörnmo, Björn Olofsson, Karl Berntorp, Karl-Erik Årzén and Anders Blomdell in close cooperation with colleagues from neighbor departments at the Robotics lab at LTH, Lund University, and ABB Robotics, Västerås, Sweden.

Robotics offers both theoretical and practical challenges. Robotics is a multi-disciplinary topic and we collaborate with both national and international robotics colleagues regarding different aspects of robotics and we also have a close cooperation with industrial partners. Our main research are in motion and compliance control, control system architectures and different sensor fusion problems with application mainly to industrial manipulators. We use mainly modified and extended ABB robot control systems as experimental platforms.

The laboratory for robotics and real-time systems is centered around industrial manipulators with open control system architectures. In the lab we have several generations of robots from an elderly ABB IRB6 robot, an ABB IRB2000 robot, an ABB Irb2400 (S4C+) to the more modern ABB IRB140 (IRC5), Gantry-Tau robot (IRC5). Hardware interfaces have been developed to create an open system suitable for control experiments (Orca/Orcinus). The computer hardware is either PCI-based with both microprocessors and signal processors integrated into an embedded system for hard realtime control in one of the labs and integrated with an additional PCI-based G4 PowerPC for the new Open Control system based on S4CPlus and the newly developed networked architecture running on Linux/Xenomai-platforms.

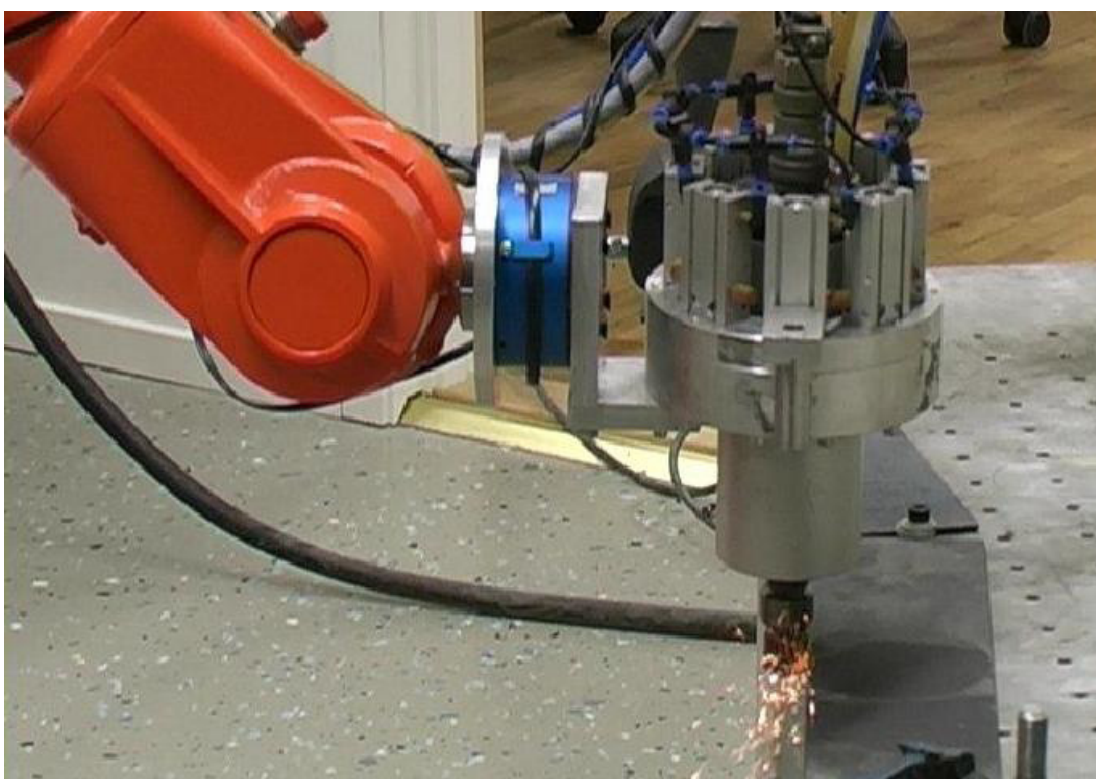


The systems are connected to a network with workstations, which are used for program development and control design. A purpose of the current project is to show how to organize open robot control systems and to verify these ideas by means of experiments.

One goal is to permit efficient specification and generation of fast robot motions along a geometric path which requires coordinated adjustment of the individual joint motions. Another aspect of robot motion control is

how to to integrate simultaneous control of force and position according to ideas of impedance control in which stability is an important theoretical issue. A major topic in this project is to integrate aspects of control, sensor fusion and application demands using robot vision and force sensing. Another project is on the structure and programming of control systems for industrial robots. The problem addressed is how the software architecture and the realtime structure of a robot control system should be designed to allow easy and flexible incorporation of additional sensors and new control algorithms.

A software layer between a supervisory sequence control layer and the basic control level has been proposed. Case studies and prototype experiments show promising results and further implementation is going on. The project Autofett aimed towards use of force control in manufacturing operations such as robotized fettling and is now continued in the SMErobot and FlexAA-projects. New sensor interfaces with modification of hardware and realtime software architectures have been developed to accommodate the use of force control algorithms based on workspace sensing.



ProFlexA — Productive Flexible Automation

Researchers: Rolf Johansson, Anders Robertsson, Olof Sörnmo, Björn Olofsson and Anders Blomdell in cooperation with Dept. of Computer Science, Lund University and Div. of Assembly Technology, Linköping University, and several industrial partners.

This project is financially supported by the Swedish Foundation for Strategic Research (SSF) under the programme ProViking. Duration: 2009-2012

Description

The Swedish casting and foundry industry is under high pressure to reduce its production cost in order to maintain its competitiveness and avoid moving its activities to low cost countries. This means that there is a need to improve efficiency, product quality and consistency and to reduce costs and lead-time. The project focuses on achieving productive and profitable robotized automation of the fettling for small and medium sized volumes.

The project has the following work packages that also reflects the expected results and deliverables.

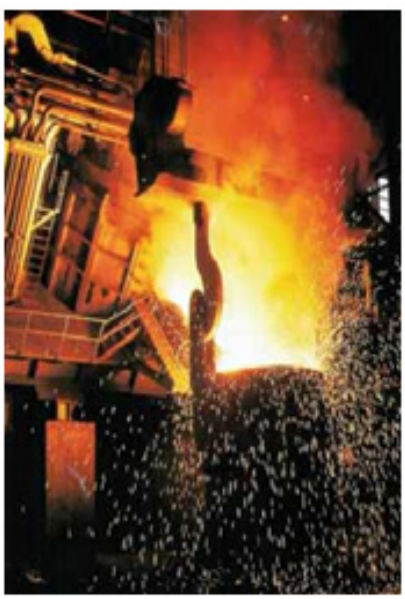
* WP1: Development of components and methods for handling of castings, inclu ding development of modular, configurable, simple and inexpensive grippers.
* WP2: Development of technology and configurators for flexibility and quick start-up of new products or product changes.
* WP3: Development of methods for measurement of excess material and compen sation of gripper errors.
* WP4: Build-up of database of process parameters for optimal material removal rate.
* WP5: Development of a Lead-through programming concept.
* WP6: Development of the Off-Line programming concept.
* WP7: Development of physical demonstrator.
* WP8: Exploration of the potential for the developed technology in other industry branches.

All of these benefits strengthen Swedish foundry industry and deliver important knowledge to other adjoining industry sectors.

Members

* Swerea SWECAST AB
* Artech Automation AB
* SVIA — Svensk Industriautomation AB
* Smålands Stålgjuteri AB
* Saab Aerosystems
* DELFOi
* Combi Wear Parts AB
* AB Bruzaholms Bruk AB
* Linköping University
* Lund University

ProFlexA official homepage: www.iei.liu.se/mt/research/proflexa?l=sv



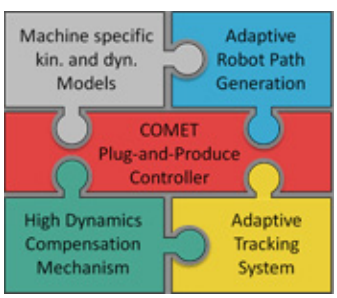

COMET — Plug-and-produce COmponents and METhods for adaptive control of industrial robots enabling cost effective, high precision manufacturing in factories of the future

Researchers: Rolf Johansson, Anders Robertsson, Björn Olofsson and Olof Sörnmo in cooperation with Dept. of Computer Science, Lund University and several academic and industrial partners.

This project is financially supported by the European Union's Seventh Framework Programme FP7 under the programme "Factories of the Future", ref. #258769 COMET. Duration: 2010-2013

Description

The COMET project aims at creating solutions enabling the use of industrial robots for high-end machining tasks in industry. The goal of the project is to develop a Plug-and-Produce platform, which will fulfill the needs from the manufacturing industry for cost effective, flexible and reliable manufacturing solutions. The components of the project are described by the figure:



The four pieces of the puzzle in the figure above define the different parts of the project, which also constitute the technical work packages:

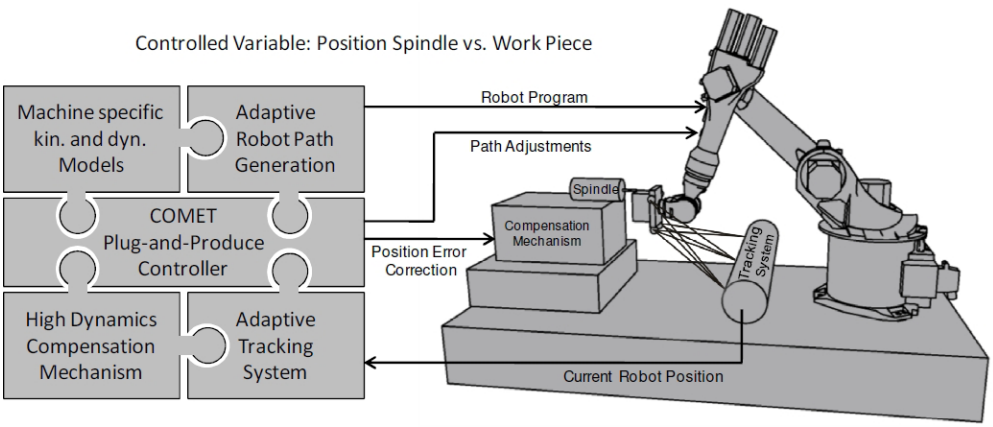
WP1: In this work package, a methodology for describing kinematic and dynamic models of an industrial robot will be developed. Those models will accurately define the static and dynamic behavior of any industrial robot, which then is represented by its unique signature.

* WP2: An integrated programming and simulation environment for adaptive robot path generation will be developed in the second work package. The path generation system will utilize the models of the robot obtained in WP1 for accurate path generation.

* WP3: The third work package is to develop an adaptive tracking system for industrial robots to detect deviations from the programmed robot path and to adaptively initiate real-time corrections via the robot controller to ensure the necessary machining accuracy.

* WP4: For high-precision machining, a high-dynamic compensation mechanism will be developed. By utilizing this mechanism, the aim is to accomplish an absolute ac-

curacy better than 50 um in machining tasks. This is significantly below the structural capability of the robot system on its own, due to the limited stiffness and positioning accuracy of the robot.



Members

* AMRC Manufacturing Ltd, United Kingdom
* ARTIS, Germany
* BTU Cottbus, Germany
* Delcam, United Kingdom
* DemoCenter-Sipe, Italy
* Fraunhofer IPA, Germany
* Gizelis Robotics, Greece
* Lund University, Sweden
* N. Bazigos S.A., Greece
* Nikon Metrology, Belgium
* Nisaform s.r.o., Czech Republic
* SIR SpA, Italy
* TEKS, France
* University of Patras, Greece

COMET official webpage: www.cometproject.eu

ROSETTA—RObot control for Skilled ExecuTion of Tasks in natural interaction with humans; based on Autonomy, cumulative knowledge and learning

Researchers: Rolf Johansson, Anders Robertsson, Magnus Linderoth, Andreas Stolt

Integrated project funded under the European Union's Seventh Framework Programme (FP7), (Ref. FP7 ICT-230902 ROSETTA).

The ROSETTA research project develops technology for industrial robots that will not only appear more human-like, but also cooperate naturally with human workers. This project is funded by the European Union under the FP7 grant 230902.

The following 4 **objectives** are set forth:

* to enable robots to be used in complex tasks with high flexibility and robustness
* to ease the deployment effort to allow fast production changeover from product A to product B
* to produce an easy-to-use programming system to access ROSETTA robot fun ctionality without the need for highly skilled robot programmers
* to provide new sensing, control and decision making methods for safe physical human-robot interaction.

Members (in alphabetical order):

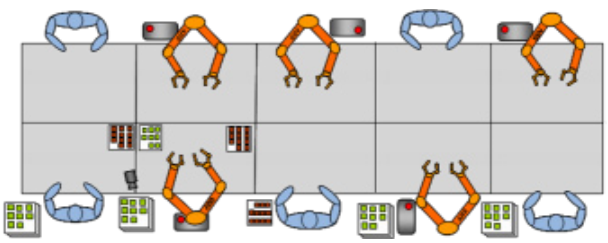
* ABB AB (Sweden, Coordinator)
* ABB AG (Germany)
* Dynamore GmbH (Germany)
* Fraunhofer IPA (Germany)
* K.U. Leuven (Belgium)
* Ludwig-Maximilians-Universität Munich (Germany)
* Lunds Universitet (Sweden)
* Politecnico di Milano (Italy)

Project information

ROSETTA is the acronym for a new European Large-Scale Integrating Research Project "RObot control for Skilled ExecuTion of Tasks in natural interaction with humans; based on Autonomy, cumulative knowledge and learning". The 4-year project started March 1st, 2009, and has a total budget of 10 MEUR.

Goals

ROSETTA develops "human-centric" technology for industrial robots that will not only appear more human-like, but also cooperate with workers in ways that are safe and perceived as natural. Such robots will be programmed in an intuitive and efficient manner, making it easier to adapt them to new tasks when a production line is changed to manufacture a new product.



Key Issues

The need for such robot systems stems from analyses showing that future factories will produce more and more goods with high volumes, but with many variants and limited product lifetime. This requires a flexible manufacturing system allowing for frequent production changes. Robot systems are the automation method of choice to meet these demands, but they need the ability to adapt even more quickly to new tasks, and to obtain full production output faster than today. Also, it is mandatory to easily integrate robots into manufacturing lines with human workers, as the combination of manufacturing by humans and robots promises highest flexibility. Tasks difficult to automate will in this scenario remain the domain of humans, whereas operations with low automation threshold or high quality requirements will be performed by these robots.

Scientific/Technical Approach

The project will address the challenges by developing methods to engineer and program robot systems in ways that are more intuitive, more related to the task, and less specific to the installation. This will require robots to be able to execute tasks more autonomously, without the need for detailed description of every step, and will lead to a significant reduction in programming effort. Once programmed, the robots will use sensor-based learning to autonomously improve their abilities ("skills") to perform the task quickly, quite like a human worker. When the operation is optimized in this way, the robot shares the knowledge of how to best perform the operation with other robots by sending the parameters over a network to a central server. Other robots do the same,

which results in a quick build-up of production knowledge ("cumulative learning"). Storing and sharing production-related data will make use of latest techniques developed for the Web 2.0, representing such data as form of "knowledge" that can be accumulated, enhanced and re-used by a population of robots.

The production scenario that involves robots and humans working side-by-side and interacting safely requires that design, control and supervision devices and methods are found for robots to be harmless, and to act in a way that humans anticipate and feel comfortable with. This involves developing human-like motion patterns, speech interaction as well as avoidance of any situation that may pose a hazard or uncomfortable situation to human workers or operators. The human-machine cooperation will be supervised by a multi-level sensor system involving different sensor types and a reasoning unit that will analyse the robot environment and give the robot instructions in real-time how to adjust to changing environments and to human presence.

Expected Impact

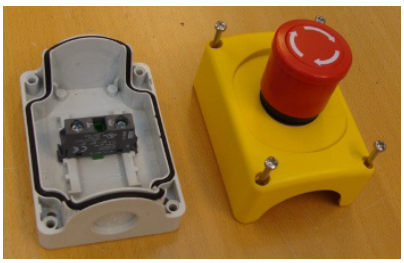
The engineering and production methods will make robot automation accessible for a variety of new applications, in particular where production is frequently adapted to new product lines. This will enable the European industry to increase its competitiveness by reducing production cost and by increasing production quality. A thorough understanding and modelling of the human/robot contact and interaction in a production scenario are major efforts of ROSETTA. The theoretical and experimental investigations will lead to injury risk classifications with the goal of creating future safety standards for human-robot cooperation, helping the industry to better utilise the potential of robots working in human environments.

Work Packages

WP	*Title*	*WP Leader*
1	Knowledge and skill representation	Lund University
2	Knowledge transformation and learning	K.U. Leuven
3	Robust task execution	Lund University
4	Injury risk knowledge	Fraunhofer
5	Safe human-robot interaction control	Politecnico di Milano
6	Application and engineering principles	ABB
7	Demonstration platform for validation	ABB
8	Exploitation and dissemination	ABB
9	Management of consortium activities	ABB

Research in Lund @Control

Research so far has been focused on force controlled assembly. The implementation has been based on iTaSC, instantaneous Task Specification using Constraints. The main

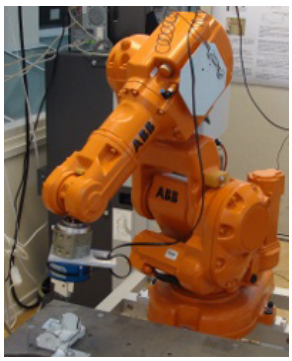


The emergency stop button used as the main scenario.

scenario has been the assembly of an emergency stop button.

Snapfit assembly

A switch should be snapped into one of many available slots. It has been assumed that the location of the bottom box as well as the gripping of the switch has been uncertain to some extent. These uncertainties have been resolved using a 6 DOF force/torque sensor. A method for detecting the transient from the snap, when the switch is inserted into the slot, has been designed and a learning strategy has been used to increase the assembly speed.



Execution of the snapfit assembly.

Red button assembly

The red button should be inserted into the yellow case. This is a typical peg-in-hole assembly task. Location of the yellow case and the gripping of the button is uncertain, and the uncertainty is resolved using force sensing. The button has further on been assumed to be rotationally symmetric. This introduced a redundant degree of freedom, which has been used to optimize the task.

Execution of the red button assembly.

Dual robot leadthrough

A dual arm leadthrough demo has been developed. Each robot is equipped with a force/torque sensor and is given a virtual mass and damping through an impedance control scheme. The robots are further on connected to move simultaneously, as if being rigidly connected. This is a demonstration of sensor fusion and coordinated control of two robots.

Dual robot assembly

The snapfit assembly has been implemented in a dual robot setup. Previously the bottom box was placed in a fixture, but in this setup a second robot is used to hold it. Different kinds of motions have been superimposed onto the motions required for the assembly.

ROSETTA official webpage: www.fp7rosetta.org

ENGROSS - Enabling Growing Software Systems

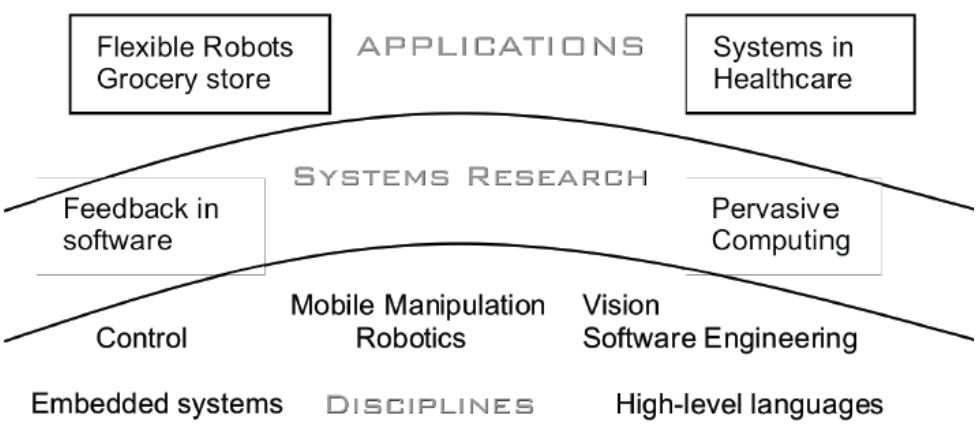
Researchers: Karl Berntorp, Anders Robertsson, and Karl-Erik Årzén, in collaboration with the Department of Computer Science, Lund University and the Department of Mathematics, Lund University.

The project is funded by SSF, the Swedish Foundation for Strategic Research.
Duration: 2009 - 2013

ENGROSS official homepage: www.engross.lth.se

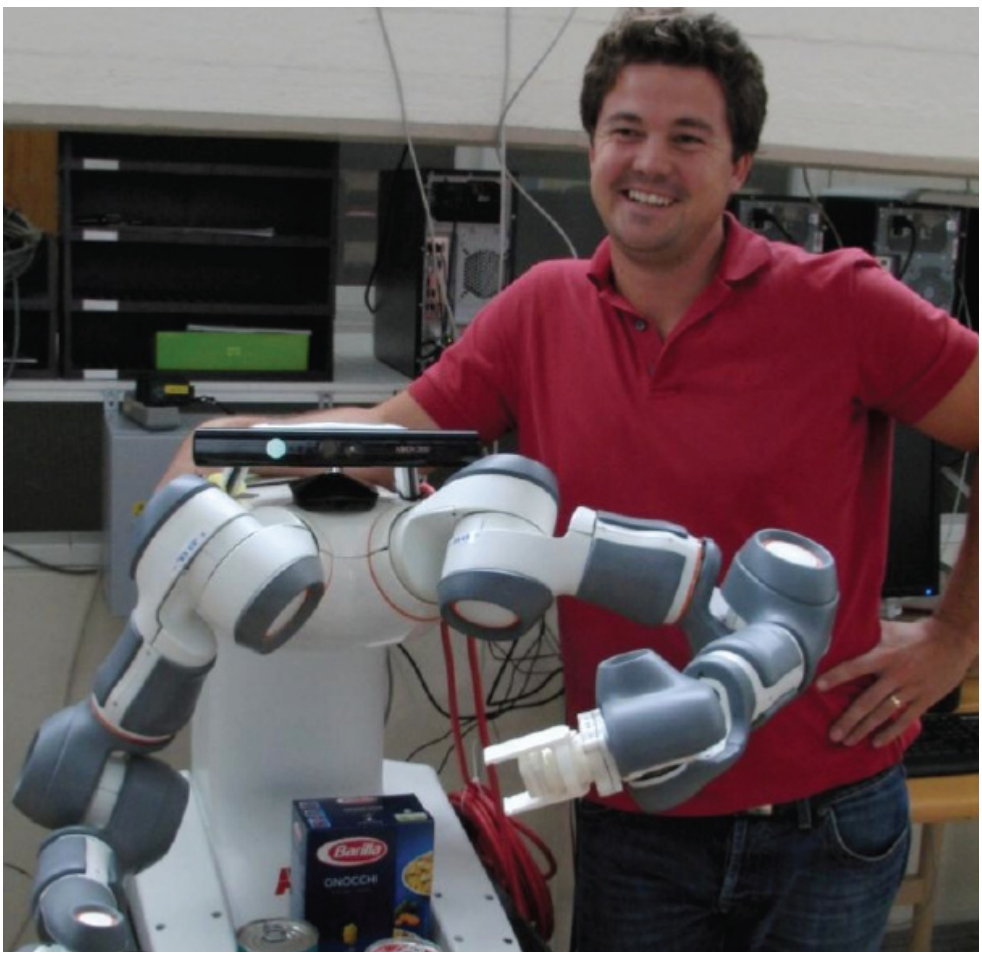
The ENGROSS project is an SSF framework project on software-intensive systems. This project is focused on the central problems of complex software systems; how such systems can be built in order to be more flexible, robust and possible to compose at the same time. The project is structured in three layers:

* Systems Research
* Demonstrator
* Disciplinary Research



The systems research is based on previous work at Department of Computer Science in the form of the Palcom middleware for loosely interconnected systems. In ENGROSS Palcom is extended to support real-time applications and safety-critical applications.

The main demonstrator in ENGROSS is a grocery-store mobile service robot and surrounding IT systems, sensing, and communication. The primary task for a grocery robot is to put arriving items on shelves in the shop. The robot demonstrator gives rise to many situations where systems need to be integrated in new ways. The current version of the demonstrator is based on the Frida two-armed robot from ABB (see the picture) and a mobile service robot platform from the Fraunhofer Institute for Manufacturing Engineering And Automation (IPA).



The robot demonstrator also serves as a platform for the disciplinary research in the project:

* Mobile manipulation
* Vision
* Localization and navigation
* Resource-constrained embedded systems
* Safety

INROSY—Intelligent Networked RObotics SYstems with reconfigurable exogenous system sensing

Researchers: Klas Nilsson, Dept. Computer Science, Rolf Johansson and Anders Robertsson in cooperation with Prof. Il Hong Suh, Hanyang University, Seoul, Korea.

Funding: STINT-KOSEF Institutional Grant for cooperation with Hanyang University (Prof. Il Hong Suh), Seoul, Korea.

Nowadays, we are living with automation systems that have intelligence such as cleaning robot, human care robot and guiding robot within everyday life. These robots will be key components of our daily life. It is true that quality of our life can be improved by these robots. Unlike the industrial robots that continuously repeat their given jobs in a fixed environment, service robots have to provide event-driven services, while keeping natural human-robot interaction in dynamic changing environment. Therefore, intelligence including sensory-motor coordination is thought as a core element of everyday life robot. The intelligence of a robot depends on the cognitive ability for environment, and how the robot acts properly with cognitive results.

In this project, we address research issues on software architectures for reactive, cognitive behavior in robotics work spaces.

Process Learning

Resarchers: Anders Robertsson, Isolde Dressler,
Andreas Stolt, Olof Sörnmo, Magnus Linderoth

Funding: ELLIIT
Performed in cooperation with Linköping University

The project consists of two subprojects having slightly different emphasis, but with several common aspects. One common theme is the aim to model, or with an alternative terminology, to learn the properties of a system. Another common aspect is related to the sensor inputs where multi dimensional sensors are used in both subprojects and where the information has to be fused into a lower dimensional space.

In the first subproject the aim is to study how learning can be used for control of industrial robots to compensate for various types of errors and to reach accuracy close to the repeatability level of the robot mechanics. The goal of the subproject is to develop the automatic learning using sensors on the manipulator and to include also measurements from the process result. The sensors measuring the process results can include sensors like, 6 Degrees of Freedom force/torque sensors, 3D scanners and stereo vision systems. The aim of the project is to span the entire range from theoretical aspects of algorithm design, via utilization of control system hardware for implementation and experimental evaluation, and the project will encompass several important research topics. One example, including additional sensors such as force sensors, vision systems, or IMUs, is to make it necessary to integrate information from different sensors in order to get estimates of position, orientation and various types of performance related quantities.

The second subproject is focused on system identification, which is an approach to process learning where mathematical models are estimated from measured input and output signals from a system. The objective is to investigate the possibilities and difficulties that arise when the output signals are measured using a computer vision system. Normal sensors will typically yield measurements clustered symmetrically around the correct value, such that the effects of noise can be averaged out in a straightforward way. In contrast, measurements coming from a computer vision system are often plagued by outliers or missing data. To exemplify, a camera monitoring a robot might lose track during fast motions or be occluded by other objects. Questions about robust estimation methods, conflicting vision measurements, and choice of model structures will be studied. A class of outlier detection problems arising in vision has recently been shown to be solvable in polynomial time and we want to explore the possibilities of extending these results to problems in system identification.

3.6 Automotive Systems

Projects devoted to vehicle dynamics and combustion control run in cooperation with major car manufacturers.

Diesel Combustion with Low Environmental Impact

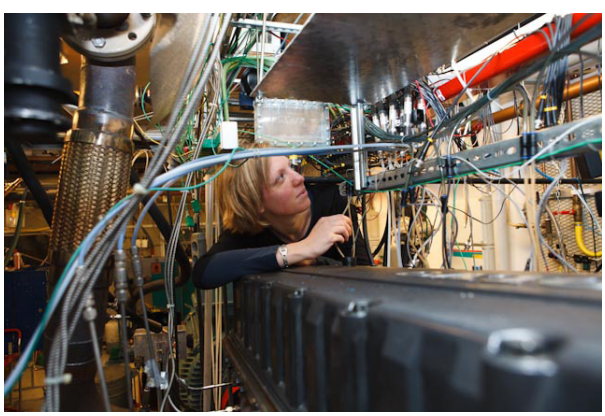
Researchers: Maria Henningsson and Rolf Johansson in cooperation with Kent Ekholm, Prof. Bengt Johansson, Dr. Per Tunestål, Div. Combustion Engines, Lund University, Petter Strandh, Johan Dahl, Stefan Strömberg, Volvo Powertrain, Urban Carlson, Anders Höglund, Cargine.

This project is financially supported by Volvo Powertrain, Inc., Cargine, and the Swedish Energy Agency (program FFI P32067-1).

The heavy-duty engine market is dominated by compression-ignition diesel engines because of their high energy conversion efficiency. High efficiency is essential both in terms of fuel economy and the impact on global warming through CO2 emissions. Beside the goal of energy efficiency, diesel engines must fulfill numerous other requirements, such as legal constraints on emissions of NOx, soot particles, and hydrocarbons. There are also legal restrictions on the audible noise from the engine, and market demands for reliability, durability, and competitive pricing.

To steer the combustion process to the optimal trade-off between emissions, fuel economy, and audible noise, a number of sensors and actuators are available. We work on optimal control methods to manage the trade-off between emissions and fuel economy on-line. Among control methods successfully applied, linear quadratic Gaussian control and model-predictive control have been implemented and tested. Our current focus is to integrate the control of the gas flow and fuel injection processes in the engine. We also investigate dual-fuel operation, combining direct injection and port injection of different fuels to improve fuel economy.

During 2011, a new six-cylinder heavy-duty Volvo engine was installed in the lab. Research focused on machine-learning methods to extract information from in-cylinder pressure sensors to predict emissions during transient engine operation. Niklas Everitt, a master's thesis student, implemented and evaluated an experimental setup for using Cargine's free valve system on a six-cylinder engine.



KCFP, Closed-Loop Combustion Control

Researchers: Rolf Johansson and Anders Widd in cooperation with Patrick Borgqvist, Assoc. Prof. Per Tunestål and Prof. Bengt Johansson, Div. Combustion Engines, Lund University.

Competence Center Combustion Processes (KCFP) at Lund University focuses on research of combustion processes between HCCI (Homogeneous Charge Compression Ignition) and classical Otto and Diesel engines.

Project aims:

* Reducing emissions, improving efficiency and repeatability of HCCI and partially pre-mixed combustion (PPC) using closed-loop control;
* Control-oriented modeling and simulation of combustion processes;
* Model-based control and optimization evaluated on test beds.

Within the project a cycle-resolved physics-based HCCI model has been developed. The model includes a low-complexity model of the cylinder wall temperature dynamics in order to capture the relevant time-scales of transient HCCI when only small amounts of hot residuals are trapped in the cylinder. The temperature evolution of the gas charge is modeled as isentropic compression and expansion with three heat transfer events during each cycle.

Model predictive controllers based on linearizations of the model have been designed and evaluated experimentally. The considered control signals were the inlet valve closing and the intake temperature. The control performance was evaluated in terms of response time to set-point changes and the resulting output variance. The benefits of using hybrid models comprised of several linearizations of a nonlinear model have also been investigated.

During 2011, a continuous time model of partially premixed combustion was developed and implemented in the Modelica language. The JModelica.org framework was used to formulate optimization problems on the resulting model. One use of this possibility is automatic calibration of the model parameters.

Predictive Control and System Optimisation of Wheel Loaders

Researchers: Toivo Henningsson and Anton Cervin, in cooperation with
Bobbie Frank and Mats Alaküla, Dept. Industrial Electrical Engineering
and Automation, Lund University, and Anders Fröberg,
Volvo Construction Equipment

This project is financially supported Energimyndigheten.
Duration: 2011—2014

Today evaluating a hybrid drivetrain concept for contruction machine applications is a time consuming process. This is true as the control strategy needs to be developed by hand and tuned for the concept and each new sizing of the components and eventually optimized such that the concept can be compared with other concepts at its best. The result is that too few concepts are studied and strategic decisions on drivetrain types is most suitable per machine / region / application / customer type and in overall are stalled due to insufficient decision material. The project at hand implements tools for comparing concepts in a fast manner where the control strategy is generated during concept optimisation. The same control strategy is input to online control performed in the prototype machine used for validation of the results within the project. The goal in the project is to make the transition from the generated control code to implementation in machine with real-time constraints as smooth as possible. Actual concept comparison is carried out in the project and will be used as decision material for which future drivetrain layout to use for wheel loaders of different sizes. The project also results in competence development at Lund University and that the Volvo CE industrial student reaches a licentiate degree.

Optimal Maneuvers

Researchers: Björn Olofsson, Karl Berntorp, Bo Bernhardsson,
Anders Robertsson

Funding: ELLIIT
Performed in cooperation with Linköping University

Construction of efficient maneuvers is critical for both vehicle control and robotics. The goal of the project is to obtain techniques to handle situations with complicated nonlinear dynamics and significant model uncertainty to be solved in time-critical situations. The intention is to go beyond the classical approaches consisting of offline optimization of reference trajectories combined with online local feedback. From a modelling perspective preparation needs to be made for efficient handling of online replanning, where simpler models are needed for reasons of speed. The models still need to capture relevant phenomena, and it is also necessary to handle cases with sensor outages and sudden model discrepancies. A complicating factor is being close to safety limits, leading to an intricate interplay between model complexity and expressiveness together with control and optimization.

The two subprojects considered are ”Optimizing Vehicle Maneuvers” and ”Narrow Lane Robotics”. The former focuses on investigating and develop models for optimal control in critical situations (e.g. evasive maneuvers), as well as studying the maneuvering strategies that are obtained from these optimizations and how they can be utilized in future advanced safety systems. The second subproject is subject to similar problems, applied to robotics for industrial production purposes, focusing on the optimal control task for traversing a ”narrow lane” (defined by tolerated path deviations) subject to e.g. actuator saturation.

3.7 Biomedical Projects

DIAdvisor™-Personal mobile short-term blood glucose predictor and treatment advisor

Project leader: Rolf Johansson.
Researchers: Marzia Cescon, Fredrik Ståhl, Meike Stemmann, Rolf Johansson, Georgios Chasparis and Dawn Tilbury.

This project is financially supported by the European Commision through the Information Society Technologies (IST) programme under the Seventh Framework Programme (FP7) n° 216592.

Partners

Novo Nordisk A/S, Bagsværd, Denmark, www.novonordisk.com, Coordinator
Johannes Kepler University, Linz, Austria, www.jku.at, Control & advisory algorithms
Lunds University, Lund, Sweden, www.lu.se, Data based models
University of Padova, Padova, Italy, www.unipd.it, Physiological models and clinical trials
Centre Hospitalier Universitaire de Montpellier, Montpellier, France, www.chu-montpellier.fr, Clinical trials
Toumaz Technology Ltd, Abingdon, UK, www.toumaz.com, Device integration
Sensor Technology and Devices Ltd, Belfast, UK, www.stnd.com, Vital sign sensors
Ondalys, Montpellier, France, www.ondalys.fr, Non invasive glucose measurement
RomSoft, Iasi, Romania, www.rms.ro, Software
Institute for Clinical and Experimental Medicine, Prague, Czech Republic, www.ikem.cz, Clinical trials
RICAM, Linz, Austria, www.ricam.oeaw.ac.at, Mathematics
Ramboll, Virum, Denmark, www.ramboll.com, Risk management
Federation Internationale du Diabete Region Europe, Brussels, Belgium, www.idf-europe.org, Validation and Dissemination

Background

Diabetes Mellitus is a chronic disease of disordered glucose metabolism due to defects in either insulin secretion from the pancreatic beta-cells or insulin action. Type-1 diabetes (T1DM), also called insulin-dependent diabetes mellitus (IDDM) is characterized by no production of insulin what so ever, whereas type-2 diabetes is caused by decreased sensitivity of the tissues to the metabolic effect of insulin. The basic effect

of insulin lack or insulin resistance is to prevent the efficient uptake and utilization of glucose by most cells of the body, resulting in abnormally high blood sugar levels (hyperglycemia). Sustained hyperglycemia is associated with acute ketoacidosis, nephropaty, rethinopaty,neuropathy and damages to the cardio-vascular system, therefore intensive insulin therapy aiming at near-normoglycemia(80-100 mg/dL) has been strongly promoted during the last decade, following the results of the major Diabetes Control and ComplicationsTrial (DCCT) and follow-up Epidemiology of Diabetes Interventions and Complications (EDIC) studies. Focusing on tight blood glucose targets, the strategy comprises test of blood glucose levels at least four times a day, taking insulin at least three times a day by injections or using a pump and patient assistance by healthcare team through visits and phone calls. Meanwhile, the lack of improved quality of life and above all, the occurence of induced hypoglycemic events which may result in seizure, coma and eventually death preclude the feasibilityof such a DCCT-like intensive therapy.

The problem of maintaining glucose levels within a predefined range by acting on insulin delivery is a control poblem, whose controlled variable is glucose utilization, measured output is either the subcutaneous glucose provided by the CGMS or the capillary glucose provided by the fingerprick, control input is the insulin intake, and the clinical criterion for success is plasma glucose. The system is subject to disturbances, the most important one being the meals. Control strategies involving the regulation of blood glucose levels in type 1 diabetes subjects range from classic PID feedback controller, run-to-run strategies to MPC algorithms.

The DIAdvisor™ project

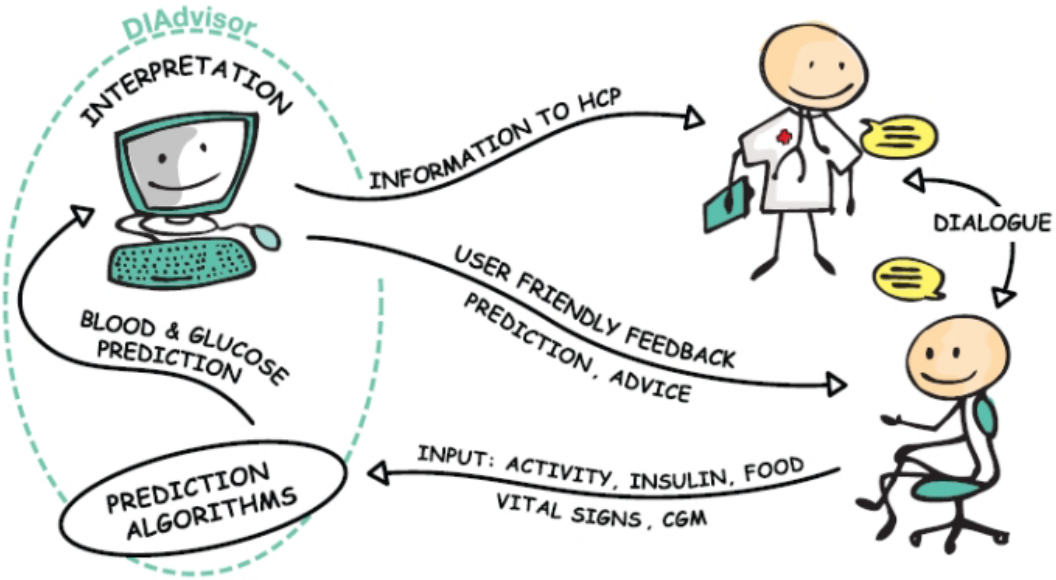
The DIAdvisor™ is a large-scale integrating project (IP) aiming at the development of a prediction based tool which uses past and easily available information to optimise the therapy of type 1 and developed type 2 diabetes. The DIAdvisor™ is not dependent on specific sensor technologies and can be adapted to technologies like standard strip sensing, minimally-invasive continuous glucose sensors and emerging non-invasive methods.

For safety reason, the DIAdvisor™ system will be able to self-assess the confidence of its proposed decisions. For safety reasons as well as for the sake of therapy improvements, the system connects and provides information and trends to the Health Care Provider.

Glucose prediction is difficult and requires advanced science within the fields of physiological modelling, identification theory, control theory, medical device technology, risk management theory, sensor science and user understanding. It can be achieved only by a well balanced group of eminent experts, including academics, clinicians, user representatives and leading companies.

The expected impact of DIAdvisor™ will be improved diabetes control and quality of life in large populations of insulin treated patients, leading to fewer diabetic complications and lower Health Care costs. Moreover, the project will constitute a valuable opportunity for European companies to build up a special know-how leading to products that profoundly and positively have an impact on the lives of millions of people with other indications than diabetes.

Official Website: www.diadvisor.eu



Cerebellar Control and Adaptation

Researchers: Jonas Dürango, Anders Rantzer and Rolf Johansson in collaboration with Dr. Henrik Jörntell (Div. Neurophysiology, Dept. Experimental Medical Science, Lund University).
Project Leader: Rolf Johansson

Funding: LCCC, Swedish Research Council; Ref. VR 2007-8646.

Cerebellar contribution to motor control and motor learning

The cerebellum is a structural unit of the central nervous system that plays a significant role in motor control and coordination, motor adaptation and the acquisition of new motor skills. It also provides large contributions to cognitive functions such as speech. Rather than initiating movement, the cerebellum influences movement control by integrating sensory signals and cerebral cortical signals related to the movement task at hand, and projecting it back to the motor areas of the cerebral cortex and brainstem. This is evident from studies where cerebellar lesions won't cause paralysis, but rather by leaving the patient with poorly controlled movements and unable to learn new motor skills or adapt existing movement patterns to new conditions.

The cerebellar cortex is built up from networks of different types of neurons. Purkinje cells act the main output of the cerebellar cortex, and each of these cells recombines information from a vast amount (~200 000) of other cerebellar cells. Each Purkinje cell is also contacted by a single climbing fiber, which is thought to encode information signalling to the cerebellum that an erroneous output is being made, and from this error the connection strengths between the Purkinje cell and the innervating cells are altered. This highly plastic and modular wiring of the cerebellar cortex allows for the cerebellum to adapt its output to better control and coordinate complex movement tasks.

From a control theory point of view the cerebellum can be viewed as an adaptive element contributing to motor control tasks in a larger decentralized control scheme. The aim of this project is to combine recent experimental findings with control theory to gain better insight of the mechanisms of cerebellar function.

Anesthesia in Closed Loop

Researchers: Tore Hägglund (area leader) and Kristian Soltesz in collaboration with professor Guy Dumont and the ECEM group, University of British Columbia, Vancouver, Canada.

Funding: LCCC, Swedish Research Council; Ref. VR 2007-8646.

Computer controlled, or automatic, drug delivery is the process of administering a therapeutic regime to a patient with computer assistance for calculation of optimal dose and delivery schedules. Computer control can improve drug therapy by reducing drug usage and costs, by permitting health care staff to work more efficiently and to provide better standard of care, by allowing the safe use of drugs that are difficult to administer, and by compensation for human failings with computer strengths, such as unlimited attention span and patience, and capacity for quick, accurate and redundant calculation.

Our goal is to develop an automatic control system for anesthesia and to demonstrate its efficacy, safety and benefits in an operating room. Although closed-loop anesthesia has previously been proposed and tested, it has yet to have a significant impact on clinical practice. Recent developments in sensing for anesthesia have opened new possibilities for closing the loop. Our research will focus on the deployment of new sensors optimized for controlled drug delivery, robust control methodology and extensive clinical validation.

Clinical partner in the project is the Department of Anesthesia at the British Columbia Children's Hospital (BCCH), Vancouver, Canada, where patient modeling data is collected and clinical trials of the control system are conducted.

A PID controller based drug delivery system for depth of hypnosis control was evaluated in a patient study (BCCH REB approval H10-01174) during 2011.

Our current aim is to extend the system to control hypnosis and analgesia simultaneously, by adding a second drug.

3.8 Tools

A large number of software tools for analysis, design, and simulation of control systems have been developed at the department since the 1970's. Below we list tools that are being actively developed or maintained at the current time. The tools are free software and can be downloaded from the department web page.

TrueTime

TrueTime is a Matlab/Simulink-based simulator for networked and embedded control systems. It facilitates detailed co-simulation of plants, controllers, real-time scheduling algorithms and network transmissions. During 2010, the work on a new major release, TrueTime 2.0, has continued. Also, TrueTime Network for Modelica was released. Two versions have been developed - one based on an external C code implementation and one based on native Modelica. The development has been done within the ITEA 2 project EUROSYSLIB.

Jitterbug

Jitterbug is a Matlab toolbox that facilitates stochastic analysis of control loops with random delays. The toolbox can evaluate a quadratic cost function for a linear control system with Gaussian noise under various timing conditions. Using Jitterbug, it is easy to assert how sensitive a given control loop is to sampling jitter, input-output delay, output jitter, and lost samples, without resorting to simulation. During 2010, functions for jitter-robust LQG design and LQG control design with integral action has been added to the toolbox.

MPCtools

MPCtools is a freely available MATLAB/Simulink toolbox for simulation of MPC controllers. MPCtools provides functions to create and simulate basic MPC controllers based on linear state space models.
The toolbox provides support for quadratic cost functions, linear inequality constraints on states and controls, integral action by means of disturbance estimation and two different QP solvers for solving the optimization problem. MPCtools is primarily intended for research and teaching but is free to use for all purposes. During 2010, mainly maintenance and bug-fixing was done.

JModelica.org

JModelica.org is an open source software for optimization, simulation and analysis of complex dynamic systems. The software provides algorithms for solving optimal control and parameter estimation problems based on large-scale DAE systems expressed in

the Modelica and Optimica modeling languages. The software also supports open standards specifying model exchange formats in C and XML, in order to facilitate integration with other tools.The software is developed in a collaboration between the Lund-based company Modelon AB and the departments of Automatic control, Mathematics and Computer science at the faculty of Engineering, Lund university. During 2010, the department of Automatic control supported the development of the JModelica.org compiler. The software was also used in the research project PIC-LU and in a master's thesis on optimal robotic control.

JGrafchart

Grafchart is a language for supervisory level sequence control and procedure handling that has been developed at the department since 1991. Grafchart is based on ideas from Grafcet/Sequential Function Charts, Petri nets, Statecharts, and object-oriented programming.
The original implementation of Grafchart had the same name and was developed in G2 from Gensym Corporation. Using this platform Grafchart was used for batch recipe control, diagnosis of mode-changning processes, alarm filtering, implementation of operator decision support systems, and implementation of robot cells.
In the beginning of 2001 a decision was made to create a new implementation of Grafchart in Java. It is called JGrafchart and is used in our laboratory exercises on logical sequence control and batch control. It has also been used within the EU/GROWTH project CHEM.
JGrafchart is available for download as freeware. The included documentation for the latest version is also available online. During 2011 support for DPWS has been added. There have also been four public releases of Grafchart, for more details see the release notes.

Grafchart for Industrial Automation

Researchers: Alfred Theorin, Charlotta Johnsson
Funding: LCCC

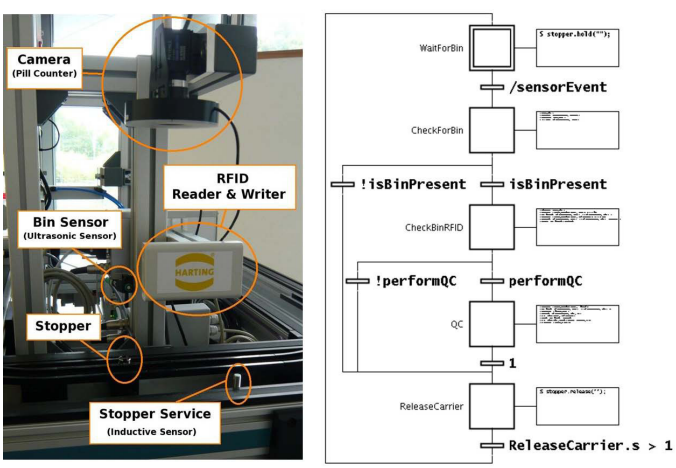
Grafchart has proven to be a very capable and suitable language for various control applications on both local and on supervisory level as well as for all levels of automation. It also has potential for formal descriptions, validation, and analysis. It has been used with for a wide variety of applications, e.g. batch control, discrete control, and diagnosis and the paradigm fits all of these very well.

Project aims:

- To evaluate the advantages and disadvantages of using Grafchart for industrial applications compared to the languages used today
- To improve the state of art of Grafchart

The research in this project primarily focuses on aspects that are considered important and useful for the industry. In particular the current focus is on the following topics:

- Add SOA support for Grafchart, and evaluate it in real setups. The SOA paradigm is promising approach to deal with the currently increasing complexity, increasing requirements on flexibility, and increasing demand for vertical integration.
- Real-time execution of Grafchart applications. This also enables exploring how to handle e.g. reconfiguration of running applications. Reconfiguration is taken for granted in the automation world but is rather unexplored from a research point of view.
- Improved object orientation support for Grafchart. Analyse various constructs of other modern programming languages, check if they are possible to add to Grafchart, and evaluate the benefits of adding them.



4. External Contacts

A healthy mix of fundamental and applied work is a cornerstone of our activities. In the applications projects the goal is to solve real control problems together with external partners. In these projects the problems are approached with an open mind without glancing at particular methods. One purpose is to learn about real problems, another is to learn about new problems that are suitable for theoretical research. An important role for universities is to organize knowledge in such a way that the results can easily be digested by engineers in industry. There is naturally a strong symbiosis with teaching in this activity. A good mechanism is thus to introduce new research material into existing and new courses. A related form of technology transfer is to write books and monographs and to develop software. Exchange of personnel between industry and university is another very effective vehicle for technology transfer.

4.1 Academic Contacts

We have very good and fruitful relations and cooperations with a number of universities and academic institutions throughout the world. This year we have had important contacts with:

- Department of Computer Science, Lund University, Sweden
- Department of Electrical Engineering and Information Technology, Lund University, Sweden
- Department of Chemical Engineering, Lund University, Sweden
- Department of Mathematics, Lund University, Sweden
- Department of Heat and Power Engineering, Lund University, Sweden
- Department of Mechanical Engineering, Lund University, Sweden
- Department of Cardiology, Lund University Hospital, Sweden
- Department of Clinical Sciences, Lund University Hospital, Sweden
- Department of Logistics, Lund University, Sweden
- Universidad Politecnica de Valencia, Spain
- Umeå University, Sweden
- Jaén University, Spain
- Norwegian University of Science and Technology, Trondheim, Norway
- Universidad de Valladolid, Spain
- Universidad de Almeria, Spain
- Universita di Roma, La Sapienza, Italy
- Universita di Siena, Italy
- Parades, Rome, Italy
- Herlev University Hospital, Copenhagen, Denmark

- Tsinghua University, Bejing, China
- Zheijang University, Hangzhou, China
- Sung Kyun Kwan University, Korea
- Linköping University, Sweden
- EPFL, Switzerland
- Scuola Superiore St'Anna, Pisa, Italy
- KU Leuven, Belgium
- Texas A&M University, Texas, USA
- Politecnico di Milano, Italy
- TU Kaiserslautern, Germany
- Caltech, USA
- Centre Hospitalier Universitaire de Montpellier, Montpellier, France
- Institute for Clinical and Experimental Medicine, Prague, Czech Republic
- Johannes Kepler University, Linz, Austria
- University of Padova, Italy
- Hanyang University, Seoul, Korea
- Fraunhofer IPA, Stuttgart, Germany
- UNED, Spain

4.2 Industrial Contacts

We have very good working relations with many companies and organizations The interactions are at different levels and of different intensities, from visits and discussions to joint projects. Master's theses and education are also important ingredients. During the year we have had major projects with:

- ABB Automation Technologies/Robotics, Sweden
- ABB CRC Västerås, Sweden
- ABB Corporate Research Sweden/Germany
- ABB Robotics Products, Västerås, Sweden
- Boeing R&D, Sweden
- Borealis AB, Sweden
- Castings Technology International, England
- Ericsson, Karlskrona, Sweden
- Güdel AG, Switzerland
- KPS Rinas, Denmark
- Novo Nordisk AS, Denmark
- Perstorp AB, Sweden
- Pidab AB, Sweden
- SKB Oskarshamn, Sweden
- TetraPak, Sweden
- Toumaz Technology Ltd, Abingdon, UK

- Volvo Powertrain, Inc., Gothenburg, Sweden
- Novozymes AS, Denmark
- Evidence, Italy
- Akatech, Switzerland
- Modelon AB, Lund, Sweden
- Rockwell Automation, Lund, Sweden
- Stora Enso Hylte AB, Sweden
- Ondalys, Montpellier, France
- RICAM, Linz, Austria
- Ramboll, Copenhagen, Denmark
- RomSoft, Iasi, Romania
- Sensor Technology and Devices Ltd, Belfast, UK
- Toumaz Technology Ltd, Abingdon, UK
- SAAB Bofors Dynamics, Linköping, Sweden
- Volvo Construction Equipment

4.3 European Collaboration

During 2011 the department was involved in the 6th and 7th Framework Program of the European Commission.

FP6 Projects:

- ARTIST2 – Embedded Systems Design
- HYCON – Hybrid Control: Taming heterogeneity and complexity of networked embedded systems
- EURON-II – European Robot Research Network
- SMErobot™

FP7 Projects:

- ACTORS
- AEOLUS
- ArtistDesign
- CHAT
- DIAdvisor™
- ROSETTA

4.4 SESAM-Sverige - a network for industrial automation

SESAM-Sverige (English: SESAM-Sweden) is an industry independent network with focus on industrial automation. The membership is aimed for companies that have an interest in industrial automation. The main activitiy of SESAM-Sverige is to organize, mainly in southern Sweden, frequent seminars around topics related to industrial automation in which trends, actual problems and relevant technologies are presented and discussed. SESAM-Sverige wants to strengthen the position of their member-companies by providing a network for the companies' employees around industrial automation.

The very first meeting around a potential network for industrial automation in Sweden was arranged in February 2011 at Dept of Automatic Control, Lund university. The organizers were Dept of Automatic Control together with SESAM-Denmark. There was a large interest and a working group was formed with the aim to find a name, schedule of activities, and suitable forms for collaboration with SESAM-Denmark. The working group met four times during spring 2011.

SESAM-Sweden was officially formed in June 2011. It's board consists of 8 members (and 4 suppleants) and the main task is to find and organize interesting seminars for the members. During 2011 there has been 4 board meetings and 1 seminar.

Seminar-1 was focued on "IT sequrity in Automation" and was held at Alfa-Laval in Lund Sweden on September 28, 2011. The seminar included 6 presentations and a guided tour at Alfa-Lavals production site in Lund. It attracted about 40 attendees, mainly from industry.

Involvement: The department of Automatic Control was mainly involved in the start-up of SESAM-Sverige. The initative to create the Swedish Network for Industrial Automation, called SESAM-Sverige, was taken jointly by Carsten Nyckleby from SESAM-Denmark and Charlotta Johnsson from Dept. of Automatic Control. Today, Charlotta Johnsson is a board member of SESAM-Sverige and the daily operations is managed by Carsten Nyckleby and the SESAM-Denmark team.

SESAM-Sverige official website: http://www.sesamsverige.se/

5. Staff

During 2011 the staff at Automatic Control has grown appreciably. One new PhD student has been employed, one new associate professor and four new post docs. We have also had the pleasure of hosting several international guests for shorter or longer periods.

In the coming parts the personnel and its activities will be described.

5.1 Personnel and Visitors

Professors

Tarek Abdezaher vistiting professor (August-December)
Karl Johan Åström, senior professor
Per Hagander, senior professor
Rolf Johansson
Dawn Tilbury, visiting professor (until June)
Karl-Erik Årzén
Bo Bernhardsson
Tore Hägglund
Anders Rantzer, prefekt
Björn Wittenmark (until March)

Associate Professors

Anton Cervin
Charlotta Johnsson
Andrey Gulchak, 50%
Anders Robertsson

Assistant Professor

Johan Åkesson (on leave 80%)
Giacomo Como

Research Engineers

Leif Andersson
Rolf Braun
Stefan Skoog
Anders Blomdell
Anders Nilsson

Secretaries

Britt-Marie Mårtensson
Monika Rasmusson (from August)
Eva Westin
Ingrid Nilsson
Eva Schildt

Postdoctors

Georgios Chasparis
Maxim Kristalny
Vladimeros Vladimerou
Yumiko Ishido (from April)
Laurent Lessard (from October)

PhD Students

Karl Berntorp
Isolde Dressler
Mahdi Ghazaei (from December)
Martin Hast
Toivo Henningsson
Ola Johnsson
Mikael Lindberg
Anna Lindholm
Anders Mannesson
Jerker Nordh
Anders Pettersson
Vanessa Romero Segovia
Kristian Soltesz
Olof Sörnmo
Andreas Stolt
Alfred Theorin
Marzia Cescon
Jonas Dürango
Pontus Giselsson
Maria Henningsson
Erik Johannesson (until October)
Per-Ola Larsson (until November)
Magnus Linderoth
Daria Madjidian
Karl Mårtensson
Björn Olofsson
Philip Reuterswärd
Alina Rubanova
Aivar Sootla
Meike Stemmann
Fredrik Ståhl
Anders Widd

Project Assistants

Gustav Cedersjö
Manfred Dellkrantz (from September)
Mikael Kralmark
Yang Xu (from December)

Longer Stays

Tarek Abdelzaher, Professor, University of Illinois at Urbana-Champaign, USA; August - December
Joel Andersson, PhD student, KU Leuven, Belgium; September - December
Benjamin Biegel, Master's thesis student, University of Aarhus, Denmark; February - May
Dang Doan, PhD student, Delft University, the Netherlands; April - May
Yiping Feng, PhD student, Zhejiang University, China; August - September
Dragoljub Gajic, PhD student, University of Belgrade, Serbia; until June
Keith Glover, Professor, Cambridge University, Great Britain; May
Bernt Lie, Professor, Telemark University College, Norway; August
Yongxin Liu, Tech. Dr, University of Hohot Inner Mongolia, Mongolia; until March
Lennart Ljung, Professor, Linköping University, Sweden; until June
Andrzej Pawlowski, PhD student, University of Almeria, Spain; August - October
Enrique Pico, UP Valencia, Spain; from December
Gang Rong, PhD student, Zhejiang University, China; August - September
Dawn Tilbury, Professor, University of Michigan, USA, until June
Hong Wang, PhD student, Zhejiang University, China; from August

5.2 Staff Activities

Åkesson, Johan

Assistant Professor, PhD (2007); joined the department in 2001. Johan's main research interest is in the field of languages and tools for dynamic optimization of large scale systems, including language design, compiler design and implementation, numerical algorithms, and industrial applications. He is currently leading the JModelica.org project aimed at developing a Modelica-based open source platform for optimization of dynamic systems. Within the PIC-LU project, he was part of the management team during 2011 and he was leading an associated project dealing with grade change optimization in cooperation with the plastics manufacturer Borealis. During the year, Johan took part in the supervision of five master's thesis projects and five PhD students. He served as the course responsible for the course Project in Automatic Control (FRT090). Johan is also associated with Modelon AB, where he works part time.

Andersson, Leif

MSc, Research Engineer since 1970. Leif started at the department with a responsibility for the teaching laboratory. He designed some lab equipment, notably an analog computer. In 1976 he started in ernest with digital computers, and has been responsible for the department computing facilities since then. The main computer systems have been RT11, VAX/VMS, Sun Solaris, Linux and lately MacOSX. He has also been forced to handle Microsoft Windows. His professional activities, apart from computer system maintenance, have ranged from computer typesetting (TeX and LaTeX) via Real Time Programming to using Java as a tool for writing educational software.

During the last few years he has been involved in converting the department web server from the 'Roxen Webserver', used for about ten years, to the more common 'Apache Webserver'. In that connection the creation of web pages has been moved from direct editing of HTML code to the use of a Content Management System. The particular system chosen has been 'CMS Made Simple', an open source package. This has given the department web pages a much more unified style than before, but has also meant quite a lot of conversion work.

Årzén, Karl-Erik

Professor (2000), PhD (1987): Joined the department in 1981. His research interests are real-time and embedded control, real-time systems, programming languages for control, Petri nets and Grafcet, and monitoring and diagnosis. Leader of the Design for Adaptivity activity in the EU/IST FP7 network of excellence ArtistDesign. During the year he has primarily been involved in the VR project Feedback-based resource management for embedded multicore platforms and in the SSF project ENGROSS. He has been responsible for and taught the undergraduate course Real-Time Systems. He is partly or fully involved in the supervision of four PhD students.

Åström, Karl Johan

Professor in Automaic Control since 1965, founder of the department, emeritus from 2000, senior professor since 2009?. In April he visited Caltech to work on the new edition of Feedback Systems, and UCSB and Berkeley to lecture. Participated in the SPIE Conference on Integrated Modeling of Complex Optomechanical Systems in Kiruna in August where he gave an invited plenary lecture. Participated in the IFAC World Congress in Milan. Visited China in November to deliver an invited plenary at the Chinese Automation Congress on the occasion of the 50 year celebration of the Chinese Automation Society. Lectured at Tshinghua University, the Key Laboratory of Systems of the Chinese Academy of Sciences, the Institute of Automation and the Taiyuan University.

Bernhardsson, Bo

PhD 1992, Professor since 1999, has also worked at Ericsson for 9 year. Director of Studies for the PhD education at the department and a member of the LCCC board. His research interests are in linear systems, applications of control theory and the connection between communication and control theory. During 2011 he gave the basic control course for the FiPI and CMN programmes, and organized a PhD course in Simultaneous Localization and Mapping. He supervised two master's thesis projects. He arranged the 2nd Swedish indoor navigation workshop in Lund, and he participated in the LCCC workshops, the Swedish-Chinese conference, the IFAC world congress in Milano and the EIT Circuit Design Workshop in Lund. He was opponent for the PhD thesis by Jeroen Hol, and the Licentiate theses by Jonas Callmer and Sina Parastegari, all three in Automatic Control in Linköping. He was also part of the examination committes for three PhD theses in Lund: one in Combustion Engineering, one in Communication Theory and one in Circuit Design.

Berntorp, Karl

M.Sc. in Engineering Physics, Ph.D. student since February 2009. Karl is part of the SSF sponsored ENGROSS project, where the work in 2011 focused on sensor fusion algorithms for indoor navigation and localization, as well as mobile robot manipulation. Within the ELLIIT project he worked with optimization-based strategies for future vehicle safety systems. During the year he has been involved in teaching the courses Multivariable Control, Nonlinear Control, and Real-Time Systems. He also attended PhD courses.

Blomdell, Anders

Research Engineer at the department since 1988. Heavily involved in almost all aspects of Robotics Research at the department, also responsible for the department network and lab computers for teaching and research. During 2011 Linux namespaces were successfully investigated as a way to separate different users rights when running on our computers.

Braun, Rolf

Research Engineer at the department since 1969. Designs and builds equipment for education and research, and handles hardware maintenance of computers and equipment. He also plans and supervises maintenance and rebuilding of offices and labs.

Chasparis, Georgios

PhD 2008. Georgios has been a post-doctoral scholar in LCCC since December 2010. His research interests lie in the general area of distributed control and optimization. He is currently working on the distributed optimization of power flow in electricity markets.

Cho, Jang Ho

PhD (2010). He has been a post-doctoral researcher at the LCCC since September 2011. His research interests include haptics and robotics. He has been involved surgical robotics which is one of seed research areas of LCCC. He is currently working on the improvement of haptic perception ability for robotic sutures and collision avoidance of the telesurgical systems.

Cervin, Anton

Associate professor, PhD (2003); joined the department in 1998. Anton's research interests include real-time systems, event-based and networked control, and computer tools for analysis and simulation of controller timing. During 2011, he was leader of the research projects ``Suboptimal methods for event-based control and estimation" (funded by the Swedish Research Council and LCCC) and ``Integrated scheduling and synthesis of networked embedded event-based control systems" (funded by ELLIIT). He was also involved in the EU/FP7 project ArtistDesign. He has been coordinator and lecturer in the basic-level courses Systems Engineering, Process Control, and Automatic Control, Basic Course (China). He is program director for the China Profile and deputy member of the Academic Appointments Board 2 at LTH. Anton was on parental leave during January--March, 2011.

Cescon, Marzia

Marzia Cescon, Lic. Tech., graduate student since July 2008. Main research interest involve system identification techniques with application to biomedical systems. Currently, she is working on the DIAdvisor project within the European FP7-ICT program, pursuing research on prediction and predictive control of blood glucose concentration in diabetic subjects. Her teaching activities during the Spring were related to the Control Theory Course, and during the Fall to the Automatic Control Basic Course and the Predictive Control Course.

Como, Giacomo

PhD (2008). He has been an Assistant Professor since August 2011. His research in-

cludes different aspects of dynamics over large scale networks, including social and transportation networks, as well as problems in Information and Control.

Dressler, Isolde

Msc, graduate student since September 2004. Isolde is interested in robot modeling, calibration and control, particularly of parallel kinematic robots. Currently, she is working on tool force controlled robot leadthrough teaching. From January to April she was on maternity leave.

Dürango, Jonas

MSc in Engineering Physics and with the department as PhD student since July 2010. His main research interest include biological motor control and learning with focus on the cerebellum, where he is collaborating with partners from the Faculty of Medicine. During the year he has been assisting in teaching undergraduate courses to engineering students, as well as following graduate courses at the department.

From, Pål Johan

PhD (2010). He has been a researcher with the LCCC since July 2011. His research includes surgical robotics and he is currently working on improving the haptic perception for the surgeon during robotic surgery.

Ghazaei, Mahdi

I am a Ph.D. student in the Department of Automatic Control since Dec. 2011. I received a M.Sc. in Information Technology Engineering - Secure Telecom from Iran University of Science and Technology in 2007. As my major assignment, I am involved in a European robotic project named PRACE (the Productive Robot ApprentiCE). The target is to develop a dual-armed mobile robotic system to automatize a part of shop floor environments. A challenge is to increase flexibility and productivity by shortening the set-up time through intuitive demonstration of tasks to the robot.

Giselsson, Pontus

MSc, graduate student since November 2006. Pontus research interests include optimal control and Model Predictive Control (MPC). His work covers both practical and theoretical aspects of MPC. The practical work, in which MPC is applied to a pendulum system, became a laboratory exercise in the under-graduate course, Nonlinear Control and Servo Systems. His current research focus is on theory for distributed MPC and on execution time certification in standard MPC.

Hagander, Per

Senior Professor, PhD (1973). Per has been with the department since 1968 and works with linear system theory and with applications in biotechnology and medicine. During 2010 he taught the course Control Theory.

Hägglund, Tore

Professor, PhD (1984). Has been at the department since 1978 except for four years when he worked for ABB. He is responsible for two of the basic courses in Automatic Control in the engineering program. His main research interests include process control, PID control, adaptive control, control loop monitoring and diagnosis. Main research activities during the year have been design of PID controllers, decentralized control structures, and valve stiction diagnosis. Tore Hägglund is also deputy centre director of Centre for Research and Competence Development for the Process Industry, PIC-LU.

Hast, Martin

M.Sc. in Engineering Physics, Ph.D. student since February 2010. His research interests are in feedforward structures and the design of feedforward controllers for disturbance attenuation, supervised by Prof. Tore Hägglund. Martin has previously been involved in the development of a Modelica-based verison of TrueTime. He has also been a teaching assistant in the basic course and the project course.

Henningsson, Maria

LicSc, graduate student since 2005. She is working with Professor Rolf Johansson in the project Diesel combustion with low environmental impact, in cooperation with Volvo Powertrain and the division of combustion engines at Lund University. During 2011 she worked on the control system for a new heavy-duty engine in the engine research lab. She also worked on machine-learning methods for extracting information from in-cylinder engine pressure sensors.

Henningsson Perby, Toivo

Lic. Tech., graduate student since August 2005. His research interests are in event based, distributed and embedded control and estimation. During the year, he has been developing a mathematical framework and software toolbox for modeling, analysis, and control design for stochastic hybrid systems, with an emphasis on event-based control systems.

Ishido, Yumiko

PhD. She has been a postdoc at the LCCC since April 2011. Yumiko's main research interests are analysis and synthesis of nonlinear systems. Previously, she has suggested a new mathematical framework for stability analysis of quantized feedback systems in her PhD work. She joined the department in 2011 with a strong interest in a project of developing a new, practical framework for a wider class of nonlinear systems. In the LCCC, she has started with Associate Professor Anton Cervin a work on extending her PhD results to event-triggered networked systems for the purpose.

Johannesson, Erik

PhD (2011), MSc in Engineering Mathematics, Master in Cognitive Science. Spent most of the year finishing his Phd thesis, "Control and Communication with Signal-

to-Noise Ratio Constraints", which was subsequently defended in October. In the late fall, he lectured the basic control course held at Zhejiang University, Hangzhou, China.

Johansson, Rolf

Professor, MD, PhD. Active at the department since 1979. Rolf Johansson's research interests are in system identification, robotics and nonlinear systems and automotive control. He is node leader for the research projects DIAdvisor, HYCON, SSF ProViking ProFlexa, Vinnova PFF Diesel HCCI, ROSETTA. He is coordinating director for Robotics Laboratory with cooperation partners from Dept Computer Science, Dept Mechanical Engineering, Dept. Mathematics and industrial partners. He has industrial cooperation with ABB Robotics, ABB Corporate Research, Novo Nordisk AS, Volvo Powertrain. He is responsible for the two courses FRT041 System Identification and FRT050 Adaptive Control. Together with Dr. Måns Magnusson he leads research at the Vestibular Laboratory, Dept. Otorhinolaryngology, Lund University Hospital.

Johnsson, Charlotta

Research Associate, PhD (1999). Charlotta has been at the department since 1993 except for 4 years (2000-2004) when she worked for Siemens. Charlotta's main research interest is in Production Control, Batch Control Systems, Manufacturing Operations System. Charlotta is one of the principal investigators of the LCCC research program. She is also part of the management team for the research centers LCCC, PIC-LU and LISA.
Charlotta is serving as the Program Leader for Technology Management, a joint programme run by Lund Institute of Technology and the School of Economics and Management at Lund University. During the year, Charlotta has been involved in a variety of courses stretching from technical courses for master students to pedagogical courses for teachers in higher education.

Johnsson, Ola

MSc in Biotechnology, graduate student since August 2010. Works within the field of fermentation control, as a project within Process Industrial Centre Lund (PICLU). Spent 2011 developing a new fermentation control strategy and implemented it in several series of experiments, in pilot scale. Has also taken various courses and been involved in teaching both at the Department of Automatic Control and the Department of Chemical Engineering.

Kristalny, Maxim

He has been a post-doctoral researcher at the LCCC since August 2010. His research interests include analytical methods in distributed control and the use of preview in control and estimation. In 2011 Maxim continued his work within the Aeolus project. He focused mainly on the use of previewed measurements of the wind speed for the reduction of loads experienced by wind turbines. He also started a new project related to the use of distributed control techniques in teleoperation and haptics.

Larsson, Per-Ola

Phd (2011), M.Sc. in Electical Engineering (2005). Worked in two different process control projects in parallel during the year and defended his Ph.D. thesis ”Optimization of Low-Level Controllers and High-Level Polymer Grade Changes” in November.

Lessard, Laurent

PhD, post doc. Laurent joined the department as an LCCC post-doctoral researcher in October, 2011. His research has been primarily focused on finding analytical and structural results related to the optimal control of decentralized systems. Specifically, he has been studying sparsity and time-delay constraints, which are very prevalent in distributed systems such as the internet or power grids.

Lindberg, Mikael

Tech. lic, graduate student since July 2007. Main research interests lie in feed back resource management for cyber physical systems, such as cellular phones and autonomous robots. During the spring of 2011, Mikael was on parental leave from the department, returning in full during May. During the fall he was taking graduate level courses in control and supervising laboratory exercises in the Realtime systems course. Preliminary work on management for networked systems was initiated, aiming at a series of papers during 2012.

Linderoth, Magnus

Lic. Tech., graduate student since September 2008. He defended his licentiate thesis in June 2011. He is working in the Rosetta project, which aims to develop robots that are easy to program, adaptive, can share information and work safely next to humans. Magnus focuses on force control, redundancy resolution and vision feedback. During 2011 he has been involved in teaching of Real-Time Systems and Projects in Automatic Control. He was also a co-supervisor of Martin Ericssons master thesis titled ”An Improvement of the Autonomous Features of a Quadrotor”.

Lindholm, Anna

Anna has a M.Sc. in Engineering Physics and has been a graduate student at the department since February 2009. She is currently working on developing methods for handling plant-wide disturbances within the process industry. During 2011, she published three conference papers on the topic, and in October she presented her licentiate thesis: ”Utility Disturbance Management in the Process Industry”. She was also a teaching assistant in the Nonlinear Control course, and during the fall she spent three weeks at Zhejiang University in Hangzhou, China, teaching the basic course in Automatic Control.

Madjidian, Daria

Daria has a M.Sc in Electrical Engineering and started as a Ph.D student at the depart-

ment of Automatic control in August, 2008. Until September 2011 he was involved in the EU-funded research project Aeolus with Anders Rantzer. The objective of AEOLUS is to address the effect of aerodynamic coupling in wind farms. Daria's current topic of research is coordinated control of wind turbines in wind farms. During Spring of 2011 Daria supervised the Master Thesis of Benjamin Biegel, titled "Distributed Control of Wind Farm". During Fall of 2011 he tutored the basic course in Automatic Control at Zhezhang University, Hangzhou, China.

Mannesson, Anders

M.Sc. in Electrical Engineering (2005) and B.Sc. in Business and Economics (2005), Graduate student since June 2010. Anders is working together with Professor Bo Bernhardsson on indoor navigation within the ELLIIT project. His main research topics involves estimation, filtering and optimization. During the year Anders has also been teaching the introduction course in Automatic Control.

Mårtensson, Britt-Marie

Secretary at the department since 1974. She is responsible for the department library, orders books and handles the mail and office supplies. Assistant Webmaster. She also handles the contact with printing offices for dissertations and other publications. Britt-Marie is also the department's service person. Working part time.

Mårtensson, Karl

MSc, graduate student since December 2006. Karl's research concerns Distributed Control, where he is focusing on structured LQG controllers. In this area, he is working with Professor Anders Rantzer. He has been part of the EU project with acronym CHAT, with the focus of developing algorithms for distributed resource management. He has also worked with Model Predictive Control, especially dealing with computational delays. Karl has been involved in teaching the basic course in Automatic Control, as well as in more advanced courses, e.g. Nonlinear Control and Control Theory.

Nilsson, Anders

PhD (2006), Research Engineer since 2010. Spends most of the time trying to replace Leif's duties looking after the department computers. With a past at the department of computer science developing compiler and runtime system for real-time Java, he also tries to squeeze in some time for research. For the last two years this has meant being involved in the EU FP7 ROSETTA project, trying to use compiler technology knowledge and tools for managing formal knowledge and ontologies with the goal to make industrial robots easier to use.

Nilsson, Ingrid

Administrator at the department since March 2009. Ingrid is mainly responsible for the financial transactions at the department such as bookkeeping and reporting to our sponsors.

Nordh, Jerker

MSc Engineering Physics, graduate student since August 2010. During 2011 the teaching duties have been fulfilled by teaching in the Real-time Systems Course, the Projects in Automatic Control course and supervising a master thesis; Control of a Quadrotor. The research has been focused on indoor navigation within the ELLIIT project and the rest of the time has been spent following courses.

Olofsson, Björn

MSc in Engineering Physics, PhD student at the department since August 2010. His research interests are in robotics and optimal control. During the year, he has been active in the EU/FP7 project COMET and the SSF/ProViking project ProFlexA, both involving industrial robots for performing tasks relevant for industry. He has also taken graduate courses within control theory and mathematics and taken active part in the teaching at the department within the undergraduate engineering programs.

Rantzer, Anders

Professor of Automatic Control since 1999 and head of department 2003-2011. He is coordinator for the Linnaeus center LCCC and has broad interests in modeling, analysis and synthesis of control systems, with particular attention to robustness, optimization and distributed control. Anders Rantzer is the main supervisor for several PhD students. One of them, Erik Johannesson, finished his PhD during 2011. He was also responsible for the courses ”FRTN05 Nonlinear Control and Servo Systems” and ”FRT095 Mathematical Modelling”.

Rasmusson, Monika

Economist/administrator at the department from August 2011. My work, as a part of a team, includes reimbursements, reporting EU projects such as MONROE, COMET and SME Robotics among other administrative tasks.

Reuterswärd, Philip

Civ.ing., Dipl.-Math. techn., PhD student. Philip has postponed his own nirvana and chosen to take rebirth in order to serve the department. He is currently looking into pseudopsectral optimization and has recently realized that one should never mobilize without first fixing an objective.

Robertsson, Anders

Associate professor (2007), ”Docent” (2005), Research Associate (May 2003), PhD (1999). Excellent Teaching Practitioner (ETP) in 2007. His main interest is in nonlinear control and robotics. Currently he is working on parallel kinematic robots, sensor-data integration and force control of industrial robots in collaboration with ABB Robotics/ABB CRC. The research has been conducted with the LUCAS project, the Robotics Lab, The Linneaus Centre LCCC and the EU funded projects ROSETTA

(FP-7), COMET (FP-7), MONROE (FP-7), PRACE (FP-7). He has also been doing research on admission control in network nodes and control of server systems in cooperation with the Department of Electrical and Information Technology, LTH, Lund University, and Ericsson AB, Karlskrona. He has lectured in the course Multivariable Control and in the course on Nonlinear Control and Servo Systems, and acted as advisor/co-advisor for 7 PhD students and several Master's Thesis projects.

Romero Segovia, Vanessa

Born in Peru, she has a Lic. Sc. since September 2009 and an M. Sc. in Electrical Engineering since August 2008. Vanessa is a PhD student at the department since September 2008. Her current research work is related to the design of filters for PID and PI controllers, which can be used in many industrial process applications. She is an active member of the Process Industrial Centre at Lund University (PICLU). Her past research interests have been related to real-time systems. She has been an active member of the EU Project ACTORS, where her task was the design and implementation of different control algorithms to achieve CPU bandwidth adaption in multicore systems. As part of ger PhD duties she is a teaching assistant of courses such as Automatic Control, Process Control, Market-Driven Systems, International Project Course in Automatic Control, and Real-Time Systems.

Rubanova, Alina

Alina Rubanova is a Ph.D Student at the Department of Automatic Control since October 2009. She is doing research as part of the project Active Control of Compressor Systems Based on New Methods of Nonlinear Dynamic Feedback Stabilization. She is working with Analytic Parameterization of Stabilizing Controllers for the Moore-Greitzer Compressor Model. The simulation model and the analytical parametrization of the family of controllers have been made. The set of sufficient conditions for stability has been updated. With any set of parameters that satisfy the given constraints, the closed-loop system with the dynamic output feedback controller defined by these parameters is stable. She is working now with two steps of the investigation. The first step is characterization of the stabilizing controllers and the description of the parametric properties. The second step is the analytical investigation based on the theory and the new modeling results. She can now present the data of the stabilizing controllers and the new constraints for the corresponding parameters. It remains a challenging problem to characterize all stabilizing controllers., which is her current work.

Schildt, Eva

Secretary at the department since 1970 and responsible for the overall administration. She is responsible for the personnel administration and takes care of the administration concerning visitors at the department. Working part time since january 2010.

Soltesz, Kristian

M.Sc., graduate student since October 2008. Kristian has spent the first two years of

his PhD looking into system identification for PID tuning. He will present his licentiate thesis on PID tuning in early 2012. Kristian was on leave of absence during the first half of 2011. During the second half of the year, he continued a collaboration with the group of professor Guy Dumont at the University of British Columbia (UBC), Vancouver, Canada, locally supervised by professor Tore Hägglund. The aim of the collaboration is to develop a system for closed-loop anesthesia, guided by brain wave measurements. A successful patient study, authorized by British Columbia Children's Hospital (BCCH) REB: H10-01174, was conducted during the second half of 2011 at BCCH, Vancouver, Canada.

Sootla, Aivar

Lic.Sc., graduate student since September 2006. Aivar's main research interest lies in reduced order modeling of linear systems. A few different problems were considered in his PhD project such as parameterized model reduction, order reduction in the nu-gap metric, model reduction of structured systems. During the 2011 he published two papers in major conferences: American Control Conference held in San Francisco, CA, USA and IFAC World Congress held in Milan, Italy. He is also preparing three journal submissions in high impact journals such as IEEE Transactions on Automatic Control and Automatica. As a teaching assistant he has been involved in the Multivariable Control course and in the Automatic Control basic course. He is scheduled to hold his PhD defense on January 12, 2012.

Sörnmo, Olof

MSc in Engineering Physics, PhD student since May 2010. Olof's main research interests are within robotics and he is involved in both the EU/FP7-project COMET and the SSF/ProViking-project ProFlexA. His research focuses mainly on improving machining processes performed with industrial manipulators. Topics include adaptive force control, stiffness compensation, modeling and control of a high dynamic external compensation mechanism used in milling processes..

Ståhl, Fredrik

M.Sc.(2003), 50 % graduate student since 2008. Fredrik is involved in the DIAdvisor project, where his research has focused on modeling, identification and prediction of blood glucose dynamics.

Stemmann, Meike

MSc, graduate student since November 2009. Meike is involved in the DIAdvisor project within the European FP7-ICT program, which is aimed at developing a blood glucose prediction and treatment advisory system for diabetic patients. Within this project, she has worked on developing a control algorithm, that determines the doses of insulin injections and eventual additional carbohydrates for diabetic patients using multiple daily insulin injections. This control algorithm uses individualized patient models and determines the doses of insulin and carbohydrates through optimization.

Stolt, Andreas

MSc, graduate student since March 2010. He is working in the Rosetta project, which aims to develop technology for industrial robots that will not only appear more human-like, but also cooperate naturally with human workers. Andreas main focus has been force controlled compliant assembly. During the spring, he was a teaching assistant in the basic course and in the system identification course.

Theorin, Alfred

MSc in Engineering Physics. PhD student since January 2010. Alfred's main research interests involve control languages and industrial automation. During the year he has been working with development of the JGrafchart tool, primarily with creating a generic DPWS client implementation to support and evaluate service-oriented architecture for control applications. During the spring he was a teaching assistant in the International Project course. During the fall he was a teaching assistant in the Multivariable Control course.

Westin, Eva

PhD in French linguistics. Administrator at the department since 2008. She has the overall responsibility for the registration of students and PhD students as well as for their exam results. She updates parts of the department's web site. Eva is also working with administration of the LCCC Linnaeus project and visitors at the department. She organizes conferences and meetings. Together with Bo Bernhardsson she is responsible for the Activity Report 2011. Eva is the co-supervisor of two PhD theses in French linguistics at the Center of Languages and Literature at Lund University.

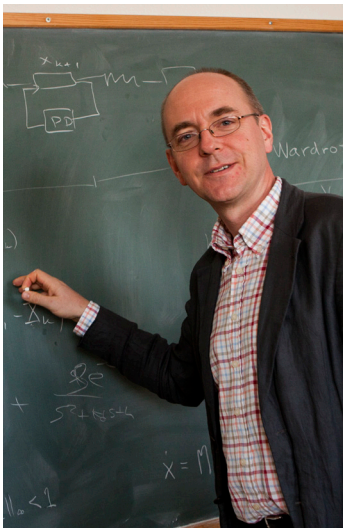
Widd, Anders

LicSc, graduate student since December 2006. He is working with Professor Rolf Johansson on the Project "KCFP, Closed-Loop Combustion Control", which is a cooperation with the Division of Combustion Engines. He has also participated in the project "Diesel-HCCI in a Multi-cylinder Engine". During the year, he has been a teaching assistant in the Automatic Control basic course, Systems Engineering, and Predictive Control.

Wittenmark, Björn

He joined the department in 1966 and took his PhD in 1973. He became full professor at the department 1989. His main research interests are adaptive control, sampled-data systems, and process control. He is currently working within projects in the area of process design and control and control of communication networks. He is now emeritus professor at the department. During July-December 2010 he was temporarily Head Librarian for Lund University Library.

Leaving the task as Head of Depatment



It is hard to believe that nine years have passed since I started as department head in 2003. On the other hand, a lot of things have happened since then. Recruitment of new staff has been the most essential and the most inspiring part of the job. In addition to a continuous growth in the number of PhD students and postdocs, we have hired five faculty members during the period, four administrators and two research engineers! It has been amazing to see how new and old members of the department have taken new roles in order to create a work environment for education and research at the highest international level.

Some research highlights from the period could be mentioned: The RobotLab has grown with strong support from European projects. Research on modelling and optimization, with the open source project JModelica.org, has expanded in synergy with the company Modelon. PiC-LU, a center for process industry research, has been established together with the department for chemical engineering. The excellence center eLLIIT devoted to information and communication technology has been created together with Linköping University. Last but not least, the new Linnaeus center LCCC, has become an international focal point for research on control of complex engineering systems.

Anders Rantzer

Giacomo Como, Assistant Professor

I joined the Automatic Control Department as an Assistant Professor (biträdande lektor) in August 2011. Previously, I had spent about three years at the Laboratory for Information and Decision Systems of MIT as a Postdoctoral Associate. Before that I had been a PhD student in Applied Mathematics at Politecnico di Torino (2005-2008), and a Visiting Assistant in Research at Yale University (2006-2007). While my scientific background is Information Theory and Coding Theory (these were the topics of my

PhD thesis), my interests have gradually broadened over the years and my current research is mainly focused on different aspects of dynamics over large-scale networks. These include, e.g., mathematical models of information propagation over social and economic networks (e.g., spread of rumors, opinion formation), the analysis of transportation networks with particular focus on their resilience (i.e., their ability to absorb shocks without loosing efficiency). I am also interested in problems at the boundary of Information Theory and Control. Moving to Lund has been a great opportunity for me, especially because of the terrific research environment in the Department. I don't have a classic background in Control, and this makes it even more of a privilege to be part of one of the world top places in the field. In my spare time here, I enjoy biking, especially when the wind doesn't blow too badly against me.

Tarek Abdelzaher, visiting Professor

Tarek Abdelzaher, Prof. in Computer Science, University of Illinois at Urbana Champaign, spent four months of his sabbatical in Lund working with Estimation and Control of Computing and Information Systems.
Modeling computation itself as a process being controlled is possible because performance of computing systems is a function of the status of data queues (such as server socket queues or TCP packet queues). The queues act as integrators of data flows, giving rise to differential equation models of software performance, amenable to control-theoretic analysis.
Traditionally, embedded software operated on a small and well-defined amount of data, such as feeds from a set of sensors. Performance metrics included throughput as well as latency and jitter in processing the data. More recently, new applications emerged that operate on much larger and less structured data sets, such as images and text fed by (generally unreliable) human observers or by sensors they operate Performance metrics include energy and quality of information derived from the noisy input data. These trends motivate two new types of optimization problems that constituted the bulk of Abdelzaher's research in Lund: (i) minimization of total energy expended on computation, and (ii) maximum likelihood estimation of quality of information.

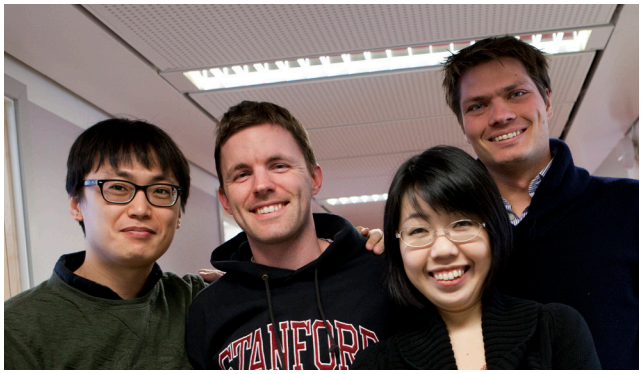
Energy optimization in cyber-physical systems
Extending prior work at UIUC, Abdelzaher developed optimization algorithms that manage trade-offs between energy, time, and performance in cyber-physical systems, and identified examples of interesting unexpected interactions between energy management components and performance in such systems.
In data centers, interactions were studied between energy management knobs in computing (cyber) and cooling (physical) subsystems. Further evidence was provided that

uncoordinated tuning of these knobs offers poor performance. Two optimization problems were addressed with collaborators at Lund. The first one optimizes latency subject to an energy constraint. The second optimizes energy, subject to a maximum latency constraint. Unexpected interactions were also studied between energy management knobs (DVFS) and the time-keeping functionality of low-end networked processors, whereby energy saving policies that use DVFS were shown to impair time synchronization, resulting in additional energy spent on re-synchronizing clocks. An optimization problem was solved to maximize energy savings taking into account the effect of DVFS on synchronization energy and synchronization error.

Estimation of quality of information
In this effort, novel performance objectives were considered motivated by the increasing importance of information processing systems in which a main output metric is quality of information. This work focused on estimating and maximizing quality of information in data processing systems (by filtering out poor inputs) in which vast amounts of data about a physical environment are supplied by humans. This scenario arises in applications that "crowd-source" observation tasks to individual human participants in order to estimate states of complex systems such as, for example, the real-time state of traffic congestion in a large city. A data distillation problem was defined where, given the vast amount of often inaccurate data (from human and sensor sources), the objective was to retain the "best" subset of the data to maximize application-specific information quality metrics. Two foundations were explored for such filtering. One focuses on maximum likelihood estimation of data accuracy. The other focuses on maximizing information by removing redundancy. Confidence bounds were computed for the results of maximum likelihood estimation of quality of information. These analytic results were developed into a working software service, called Apollo, which performs data distillation in social sensing applications.

"The Department of Automatic Control at Lund University was the ideal place to perform the above research." Abdelzaher said. "It is one of the strongest Automatic Control departments worldwide, has a unique strength in applying control techniques to computing and complex systems, has extensive ties with industry, and has made a tremendous impact over the years on both the state of the art and the state of practice. It is also a bit of a 'fairytale' place, where one can have coffee every day with such legendary faculty as Karl Johan Åström, who outside Lund one can probably only see from the distance of an audience bench as keynotes in crowed auditoria."

New post docs



Jang Ho Cho: I received mechanical engineering bachelor's and master degree in 2002, 2004 and completed PhD in 2010 at KAIST, South Korea. I joined Lund University as a post-doctoral researcher in the beginning of September 2011. My research interests include haptics and robotics and I have been involved surgical robotics which is one of seed research areas of LCCC. My life in Lund for past 9 months, it was extraordinary and more than I expected. Lund brought me many collaboration opportunities with other postdocs for both theoretical and practical problems. I am currently working on the improvement of haptic perception ability for robotic surgery and decentralized optimal controls of delayed teleoperation systems. For my second phase of Sweden, I am looking forward to getting fruitful results on my works and living with my family!

Laurent Lessard: I grew up in Toronto, Canada, and studied aerospace engineering at the University of Toronto. My search for warmer climates brought me to California, where I completed a PhD in aeronautics and astronautics at Stanford in 2011 under the supervision of Sanjay Lall. My specialization was in control theory with a focus on decentralized control. I was excited at the opportunity to join Lund as a postdoc: a large and renowned department of automatic control, a chance to explore Europe, and a return to my Canadian cold-weather roots! I have been in Lund since October 2011, and my research has primarily focused on finding analytical expressions for optimal control policies subject to decentralization constraints on the controllers. My other research interests include applications of novel control strategies to large or complex systems, and I have met with many of the other postdocs and phd students here regarding potential collaborations.

Yumiko Ishido: I completed Bachelor, Master, and PhD programs at Kyoto University, Kyoto, Japan. While visiting in the old capital of Japan many graceful temples, shrines, and gardens for a change of my mind, I worked on the study of decentralized control in the Bachelor program and control under communication constraints in the Master and PhD programs. Kyoto University gave me a lot of opportunities to visit foreign research organizations while I was a student of them, including MIT(USA), Johns Hopkins University (USA), University of Padova (Italy), INRIA (France) and Catholic University of Louvain (Belgium), which opened the door to study in Europe for me. I am now very excited at the opportunity to join Lund University as a postdoc where many excellent young and experienced researchers are actively working on various control topics. My current research interests includes nonlinear systems involving quantization,

non-uniform sampling, hysteresis, and so on. I am currently working on a project with Anton Cervin to build a new analysis and design framework for such nonlinear systems by extending some key results of my PhD work. I am also interested in possible collaborations with some new fields to me, such as biology, chemistry, and physics!

Pål Johan From: I grew up in Oslo, Norway, but studied control engineering in Trondheim at the Norwegian University of Science and Technology. I then went on to study robotics and worked a short period with ABB Robotics in Norway. During my PhD studies I worked on offshore robotics, which included robust modeling of robotic manipulators, robot kinematics and optimal trajectory planning. During my PhD studies I spent one year at the Hong Kong University of Science and Technology under the supervision of Prof. Zexiang Li and a year and a half at UC Berkeley with Profs. Shankar Sastry and Pieter Abbeel. In 2010 I completed my PhD studies and spent one year writing a book on robust robotic modeling of vehicle-manipulator system. In 2010 I started as an Associate Professor at the Norwegian University of Life Sciences where I teach control and perform research in robotics and control. Also in 2010, Prof Rolf Johansson, one of the opponents of my PhD defense, invited me join the control group in Lund. Here in Lund I work with surgical robotics with focus on haptic control. From the summer of 2011 onwards I will spend approximately 20% of my time at the department of automatic control in Lund.

Monika Rasmusson

I am a graduate from Lund University and have a degree in Business Administration.
I'm married to Håkan, the "entrepreneur", and mother of two children, Herman and Henrik. We live in Värpinge, in the western part of Lund, at a farm situated in the middle of a Golf Course, which is also our family business. Having had a long work experience at Gambro, a medical technology company in Lund, working with everything from finance to strategic purchasing, I decided to dedicate my time to the family business. Today, I am still engaged in the Golf Course business, mostly with finance and administration, as well as managing the shop/office at opening hours.
As from August 2011, I am also working part-time as an Economist/Administrator at the Department of Automatic Control. My work, as a part of a team, includes reimbursements, reporting EU projects such as MONROE, COMET and SME Robotics among other administrative tasks.
I play golf since many years and see golf more as a social event, even though I like to compete from time to time.

5.3 Awards

IFAC Control Engineering Textbook Prize

K. J. Åström and R. M. Murray Caltech, shared the IFAC Control Engineering Textbook Prize endowed in honour of Harald Chestnut First President of IFAC for their book Feedback Systems: An Introduction to Scientists and Engineers. Citation: This textbook presents an innovative and enticing approach to feedback control of dynamic systems, which is accessibel to students from diverse backgrounds. It does this by exploring a wide range of examples of dynamic systems and by drawing on conceptual methods and computer tools for analysis and design. The book is well supported by a website and by a forum for the sharing of instructional tools and experience.

SIMTech Fellow 2011

SIMTech Fellow 2011, Singapore Institute of Manufacturing Technology (SIMTech), Singapore. Rolf Johansson was awarded this during his visit in Singapore.

ETP Diploma

Charlotta Johnsson received the ETP diploma (Excellent Teaching Practitioner) in January 2011.

Readers Degree

Charlotta Johnsson received the Readers degree (Docent) in March 2011.

5.4 Assignments

Board Member

Karl-Erik Årzén: Member of the Board for the ELLIIT strategic research area project. Member of the Steering Committe for the International Conference on Cyber-Physical Systems (ICCPS). Member of the Strategic Management Board for the EU/IST FP7 IP ArtistDesign. Member of Research Board of Mathematics, Physics & Information and Communication Technology, Faculty of Engineering, Lund University

Anton Cervin: Board Member of SNART (the Swedish National Real-Time Association).

Tore Hägglund: Expert member in legal proceedings for patent at Svea Court of Appeal.

Rolf Johansson: Board Member of DIAdvisor Executive Board. Board Member of ROSETTA Project Management Board, 2009-2013. Board Member of ROSETTA Project Scientific Board, 2009-2013.

Charlotta Johnsson: Board member of WBF (the organisation for Production Technology). Charlotta serves as the Director of European Operations. Board member in Technology Management Center (TMC) at Lund University.

Anders Rantzer: Member of the Scientific Council for Natural and Engineering Sciences within the Swedish Research Council. Member of the steering committee for the International Symposium on Mathematical Theory of Networks and Systems. Member of the Advisory Board for Lecture Notes in Control and Information Sciences at Springer Verlag Heidelberg. Member of the IEEE Control System Society Technical Committee on Nonlinear Systems and Control Member of the IFAC Technical Committee on Nonlinear Systems.

Björn Wittenmark: Board member of EASE and PIC-LU. Board member Gyllenstiernska Krapperupsstiftelsen.

Member of International Program Committee (IPC)

Karl-Erik Årzén: Program Chair for the 23rd Euromicro Conference on Real-Time Systems (ECRTS 2011), Porto, Portugal July 6th - 8th, 2011. Chair for the Special Track on Cyber-Physical Systems of RTSS 2011, The 32nd IEEE Real-Time Systems Symposium. Member of the Program Committee for the Sixth International Workshop on Feedback. Control Implementation and Design in Computing Systems and Networks (FeBID 2011). Member of the Program Committe for the Second International Conference on Cyber-Physical Systems (ICCPS 2011).

Anton Cervin: Member of the Program Committee for the 23rd Euromicro Conference on Real-Time Systems (ECRTS'11).

Tore Hägglund: IFAC Conference on Advances in PID Control, Brescia, Italy, 2012 IFAC Symposium on Advances in Control Education - ACE 2012, Nizhny Novgorod, Russia. 10th Controlo Conference, Funchal, Madeira, 2012.

Rolf Johansson: Associate Editor at Large, 2011 IEEE International Conference on Robotics and Automation (ICRA 2011), May 9-13, 2011, Shanghai, China. Associate Editor, 2011 IEEE/RSJ International Conference on Intelligent RObots and Systems (IROS 2011), San Francisco, CA, September 25-30, 2011. IPC Member, 2011 IEEE International Conference on Intelligent Robotics, Automations and Applications (IRoA-11), Gwangju, Korea,

October 20-22, 2011. IPC Member, The 5th International Workshop on Innovation and Commercialization of Micro & Nanotechnology (ICMAN 2011), November 5-8, 2011 Shenzhen, China. IPC Member, IEEE International Conference on Robotics and Biomimetics (ROBIO 2011), Phuket Island, Thailand, December 7-11, 2011.

Anders Rantzer: Member of the IPC for 3rd IFAC Workshop on Distributed Estimation and Control in Networked Systems 2012. Member of the IPC for IFAC Conference on Nonlinear Model Predictive Control 2012.

Anders Robertsson: Member of the steering committe and the Program Committee of FeBID 2011. Member of the Program Committee ICAC 2011

Björn Wittenmark: Member of the Technical Committee for IFAC Adaptive Control and Learning

Opponent and Member of Examination Committee

Karl-Erik Årzén: Member of the PhD thesis committee for Soheil Samii, Sep 23, Department of Computer Science, Linköping University. Deputy member of the PhD thesis committee for Carl Christian Rolf, Oct 3, Department of Computer Science, Lund University

Bo Bernhardsson: Opponent for PhD thesis by Jeroen Hol, Automatic Control, Linköping University; Examiner of two licetiate theses by Jonas Callmer and Sina Parastegari, both at Automatic Control, Linköping University; Member of examination committee for three PhD theses at Lund University, Combustion engineering, Communication Theory and Circuit Design.

Per Hagander: Member of examination committee for Jonas Jögi, Lund University, PhD thesis "Tomographic ventilation-perfusion lung scintigraphy in cardiopulmonary disease"

Charlotta Johnsson: Examiner of licentiate thesis "Linaer Modeling and Prediction in Diabetes Physiology", Marzia Cescon, Department of Automatic Control, Lund, Sweden, June 15, 2011. Member of Examination Committee for "On Formal Specification and Verification of Function Block Applications in Industrial Control Logic Development", Oscar Ljungkrantz, Department of Signals and Systems, Chalmers University of Technology, Gothenburg, Sweden, November 2011.

Anders Rantzer: Member of PhD examination committee for Takashi Tanaka, University of Illinois at Urbana-Champaign, USA.

Anders Robertsson: Examiner of Licetiate thesis "Adaptive CPU Resource Management for Multicore Platforms" by Vanessa Romero Segovia, Sept 9, 2011. Deputy Member of the evaluation board for PhD thesis "Turbo Charged Low Temperature Combustion - Experiments, Modeling and Control" by Hans Aulin, April 20, 2011, Lund, Sweden. 16th February 2011, Final PhD Examination - Politecnico di Milano, Dipartimento di Elettronica e Informazione, Via Ponzio 34/5 Milan, Member of evaluation committee for 16th February 2011

CONIGLIO Stefano, ore. 9.00	(Advisor Prof. Amaldi)
DESIDERIO Delia, ore 9.50	(Advisor Prof. Lovera)
GALELLI Stefano, ore 10.40	(Advisor Prof. Soncini)
LACEVIC Bakir, ore 11.30	(Advisor Prof. Rocco)
ROMANI Carlo, ore 12.20	(Advisor Prof. Scattolini)
TAHIROVIC Adnan, ore 14.30	(Advisor Prof. Magnani)
ZAPPAVIGNA Annalisa, ore15.20	(Advisor Prof. Colaneri)

Lic opponent Patrik Axelsson, "On Sensor Fusion Applied to Industrial Manipulators".

Linköping University

Björn Wittenmark: External opponent of the PhD thesis "Computational Intelligence Methods for Dynamic Control of Mobile Robots" by Marvin K Bugeja at University of Malta, October 11, 2011

Advisory Committees and Working Groups

Karl-Erik Årzén: Member of the evaluation committee for promotions at Department of Engineering Cybernetics, Norwegian University of Science and Technology

Rolf Johansson: Member of IEEE EMBS Technical Committee (TC) for Biomedical Robotics. Member of Joint EMBS/RAS Advisory Committee on Biorobotics. Reviewer, Norway. Research Council, The National Financing Initiative for Research Infrastructure, FORINFRA, January 2011. Reviewer, Norway Research Council, Information and Communication Technology (ICT) Program, VERDIKT, September 2011.

Charlotta Johnsson: Voting member in the standardisation committee ISA95 and an information member in the standardization committees ISA88 and ISA99. Member in SIS and SEK and serves as the Swedish expert in the international IEC 62264 and ISO 22400 standards.

Anders Robertsson: Member of organizing committee for the LCCC Workshop on Workshop on Control of Computing Systems, Dec 5-7, 2011

Eva Westin: Member of national reference group for LADOK3, the next generation of student documentation systems for Swedish universities.

Book and Journal Editor

Karl-Erik Årzén: Guest Editor for Special Issue on Adaptive Embedded Systems of Real-Time Systems Journal

Tore Hägglund: Editor for Control Engineering Practice.

Rolf Johansson: Associate Editor, Int. J. Adaptive Control and Signal Processing. Associate Editor, Chinese Journal of Scientific Instrument, (China Instrument and Control Society). Associate Editor, Automatic Control of Physiological State and Function.

Björn Wittenmark: Member of Editorial Board: Journal of Forecasting

Other assignments

Charlotta Johnsson: Member in UN3 (utbildningsnämnd 3) at LTH. Serving as the IFAC Liaison with IEC 65A. Editor of ISO 22400 Part 1.

Rolf Johansson: Member of LU Rector delegation to Korea 2011-03-26--04-02.

Anders Robertsson: IEEE senior member August 2011. Vice chair in educational board (Utbildningsnämnd UN1), Collage of Engineering (LTH), Lund University. Member of evaluation board for excellent teaching practitioners (ETP), LTH, Lund University.

Longer Visits

Erik Johannesson: Zhejiang University, China, September, 2011.

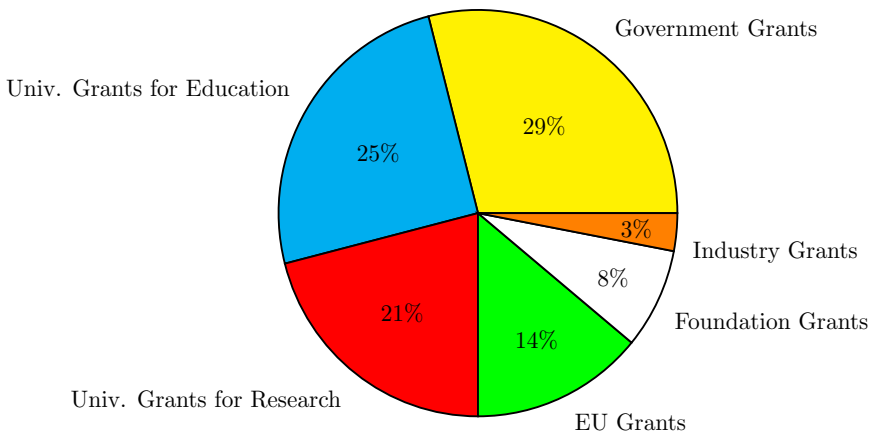
Anna Lindholm: Zhejiang University, China, September, 2011.

Kristian Soltesz: University of British Columbia (UBC), Vancouver, Canada, September-December 2011.

6. Economy and General Information

6.1 Economy and Funding

The turnover for 2011 was 46,8 MSEK. About half of the income comes from Lund University, and the rest from external grants. The distribution is shown below.



The activity and the number or employees have increased substantially in the last few years, mainly because of the Linnaeus grant "Lund Center for Control of Complex Engineering Systems", LCCC, funded by the Swedish Research Council. However, now the situation seems to have stabilized, the turnover is the same 2011 as 2010 and the same applies to the number of employees. The department participated in 11 projects funded by European Union, EU, during 2011. The Swedish Foundation for Strategic Research has also provided substantial support of the activities..

During 2011 we had the following contracts:
VR-Control with decentralized information
VR – Linnaeus grant Lund Center for Control of Complex Engineering Systems LCCC
VR - Active Control of Compressor Systems Based on New Methods of Nonlinear Dynamic Feedback Stabilization
VR – Suboptimal Methods for Event-based State Estimation and Control
VR – Remuneration for Ands Rantzers´ function as a Member of the Scientific Council for Natural and Engineering Sciences within the Swedish Research Council 2010-2012
VR – Resource Allocation and Control of Distributed Service Management Systems
VINNOVA-Saab – Adaptiv Control in Flying Vehicles
Energimyndigheten - Predictive Control and System Optimisation of Wheel Loaders

VINNOVA – Line Information System Architecture, LISA
SSF – Process Industrial Centre at Lund University, PICLU
SSF – Enabling GROwing Software Systems, ENGROSS
SSF – Productiv Flexibel Automation
SSF – ICT platform for lasting infrastructure, ICT-PSI
EU – ICT-216586 Adaptivity and Control o Resources in Embedded Systems, ACTORS
EU – ICT-216592 Personal Health Systems for Monitoring and Point-of-Care Diagnostics, DIAdvisor
EU – ICT-97518 ArtistDesign – Design for Embedded Systems, ARTIST-DESIGN
EU – ICT-224428 Control OF Heterogeneous Automaton Systems, CHAT
EU – ICT-224548 Distributed Control of Large-Scale Offshore Wind Farms, AEOLUS
EU – FP7 ICT-230902 RObot control for Skilled ExecuTion of Tasks in natural interaction with humans; based on Autonomy, cumulative knowledge and learning, ROSETTA
EU – FP7 258769 Plug-and-produce COmponents and METhods for adaptive control of industrial robots enabling cost effective, high precision manufacturing in factories of the future, COMET
EU – FP7 257462 Highly-complex and networked control systems, HYCON
EU – FP7 231143 Hyper-Modular Open Networked RObot systems with Excellent Performance, MONROE
EU – FP7 287787 The European Robotics Initiative for Strengthening the Competitiveness of SMEs in Manufacturing by integrating aspects of cognitive systems, SMErobotics
EU – FP7 285380 The Productive Robot Apprentice, PRACE
Excellence Center at Linköping - Lund on Information Technology, ELLIIT
Toyota Moter Corporation – Project on Nonlinear Model Reduction
SKB - Control of Stirwelding Process for Sealing
Vägverket –Estimation of Road Friction
Novozymes – Agreement on Co-financed PhD study
Emissions Control for Low Climate Impact, KCFP2
Energimyndigheten – Diesel Combustion with Low Environmental Impact
ACCM Mechatronics

The block grants from VR and some of the VINNOVA projects are long range. Several projects do, however, have a duration of only two years. To match these with the length of a PhD position, which is much longer, we have an internal research planning that is much more long range and we are careful to bid on projects that ft our long range research plan. This has proven an effcient way to match short-term funding to long term planning.

6.2 Internet Services

World Wide Web

Visit our homepage at this address: www.control.lth.se
Our website contains information about personnel, research, publications, seminars, education etc. It also contains fairly complete lecture notes for many courses, and in some cases software tools such as Matlab tool-boxes developed at the department. Our home-page frst appeared on the World Wide Web (WWW) in April 1994.

Electronic Mail

All personnel can be contacted by electronic mail. A personal email address consists of the full name and the department address in the following form:
firstname.lastname@control.lth.se
Double names are separated by underline, hyphens are treated as ordinary characters and accents are ignored. Examples:
anders.rantzer@control.lth.se
karl-erik.arzen@control.lth.se

APPENDIX

Publications 2011

You can find references to all the publications on www.control.lth.se/publications/ and almost all of them can be downloaded from this site. Only a limited number of copies of our reports are available for sale from the department. Any of the reports may, however, be borrowed through your library service or from the following libraries in Sweden:

- Linköpings Universitetsbibliotek, Svensktrycket, SE-581 83, Linköping
- Universitetsbiblioteket Lund, Svenska Tryckavdelningen, Box 1010, SE-221 03 Lund
- Stockholms Universitetsbibliotek, Svenska Tryckavdelningen, SE-106 91 Stockholm
- Kungliga Biblioteket, Box 5039, SE-102 41 Stockholm
- Umeå Universitetsbibliotek, Box 718, SE-901 10 Umeå
- Uppsala Universitetsbibliotek, Box 510, SE-751 20 Uppsala

	2007	2008	2009	2010	2011	Sum
Books	1	3	1	1	1	7
Book Contributions	2	4	3	4	1	14
Articles	19	21	16	13	10	79
Conference Contributions	32	33	41	50	67	223
PhD theses	5	3	2	0	2	12
Licentiate theses	0	2	3	1	4	10
Master's theses	24	24	16	45	33	142
Technical reports	5	3	2	2	3	15

Book

Åström, Karl Johan and Björn Wittenmark: Computer-Controlled Systems, Dover Publications, 2011

Book Chapter

Megretski, Alexander, Ulf T. Jönsson, Chung-Yao Kao and Anders Rantzer: *Integral Quadratic Constraints* in The Control Handbook, Second Edition, CRC Press (Taylor and Francis Group), ed. William Levine

Journal Articles

Bini, Enrico, Giorgio Buttazzo, Johan Eker, Stefan Schorr, Raphael Guerra, Gerhard Fohler, Karl-Erik Årzén, Vanessa Romero Segovia, Claudio Scordino: *Resource Management on Multicore Systems: The ACTORS Approach*, IEEE Micro, 31:3, pp. 72-81, May

2011. http://doi.ieeecomputersociety.org/10.1109/MM.2011.1.
Garrido, Juan, Francisco Vázquez, Fernando Morilla, Tore Hägglund: *Practical advantages of inverted decoupling*, Proceedings of the Institution of Mechanical Engineers, Part I: Journal of Systems and Control, 225:7, pp. 977–992, November 2011.
Guzmán, José Luis, Tore Hägglund: *Simple tuning rules for feedforward compensators*, Journal of Process Control, 21:1, pp. 92-102, January 2011.
Hägglund, Tore: *A shape-analysis approach for diagnosis of stiction in control valves*, Control Engineering Practice, 19:8, pp. 782–789, August 2011.
Hedin, Görel, Johan Åkesson, Torbjörn Ekman: *Extending Languages by Leveraging Compilers: from Modelica to Optimica*, IEEE Software, 28:3, pp. 68 - 74 , May 2011. Doi: http://doi.ieeecomputersociety.org/10.1109/MS.2010.62.
Herreros, Alberto, Enrique Baeyens Lázaro, Pedro Riverta, Rolf Johansson: *Performance improvement of a phase space detection algorithm for electrocardiogram wave morphology classification*, Journal of Electrocardiology, 44, February 2011.
Valera, Angel, F. Benimeli, Jose Solaz, H. de Rosario, Anders Robertsson, Klas Nilsson, R. Zotovic, M. Mellado: *A Car-Seat Example of Automated Anthropomorphic Testing of Fabrics Using Force-Controlled Robot Motions*, IEEE Transactions on Automation Science and Engineering, 8:2, pp. 280-291, April 2011. DOI 10.1109/TASE.2010.2079931.
Vasconcelos, J.F., Anders Rantzer, C. Silvestre, P. Oliveira: *Combination of Lyapunov and Density Functions for Stability of Rotational Motion*, IEEE Transactions on Automatic Control, 56:11, pp. 2599–2607, November 2011.
Widd, Anders, Kent Ekholm, Per Tunestål, Rolf Johansson: *Physics-Based Model Predictive Control of HCCI Combustion Phasing Using Fast Thermal Management and VVA*, IEEE Transactions on Control Systems Technology, PP:99, pp. 1-12, April 2011.
Vladimerou, Vladimeros, Pavithra Prabhakar, Mahesh Viswanathan, Geir Dullerud: *Specifications for decidable hybrid games*, Theoretical Computer Science, 412:48, pp. 6770–6785, November 2011.

Conference Contributions

Acemoglu, Daron, Giacomo Como, Fabio Fagnani, Asuman Ozdagla: *Opinion fluctuations and persistent disagreement in social networks* in 50th IEEE Conference on Decision and Control and European Control Conference, Orlando, Florida, USA, December 2011
Åkesson, Johan, R Faber, Carl Laird, Katrin Prölss, Hubertus Tummescheit, Stéphane Velut, Yu Zhu: *Models of a post-combustion absorption unit for simulation, optimization and non-linear model predictive control schemes* in 8th International Modelica Conference, March 2011
Amani, Payam, Maria Kihl, Anders Robertsson: *Multi-step ahead response time prediction for single server queuing systems* in Proceedings of FeBID'2011, Karlsruhe, Germany, In The 16th IEEE Symposium on Computers and Communications (ISCC), Kerkyra, Corfu, Greece, June 2011
Amani, Payam, Maria Kihl, Anders Robertsson: *NARX-based multi-step ahead response time prediction for database servers* in 1th International Conference on Intelligent Systems Design and Applications, Cordoba, Spain, November 2011
Andersson, Christian, Johan Åkesson, Claus Führer, Magnus Gäfvert: *Import and Export of Functional Mock-up Units in JModelica.org* in 8th International Modelica Conference,

March 2011

Andersson, Joel, Johan Åkesson, Francesco Casella, Moritz Diehl: *Integration of CasADi and JModelica.org* in 8th International Modelica Conference, March 2011

Andersson, Niklas, Per-Ola Larsson, Johan Åkesson, Staffan Haugwitz, Bernt Nilsson: *Calibration of a polyethylene plant for grade change optimisation* in 21st European Symposium on Computer Aided Process Engineering, Chalkidiki, Greece, June 2011

Årzén, Karl-Erik, Vanessa Romero Segovia, Mikael Kralmark, Stefan Schorr, Anand Meher, Gerhard Fohler: *ACTORS Adaptive Resource Management Demo* in Proc. 3rd Workshop on Adaptive and Reconfigurable Embedded Systems, Chicago, April 2011

Årzén, Karl-Erik, Vanessa Romero Segovia, Stefan Schorr, Gerhard Fohler: *Adaptive Resource Management Made Real* in Proc. 3rd Workshop on Adaptive and Reconfigurable Embedded Systems, Chicago, April 20

Åström, Karl Johan: *A Perspective on Modeling and Simulation of Complex Dynamical Systems* in Conference on Integrated Modeling of Complex Optomechanical Systems , Kiruna, Sweden, January 2011

Berntorp, Karl, Karl-Erik Årzén, Anders Robertsson: *Sensor Fusion for Motion Estimation of Mobile Robots with Compensation for Out-of-Sequence Measurements* in 2011 11th International Conference on Control, Automation and Systems, Gyeonggi-do, Korea, October 2011

Björkelund, Anders, Lisett Edström, Mathias Haage, Jacek Malec, Klas Nilsson, Pierre Nugues, Sven Gestegård Robertz, Denis Störkle, Anders Blomdell, Rolf Johansson, Magnus Linderoth, Anders Nilsson, Anders Robertsson, Andreas Stolt, Herman Bruyninckx: *On the Integration of Skilled Robot Motions for Productivity in Manufacturing* in Proc. IEEE/CIRP International Symposium on Assembly and Manufacturing (ISAM), Tampere, Finland, May 2011

Casella, Francesco, Filippo Donida, Johan Åkesson: *Object-Oriented Modeling and Optimal Control: A Case Study in Power Plant Start-Up* in 18th IFAC World Congress, Milano, Italy, August 2011

Cescon, Marzia and Rolf Johansson: *On Data-driven Multistep Subspace-based Linear Predictors* in 18th IFAC World Congress, August 2011

Cescon, Marzia and Eric Renard: *Adaptive Subspace-based prediction of T1DM glycemia* in 50th IEEE Conference on Decision and Control and European Control Conference, Orlando, Florida, USA, December 2011

Chasparis, Georgios and Jeff S. Shamma: *Information Flow and Active Social Influence in Social Networks* in Interdisciplinary Workshop on Information and Decision in Social Networks 2011, Boston, Mass., May 2011

Chasparis, Georgios, Jeff S. Shamma, Anders Rantzer: *Perturbed Learning Automata in Potential Games* in Proc. 50th IEEE Conference on Decision and Control, Orlando, FL, December 2011

Como, Giacomo, Ketan Savla, Daron Acemoglu, Munther A. Dahleh, Emilio Frazzoli: *On distributed robust routing for transportation networks under local information constraints* in 50th IEEE Conference on Decision and Control and European Control Conference, Orlando, Florida, USA, December 2011

Ghazaei, Mahdi, Henrik Jörntell, Rolf Johansson: *ORF-MOSAIC for Adaptive Control of a Biomimetic Arm* in IEEE International Conference on Robotics and Biomimetics, Phuket Island, Thailand, November 2011

Giselsson, Pontus: *Model Predictive Control in a Pendulum System* in Proceedings of the 31:th IASTED conference on Modelling, Identification and Control, Innsbruck, Austria,

February 2011
Guzmán, José Luis, Tore Hägglund, Karl Johan Åström, Sebastián Dormido, Manuel Berenguel, Yves Piguet: *Feedforward Control Concepts through Interactive Tools* in 18th IFAC World Congress, Milano, Italy, August 2011
Henningsson, Toivo: *Sporadic Event-Based Control using Path Constraints and Moments* in 50th IEEE Conference on Decision and Control and European Control Conference, Orlando, Florida, USA, December 2011
Herreros, A., E. Baeyens, P. Riverta, Rolf Johansson: *Performance Improvement of a Phase Space Detection Algorithm for Electrocardiogram Wave Morphology Classification* in Journal of Electrocardiology, Vol. 44, No. 2, March-April 2011
Johannesson, Erik: *Signal Estimation over Channels with SNR Constraints and Feedback* in 18th IFAC World Congress, Milano, Italy, August 2011
Johannesson, Erik, Anders Rantzer, Bo Bernhardsson: *A Framework for Linear Control over Channels with Signal-to-Noise Ratio Constraints* in 9th IEEE International Conference on Control & Automation, Santiago, Chile, December 2011
Johannesson, Erik, Anders Rantzer, Bo Bernhardsson: *Optimal Linear Control for Channels with Signal-to-Noise Ratio Constraints* in 2011 American Control Conference, San Francisco, California, USA, June 2011
Johansson, Rolf: *Multi-Step-Ahead Multivariate Predictors and Multi-Predictive Control* in 2011 IEEE Africon Conference, Livingstone, Zambia, September 2011
Johnsson, Ola, Jonas Andeersson, Charlotta Johnsson: *Probing control in B. licheniformis fermentations* in Proc. 18th World Congress of the International Federation of Automatic Control (IFAC), Milano, Italy, August 2011
Jonsson, Marie, Andreas Stolt, Anders Robertsson, Tom Murray, Klas Nilsson: *Force Controlled Assembly of a Compliant Rib* in SAE2011 Aerotech Congress & Exibition, Toulouse, France, October 2011
Kihl, Maria, Gustav Cedersjö, Anders Robertsson, Bertil Aspernäs: *Performance measurements and modeling of database servers* in Proceedings of FeBID'2011, Karlsruhe, Germany, June 2011
Kirchsteiger, Harald, Stephan Pölzer, Rolf Johansson, Eric Renard, Luigi del Re: *Direct Continuous Time System Identification of MISO Transfer Function Models applied to Type 1 Diabetes* in 50th IEEE Conference on Decision and Control and European Control Conference, Orlando, Florida, USA, December 2011
Kristalny, Maxim and Daria Madjidian: *Decentralized Feedforward Control of Wind Farms: Prospects and Open Problems* in 50th IEEE Conference on Decision and Control and European Control Conference, Orlando, Florida, USA, December 2011
Laird, Carl, Angelica Wong, Johan Åkesson: *Parallel Solution of Large-Scale Dynamic Optimization Problems* in 21st European Symposium on Computer-Aided Process Engineering, May 2011
Larsson, Per-Ola, Johan Åkesson, Niklas Andersson: *Economic Cost Function Design and Grade Change Optimization for a Gas Phase Polyethylene Reactor* in 50th IEEE Conference on Decision and Control and European Control Conference, Orlando, Florida, USA, December 2011
Larsson, Per-Ola, Johan Åkesson, Staffan Haugwitz, Niklas Andersson: *Modeling and Optimization of Grade Changes for Multistage Polyethylene Reactors* in 18th IFAC World Congress, Milano, Italy, August 2011
Larsson, Per-Ola and Tore Hägglund: *Control Signal Constraints and Filter Order Selection for PI and PID Controllers* in 2011 American Control Conference, San Francisco, Califor-

nia, USA, June 2011
Lavaei, Javad, Anders Rantzer, Steven Low: *Power flow optimization using positive quadratic programming* in 18th IFAC World Congress, Milano, Italy, August 2011
Linderoth, Magnus, Kristian Soltesz, Anders Robertsson, Rolf Johansson: *Initialization of the Kalman Filter without Assumptions on the Initial State* in Proc. IEEE International Conference on Robotics and Automation (ICRA), Shanghai, P.R. China, May 2011
Lindholm, Anna: *A method for improving plant availability with respect to utilities using buffer tanks* in 31st IASTED International Conference on Modelling, Identification, and Control, Innsbruck, Austria, February 2011
Lindholm, Anna, Hampus Carlsson, Charlotta Johnsson: *A General Method for Handling Disturbances on Utilities in the Process Industry* in Proc. of the 18th World Congress of IFAC, Milano, Italy, August 2011
Lindholm, Anna, Hampus Carlsson, Charlotta Johnsson: *Estimation of Revenue Loss due to Disturbances on Utilities in the Process Industry* in 22nd Annual Conference of the Production and Operations Management Society , Reno, Nevada, U.S.A., April 2011
Lindholm, Anna, Anders Widd, Aivar Sootla, Anna-Lena Sahlberg: *Utvärdering av förståelse på skriftlig tentamen* in 3:e Utvecklingskonferensen för Sveriges ingenjörsutbildningar, Linköping, November 2011
Madjidian, Daria, Karl Mårtensson, Anders Rantzer: *A Distributed Power Coordination Scheme for Fatigue Load Reduction in Wind Farms* in 2011 American Control Conference, San Francisco, California, USA, June 2011
Madjidian, Daria and Anders Rantzer: *A Stationary Turbine Interaction Model for Control of Wind Farms* in Proc. of the 18th IFAC World Congress, Milano, Italy, August 2011
Mårtensson, Karl and Anders Rantzer: *A Scalable Modularized Synthesis Method for Distributed Kalman Filters* in Proc. 18th IFAC World Congress, Milano, Italy, August 2011
Mårtensson, Karl and Vladimeros Vladimerou: *Distributed resource management using iterative gradient update synthesis* in 2011 American Control Conference, San Francisco, California, USA, June 2011
Nilsson, Anders and Görel Hedin: *Metacompiling OWL Ontologies* in SLE'11: 4th International Conference on Software Language Engineering, Braga, Portugal, July 201
Olofsson, Björn, Henrik Nilsson, Anders Robertsson, Johan Åkesson: *Optimal Tracking and Identification of Paths for Industrial Robots* in Proc. 18th World Congress of the International Federation of Automatic Control (IFAC), Milano, Italy, August 2011
Olofsson, Björn, Olof Sörnmo, Ulrich Schneider, Anders Robertsson, Arnold Puzik, Rolf Johansson: *Modeling and Control of a Piezo-Actuated High-Dynamic Compensation Mechanism for Industrial Robots* in Proc. of IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS'2011), San Francisco, CA, USA, September 2011
Rantzer, Anders: *Distributed Control of Positive Systems* in 50th IEEE Conference on Decision and Control and European Control Conference, Orlando, Florida, USA, December 2011
Romero Segovia, Vanessa, Mikael Kralmark, Mikael Lindberg, Karl-Erik Årzén: *Processor Thermal Control Using Adaptive Bandwidth Resource Management* in Proceedings of IFAC World Congress, Milan, Italy, September 2011
Samii, Soheil, Petru Eles, Zebo Peng, Anton Cervin: *Design Optimization and Synthesis of FlexRay Parameters for Embedded Control Applications* in Proc. International Symposium on Electronic Design, Test and Applications (DELTA), Queenstown, New Zealand,

January 2011
Sen, Nevroz, Giacomo Como, Serdar Yuksel, Fady Alajaji: *On the capacity of memoryless finite-state multiple access channels with asymmetric noisy state information at the encoders* in 49th Allerton Conference on Communication, Control, and Computing, Monticello, IL, September 2011
Soltesz, Kristian and Tore Hägglund: *Extending the Relay Feedback Experiment* in 18th IFAC World Congress, Milano, Italy, August 2011
Soltesz, Kristian, Jin-Oh Hahn, Guy A. Dumont, J. Mark Ansermino: *Individualized PID Control of Depth of Anesthesia Based on Patient Model Identification During the Induction Phase of Anesthesia* in 50th IEEE Conference on Decision and Control and European Control Conference, Orlando, Florida, USA, December 2011
Soltesz, Kristian, Charlotta Johnsson, Tore Hägglund: *Teaching Control Principles to Industry Practitioners* in SEFI Annual Conference 2011, Lisbon, Portugal, September 2011
Sootla, Aivar: *Nu-gap Model Reduction in the Frequency Domain* in 2011 American Control Conference, San Francisco, California, USA, June 2011
Sootla, Aivar and Anders Rantzer: *Model Reduction of Spatially Distributed Systems Using Coprime Factors and Semidefinite Programming* in Preprints of the 18th IFAC World Congress, August 2011
Ståhl, Fredrik, R. Johansson and E. Renard: *Can Blood Glucose Drops During Exercise be Predicted From Heart Rate Data?* in Diabetes Technology Meeting 2011, San Francisco, October 2011.
Stolt, Andreas, Magnus Linderoth, Anders Robertsson, Rolf Johansson: *Force Controlled Assembly of Emergency Stop Button* in Proc. IEEE International Conference on Robotics and Automation (ICRA), Shanghai, P.R. China, May 2011
Stolt, Andreas, Magnus Linderoth, Anders Robertsson, Marie Jonsson, Tom Murray: *Force Controlled Assembly of Flexible Aircraft Structure* in Proc. IEEE International Conference on Robotics and Automation (ICRA), Shanghai, P.R. China, May 2011
Taha, Walid, T. Larsson, Karl-Erik Årzén: *Dependable Automotive Systems based on Model Certified Components* in 2011 Automotive CPS Workshop, June 20
Wallén, Johanna, Isolde Dressler, Anders Robertsson, Mikael Norrlöf, Svante Gunnarsson: *Observer-Based ILC Applied to the Gantry-Tau Parallel Kinematic Robot* in Proc. 18th IFAC World Congress, Milano, Italy, August 2011
Widd, Anders, Patrick Borgqvist, Per Tunestål, Rolf Johansson, Bengt Johansson: *Investigating Mode Switch from SI to HCCI using Early Intake Valve Closing and Negative Valve Overlap* in 2011 JSAE/SAE International Powertrains, Fuel & Lubricants, Kyoto, Japan, August 2011
Widd, Adners, K. Ekholm, P. Tunestål, R. Johansson: *Physics-Based Model Predictive Control of HCCI Combustion Phasing Using Fast Thermal Management and VVA* in IEEE Transactions on Control Systems Technology, April 2011
Widd, Anders, Hsien-Hsin Liao, J. Christian Gerdes, Per Tunestål, Rolf Johansson: *Control of Exhaust Recompression HCCI using Hybrid Model Predictive Control* in 2011 American Control Conference, San Francisco, California, USA, June 2011
Ylikiiskilä, Johan, Johan Åkesson, Claus Führer: *Improving Newton's method for Initialization of Modelica models* in 8th International Modelica Conference, March 2011
Zanchettin, Andrea M., Paolo Rocco, Anders Robertsson, Rolf Johansson: *Exploiting Task Redundancy in Industrial Manipulators during Drilling Operations* in Proc. IEEE International Conference on Robotics and Automation (ICRA), Shanghai, P.R. China,

May 2011

PhD Theses

Johannesson, Erik: Control and Communication with Signal-to-Noise Ratio Constraints; PhD Thesis ISRN LUTFD2/TFRT--1087--SE, Department of Automatic Control, Lund University, Sweden, October 2011.

Larsson, Per-Ola: Optimization of Low-Level Controllers and High-Level Polymer Grade Changes: PhD Thesis ISRN LUTFD2/TFRT--1088--SE, Department of Automatic Control, Lund University, Sweden, November 2011.

Licentiate Theses

Cescon, Marzia: Linear Modeling and Prediction in Diabetes Physiology; Licentiate Thesis 3250, Department of Automatic Control, Lund University, Sweden, June 2011.

Linderoth, Magnus: Robotic Work-Space Sensing and Control; Licentiate Thesis ISRN LUTFD2/TFRT--3251--SE, Department of Automatic Control, Lund University, Sweden, June 2011.

Lindholm, Anna: Utility Disturbance Management in the Process Industry; Licentiate Thesis ISRN LUTFD2/TFRT--3253--SE, Department of Automatic Control, Lund University, Sweden, October 2011.

Romero Segovia, Vanessa: Adaptive CPU Resource Management for Multicore Platforms; Licentiate Thesis ISRN LUTFD2/TFRT--3252--SE, Department of Automatic Control, Lund University, Sweden, September 2011.

Master's Theses

(The Master's Theses completed within the Technology Management Program, marked TM, are published on the TM homepage: www.tmonline.se)

Abdul Hamid, Mohamed: Lean Production - Identification of essential KPIs in a medical production process and design of a visual interface; Master's Thesis ISRN LUTFD2/TFRT--5874--SE, Department of Automatic Control, Lund University, Sweden, January 2011

Adlouni, Mohammed: Modeling of soot emission for heavy-duty diesel engines in transient operation; Master's Thesis ISRN LUTFD2/TFRT--5870--SE, Department of Automatic Control, Lund University, Sweden, January 2011

Berggren, David: Deriving and implementing a model of the fifth generation Haldex AWD actuator; Master's Thesis ISRN LUTFD2/TFRT--5871--SE, Department of Automatic Control, Lund University, Sweden, January 2011

Berggren, Lisa: Control Process for secondary packaging – A quality verification of corrugated cardboard for distribution of liquid food in developing countries; TM

Biegel, Benjamin: Distributed Control of Wind Farm; Master's Thesis ISRN LUTFD2/TFRT--5883--SE, Department of Automatic Control, Lund University, Sweden, June 2011

Björkegren, Erik and Jonathan Göransson: Key issues for companies entering the Chinese WEEE recycling industry; TM

Busl, Matthias: Design of an Energy-Efficient Climate Control Algorithm for Electric Cars; Master's Thesis ISRN LUTFD2/TFRT--5882--SE, Department of Automatic Control, Lund University, Sweden, June 2011

Engfors, Måns: Commercial mobile platforms in an industrial environment; Master's Thesis

ISRN LUTFD2/TFRT--5881--SE, Department of Automatic Control, Lund University, Sweden, May 2011
Ekman, Josef: Individiual Innovation Incentives; TM
Fagerberg, Pehr and Tobias Nordlund: En Processmodell för strategisk upphandling av FM-tjänsten Posthantering - Fallet AB Volvo; TM
Finocchi, Iacopo: Haptic Interface for a Contact Force Controlled Gantry-Tau robot; Master's Thesis ISRN LUTFD2/TFRT--5885--SE, Department of Automatic Control, Lund University, Sweden, July 2011
Olsson, Joakim and Magnus Flodberg: Customer Value Driven Continuous Improvements in Sales and Services - The case of Scania Retail System; TM
Ghazaei A., M. Mahdi: Adaptive Control of Arm Movement based on Cerebellar Model; Master's Thesis ISRN LUTFD2/TFRT--5886--SE, Department of Automatic Control, Lund University, Sweden, June 2011
Gustafsson, Emelie and Josefin Ejlertsson Torstensson: The PGS-framework - A study of Alfdex's environmental strategy; TM
Hagman, Henrik and Johan Persson: Improved Business Intelligence that Better Supports Purchasing Decisions - A case study of the carbon steel category at IKEA Trading in China; TM
Hansson, Anton and Linus Tufvesson: Using Sensor Equipped Smartphones to Localize WiFi Access Points; Master's Thesis ISRN LUTFD2/TFRT--5880--SE, Department of Automatic Control, Lund University, Sweden, September 2011
Hansson, Erik and Martin Sträng: Design and evaluation of a distributed control architecture over switched Ethernet in active filters; Master's Thesis ISRN LUTFD2/TFRT--5878--SE, Department of Automatic Control, Lund University, Sweden, March 2011
Hellgren, Magnus and Rikard Jacobsson: Successful Competition on Emerging Mid-Markets in China -Quality as a competitive disadvantage; TM
Hydén, Hans and Per Wilhelmsson: Automatic exposure control in network video cameras; Master's Thesis ISRN LUTFD2/TFRT--5879--SE, Department of Automatic Control, Lund University, Sweden, May 2011
Larsson, Peter: Prevention of Servo-Induced Vibrations in Robotics; Master's Thesis ISRN LUTFD2/TFRT--5889--SE, Department of Automatic Control, Lund University, Sweden, January 2011
Lilja, Gustaf and Malin Karlsson: Can Scania be stronger than steel? A study of control and delegation of purchasing in a three tier supply chain.; TM
Lindberg, Emma and Julia Hermansson: Organizing for user involvement and open innovation in fuzzy front end; TM
Muric, Kenan: Modeling of NOx formation in heavy duty engines; Master's Thesis ISRN LUTFD2/TFRT--5887--SE, Department of Automatic Control, Lund University, Sweden, September 2011
Nyquist, Caroline and Malin Eklund: A sourcing evaluation model for transportation and installation services of wind turbines - The case of E.ON Vind Sverige AB; TM
Olsson, Helen and Samuel Sjödin: INS-Modellen: En modell för kunskapshöjande konsulters arbete med försäljning; TM
Olsson, Martin and Samuel Skånberg: Resource reservation and power management in Android; Master's Thesis ISRN LUTFD2/TFRT--5875--SE, Department of Automatic Control, Lund University, Sweden, March 2011
Pedreira Carabel, Carlos Javier and Andrés Alejandro Zambrano García: Modeling, Control

and Automatic Code Generation for a Two-Wheeled Self-Balancing Vehicle Using Modelica; Master's Thesis ISRN LUTFD2/TFRT--5884--SE, Department of Automatic Control, Lund University, Sweden, June 2011

Runéus, Fredrik and Maria Björkander: Assessing the marginal value of subsidiary ownership - A case study of Alfa Laval India Ltd; TM

Sterner, Anne and Ellen Johansson: Chain of Custody on Timber Products in the Construction Industry - A case study at Skanska Sweden; TM

Stridsberg, Karin and Louise Dahlberg: Understanding customer values and service needs within the truck industry; TM

Spanne, Anton: Function of Cerebellar Microcircuitry within a Closed-loop System during Control and Adaptation; Master's Thesis ISRN LUTFD2/TFRT--5877--SE, Department of Automatic Control, Lund University, Sweden, April 2011

Ullman, Hannes and Stina Sandberg: Choosing the right projects - A Lean-inspired process for IT project portfolio selection; TM

Werber, Klaudius: Intuitive Human Robot Interaction and Workspace Surveillance by means of the Kinect Sensor; Master's Thesis ISRN LUTFD2/TFRT--5888--SE, Department of Automatic Control, Lund University, Sweden, August 2011

Technical Report

Blomé, Mikael, Daniel Hellström, Gyöngyi Kovács, Johan Zetterberg, Johan Åkesson: The Role of Courses in PhD Education at the Faculty of Engineering, Lund University; Technical Report Faculty of Engineering, LTH at Lund University, January 2011.

Broman, David, Peter Fritzson, Görel Hedin, Johan Åkesson: A comparison of metacompilation approaches to implementing Modelica; Technical Report ISSN 1404-1200 nr. 97, Computer Science, Faculty of Engineering, January 2011.

Westin, Eva, Charlotta Johnsson (Eds.): Automatic Control 2010. Activity Report; Technical Report ISRN LUTFD2/TFRT--4038--SE, Department of Automatic Control, Lund University, Sweden, October 2011.

Seminars at the department

Jan 10 Chordal sparsity in convex optimization
Martin S. Andersen UCLA

Jan 26 Master's Thesis Presentation
Modeling of soot emission for heavy duty diesel engines in transient operation
Mohammed Adlouni

Jan 27 Master's Thesis Presentation
Modellering av de drivande delarna i Haldex gen. V koppling
David Berggren
Jonas Berge

Feb 18 Master's Thesis Presentation
Resource reservation and power management in Android
Martin Olsson
Samuel Skånberg

Feb 24 Inertial Navigation
Karl Johan Åström

Feb 28 Research on Multi-Fingered Haptic Interface
Haruhisa Kawasaki, Gifu University, Japan

Mar 4 Master's Thesis Presentation
Design and evaluation of a distributed control architecture over switched Ethernet in active filters
Martin Sträng
Erik Hansson

Apr 19 Master's Thesis Presentation
Function of Cerebellar Microcircuitry within a Closed-loop System during Control and Adaptation
Anton Spanne

Apr 20 LTH, Ecofin, IMF, NASDAQ OMX och andra förkortningar
Jens Henriksson, VD Stockholmsbörsen Nasdaq OMX

Apr 21 Dual decomposition-based distributed model predictive control methods for dynamically coupled systems
Dang Doan, TU Delft

Apr 26 The ESS proton accelerator - an overview of function and design
Anders J Johansson, Dept. of Electrical and Information Tech., Lund University

Apr 29 How mathematical modeling can help us understand why we get effects when there is no drug? A case story.
Anders Källén, Automatic Control, LTH, Lund

Apr 29 Exploiting information to improve control of large-scale manufacturing systems
Dawn Tilbury University of Michigan, LCCC visiting professor at Lund University

May 3 Control Challenges in Powertrain, Combustion and Drilling Control
Keith Glover, Cambridge University

May 4 Level-triggered sampling on a finite horizon: Hard and soft limits on the number os samples
Maben Rabi, Chalmers

May 4 PD-Smart: Predictive Defense Model for the Smart Grid
Ning Lu, Pacific Northwest National Laboratory

May 6 Explaining economic inequality
Per Molander, Director General, Swedish Social Insurance Inspectorate

May 9 Cascade Mitigation in Energy Hub Networks
Mads Rønne Almassalkhi, University of Michigan

May 9 Cyber Security Analysis of Electric Power Systems: Deception Attacks on the State Estimator
André Teixeira, KTH, Stockholm

May 10 Semantic networks for improved model based estimation
Dhananjay Anand, University of Michigan

May 10 Structured Model Order Reduction
Christopher Sturk, KTH, Stockholm

May 13 Demand Response and Energy Efficiency in Smart Grids
Tariq Samad, Honeywell Automation and Control Solutions

May 13 Tracking of animal movement: studies of aerodynamics, navigation and migration
Susanne Åkesson, Anders Hedenström, Johan Bäckman, Migration Ecology Group, Lund University

May 17 Developing Experimental Research Platforms and PMU Data Applications for

Wide Area Systems
Luigi Vanfretti, KTH Stockholm

May 20 Robotic Force Control for Industrial Applications
Lim Chee Wang, Singapore Institute of Manufacturing Technology (SIMTech), Singapore

May 23 Generation adequacy risk assessment with high renewables penetrations: risk models, statistical estimation and meteorological insights
Chris Dent, Durham University

May 23 Impact of Bad Data and Cyber Data Attack on Electricity Market Operations
Le Xie, Texas A&M University

May 24 A Partial Order Approach to Decentralized Control
Parikshit Shah, MIT

May 24 Effects of Buffers on Stability of Internet Congestion Controllers
Somayeh Sojoudi, Caltech

May 27 Improved vertex control for time- varying linear discrete-time systems with state and control constraints
Per-Olof Gutman, Technion, Israel

May 27 Master's Thesis Presentation
Control of a Quadrotor
Niklas Hansson
Mikael Rudnert

May 27 Master's Thesis Presentation
Haptic Interface for a Contact Force Controlled Gantry-Tau Robot
Iacopo Finocchi

Jun 1 Master's Thesis Presentation
Modeling, Control, and Automatic Code Generation for a Two-Wheeled Self-Balancing Vehicle using Modelica
Carlos Javier Pedreira Carabel
Andres Alejandro Zambrano Garcia

Jun 7 Pedestrian Detection with Auto Brake in the new Volvo S60 - and beyond
Andreas Eidehall, Volvo

Jun 13 Integration of multiple controllers with applications to blood glucose management
Dawn Tilbury, University of Michigan, LCCC visiting professor at Lund University

Jun 15 Licentiate Seminar
Linear Modeling and Prediction in Diabetes Physiology
Marzia Cescon, Automatic Control, Lund University

Jun 16 Master's Thesis Presentation
Design of an automatic control algorithm for energy-efficient climatisation of electric cars
Matthias Busl

Jun 16 Consistency of Subspace Methods for Signals with Almost-Periodic Componenets
Giorgio Picci, Università degli studi di Padova, Department of Information Engineering

Jun 16 High-speed vision-based computed torque control of parallel kinematic manipulators, Nicolas Andreff, Université de Franche-Comté, Dpt Automatique et Systèmes Micro-Mécatroniques

Jun 17 Licentiate Seminar

Robotic Work-Space Sensing and Control
Magnus Linderoth, Automatic Control, Lund University

Jun 17 Master's Thesis Presentation
Distributed Control of Wind Farm
Benjamin Biegel

Jun 27 Micro-system and Control Technology
Zhou Zhaoying Tsinghua University, Beijing

Jun 30 Master's Thesis Presentation
Adaptive Control of Arm Movement based on Cerebellar Model
Mahdi Ghazaei

Aug 11 Using the kinect sensor for intuitive human-robot interaction, programming and robot workspace surveillance
Klaudius Werber Erasmus student Kaiserslautern / Lund University

Aug 18 Master's Thesis Presentation
Prevention of servo induced vibrations in robotics
Peter Larsson

Sep 5 Master's Thesis Presentation
Modeling of NOx formation in heavy duty engines
Kenan Muric

Sep 9 Licentiate Seminar
Adaptive CPU Resource Management for Multicore Platforms
Vanessa Romero Segovia, Automatic Control, Lund University

Sep 9 Robust stability analysis of linear time-varying feedback systems
Sei Zhen Khong, Department of Electrical and Electronic Engineering, University of Melbourne

Sep 19 Large-Scale MIMO Systems
Erik G. Larsson, Linköping University

Oct 6 New Convex Parametrizations for the Design of Sparsity Constrained Controllers
Nuno Martins, University of Maryland

Oct 7 Defence Of Doctoral Dissertation
Control and Communication with Signal-to-Noise Ratio Constraints
Erik Johannesson Automatic Control, Lund University

Oct 10 Randomness and Coherence in Large Networks: dimension-dependent and multi-scale effects of feedback
Bassam Bamieh, Dept. of Mechanical Engineering, University of California, Santa Barbara

Oct 14 Master's Thesis Presentation
Human-robot interaction: Synchronization between high-level robot programming and external sensor feedback
Eduardo Luis Otero Abad, Universitat Politècnica de València, Spain

Oct 20 Generalized Predictive Control - An Event-Based Approach
Andrzej Pawlowski, University of Almería, Spain

Oct 21 The Two-Player Problem
Laurent Lessard, LCCC postdoc at Automatic Control, Lund University

Oct 28 Licentiate Seminar
Utility Disturbance Management in the Process Industry

Anna Lindholm, Automatic Control, Lund University

Oct 28 Research and Development activities at ABB Corporate Research, Switzerland
Alexander Horch, ABB, Switzerland

Nov 11 Defence Of Doctoral Dissertation
Optimization of Low-Level Controllers and High-Level Polymer Grade Changes
Per-Ola Larsson, Automatic Control, Lund University

Dec 12 Master's Thesis Presentation
Free Valve Control in a Six Cylinder Heavy-Duty Diesel Engine
Niklas Everitt

Dec 15 Master's Thesis Presentation
Modellering av anläggningsövergripande störningars påverkan på produktionen i processindustrin
Jonas Hertz

Dec 20 Master's Thesis Presentation
A Graphical User Interface for Polyethylene Production Grade Changes
Max Stenmark

Lectures by the Staff Outside the Department

Karl-Erik Årzén: "Adaptive Resource Management Made Real", 3rd Workshop on Adaptive and Reconfigurable Embedded Systems (APRES 2011), April 11th, 2011 Chicago, USA
"Cyber-Physical Systems - Challenges and Lessons to Learn", CPSWEEK Workshop on Architectures for Cyber-Physical Systems, Chicago, April 11, 2011
"Control for Embedded Systems" - ARTIST Summer School in China 2011, Chinese Academy of Science, Beijing, 11-12th August, 2011
Karl Johan Åström: April 6 Event Based Control. Department of Computer Science, University of California Berkeley.
April 6 The Future of Control. University of California Berkeley
August 15 Kiruna Modeling and Simulation of Complex Systems. Invited plenary lecture SPIE Conference on Integrated Modeling of Complex Optomechanical Systems, Kiruna.
Sept 1, Preparing Tomorrow's Scientists and Engineers for the Challenges of the 21st Century. Panel on Education. The 18th World Congress of IFAC, Milan.
Sept 21 The Future of Control. Invited plenary lecture. General Electric Controls Symposium, GE Global Research, Niskayuna, NY.
Nov 22 A Perspective on Modeling and Simulation of Complex Dynamical Systems. Invited Keynote Lecture, Institute of Automation, Chinese Academy of Sciences, Beijing
Nov 23 Control of Micro Systems. Department of Precision Instruments, Tsinghua University, Beijing.
Nov 24 The Future of Control. Invited plenary lecture, Taiyuan University, Taiyuan, Shanxi.
Nov 25 Event Based Control, Key Laboratory of Systems and Control Chinese Academy of Sciences, Beijing.
Nov 27 The Future of Control. Invited plenary lecture. Chinese Automation Congress, Beijing
Anton Cervin: Stability of Sampled-Data Control Loops under Sampling Jitter and Output Jitter. 5th Swedish-Chinese Conference on Control, Lund, Sweden, May 31.
Tools for Average-Case and Worst-Case Performance Analysis of Real-Time Control Systems

with Jitter. 2nd ELLIIT Workshop, Lund, Sweden, October 18.
Event-Based Control of Stochastic Systems. Department of Control Science and Engineering, Zhejiang University, Hangzhou, P.R. China, November 2.
Towards Event-Based Control of Server Systems. LCCC Workshop on Control of Computing Systems, Lund, Sweden, December 7.
Tore Hägglund: Adaptive control,, University of Almeria, Almeria, Spain, April 5. Steel belt position control,, University of Córdoba, Córdoba, Spain, April 7.
Rolf Johansson: Stability of Robotic Obstacle Avoidance and Force Interaction, Seoul National University, College of Engineering, Dept. Electrical Engineering, 11 Jan 2011. Invited Lecture.
Industrial Robots and Work-Space Sensing, 2011 RoSEC Winter School, RoSEC (Robotics Specialized Education Consortium) & Hanyang University, Seoul, Korea, 12 January 2010. Invited Lecture.
Robotic Obstacle Avoidance and Work-Space Force Interaction, 2011 RoSEC Winter School, RoSEC (Robotics Specialized Education Consortium) & Hanyang University, Seoul, Korea, 13 January 2010. Invited Lecture.
Lund University Robotics Laboratory, LG Electronics, Seoul Korea, 28 March 2011
Stability of Robotic Obstacle Avoidance and Force Interaction. 5th Swedish-Chinese Conference on Control, Lund University, Lund, Sweden, 31 May 2011. Invited Lecture.
Multi-Step-Ahead Multivariate Predictors and Multi-Predictive Control. IEEE AFRICON2011, Livingstone, Zambia, 14 September 2011.
Observer-based Strictly Positive Real (SPR) Switching Output Feedback Control. Russia-Sweden Control Symposium, Saint Petersburg, Russia, 19 September 2011. Invited Lecture.
Modeling and Control of a Piezo-Actuated Compensation Mechanism for Industrial Macro-Mini Robot Configurations. Singapore Singapore Institute of Manufacturing Technology (SIMTech), Singapore, 4 Nov 2011. Invited Lecture.
MEMS in Robotic Work-Space Sensing and Control, International Workshop on Innovation and Commercialization of Micro & Nanotechnology (ICMAN 2011), Shenzhen, China, 7 Nov 2011. Keynote Speech.
ORF-MOSAIC for Adaptive Control of a Biomimetic Arm, 2011 IEEE International Conference on Robotics and Biomimetics (ROBIO 2011), Phuket Island, Thailand, 9 Dec 2011.
Nonlinear Dynamic Output Feedback Stabilization of Moore-Greitzer Models with Quadratic Constraints, 2011 9th IEEE International Conference on Control and Automation (ICCA2012), Santiago, Chile, December 19, 2011
Erik Johannesson: Control and Communication with Signal-to-Noise Ratio Constraints at KTH, October 31; Control and Communication with Signal-to-Noise Ratio Constraints at Zhejiang University, Hanzhou, China, December 5; Control and Communication with Signal-to-Noise Ratio Constraints at - Universidad Tecnica Federico Santa Maria, Valparaiso, Chile, December 22
Charlotta Johnsson: ISA Ireland, Invited speaker "Make2Pack and ISA88-Part5", May 2011.
Anna Lindholm: "Utility Disturbance Management in the Process Industry at Zhejiang University, Hanzhou, China, December 5
Anders Rantzer: Distributed Optimization of Power Flow, 7th Conference on Foundations of Computational Mathematics, Budapest, Hungary, July 9, 2011
System Decomposition for Distributed Control, Hong Kong University of Science and Technology, Hong Kong, China, July 13, 2011.

System Decomposition for Distributed Control, Zheijang University, Hangzhou, China, July 13, 2011.
Dual Decomposition for Distributed Control, Chinese Academy of Sciences, Beijing, China, July 20, 2011.
Distributed Control Using Positive Quadratic Programming, Plenary lecture at the 30th Chinese Control Conference, Yantai, July 22, 2011.
Scalable Analysis Methods for Sparse Large-scale Systems, Workshop on Uncertain Dynamical Systems, Udine, Aug 24, 2011.
Power Flow Optimization using Positive Quadratic Programming, IFAC World Congress, Milan, Aug 31, 2011.
Distributed Control of Positive Systems, 6th Swedish-Russian Control Conference, Saint Petersburg, Russia, Sep 19, 2011.
Towards a Scalable Control Theory, ISL Colloquium, Stanford University, Palo Alto, Dec 8, 2011.
Distributed Control of Positive Systems—Towards a Scalable Control Theory, 50th IEEE Conference on Decision and Control and European Control Conference, Orlando, USA, Dec 15, 2011
Anders Robertsson: Several popular science presentations and demonstrations at Teknik-, Natur- och Medicindagarna March 7, 2011 (about 100 highschool students).
Several popular science presentations and demonstrations during EURobotics week Nov 29-30, 2011 (18 sessions with above 200 students from 4th grade to high school students).
Demo of RobotLab and Dept of Automatic control (Anniversary LTH 50 years) September 28, 2011.
Russian-Swedish Control meeting St Petersburg 6th Swedish-Russian Control Conference (SweRuCon'11) Tuesday September 20, 2011, Anders Robertsson. "On Optimal Paths, Tracking and Contraint-based control for Robotic applications"
Guest lecture: Datorer i System, LTH, Oct 28 2011 kl 13-15 E:A "Reglerteknik"
se http://cs.lth.se/kurs/edaa05/edaa05_lectures_ht2/
October 5, 2011, Invited lecture, "Robotics and Control" IFR Research Lectures 2011, Stuttgart
LCCC workshop 5-7/12 2011, Workshop on Control of Computing Systems, 5 dec, 09:15 "Performance Modeling and Control of Database Servers in a Multi-Tier Environment" Maria Kihl & Anders Robertsson, Lund University
Seminar, Thu, December 15, 2011, "Robotics research at LTH - snapshots and snapfits" Linköping University
Björn Wittenmark: July 19, 2011, "Control structures and Implementation Issues for Sampled-data Controllers", Pre-conference workshop at International Conference on Process Automation, Control and Computation, Coimbatore, India
July 21, 2011, "Adaptive Control - Past and Present", Keynote address, International Conference on Process Automation, Control and Computation, Coimbatore, India
December 7, 2011, "Sample-induced delays in synchronous multirate systems", LCCC workshop on Control of Computing Systems, Lund, Sweden