Activity Report 1998
Competence Center for Circuit Design
Lund University

Jiren Yuan
Professor and Director of CCCD

Competence Center for Circuit Design
Department of Applied Electronics
Lund University

1999-03-04

Executive Summary

1998 has been an important year for Competence Center for Circuit Design (CCCD). On January 1 of the year, CCCD became a formal Competence Center of NUTEK. The contract for step 1 (980101-991231) between NUTEK, Lund University and six industrial members (Agro Vision, Cadence Design Systems, Ericsson Components, Ericsson Mobile Communications, Ericsson Radio Systems, Telia Research) was finally signed in 1998, which formed a solid base for the center's budget and activities. Sun Microsystems became an associated part of CCCD in November 1998. The contract between Lund University and the National University of Singapore will be signed separately. In addition to the ongoing research, recruiting personnel and industrial members were still on the agenda but no longer the major concern. The major activities have been focused on research, project development, education and co-operation with industries.

As planned, the research was focused on circuit design for mobile communication with the strategic goal of system-on-chip. Research activities covered three major areas of a wireless communication system, i. e. RF/Analog, Mixed Signal Design and Digital Signal Processing. 25 well-motivated projects in these areas were further developed. The research work resulted in 1 Ph.D. thesis, 1 book, 1 patent application, 10 international journal papers, 1 international journal letter, 18 international conference papers, 7 national conference papers, 3 technical reports, and 7 Masters' theses. In addition, 2 graduate courses and 2 undergraduate courses were given. The patent application was transferred to one of our industrial members, Ericsson Mobile Communications. The center has visited, and been visited by representatives from numerous research groups abroad.

A CCCD workshop was held in Lund on February 18, 1998, to exchange views on future directions. CCCD co-organized the Competence Center Day which was held in Lund on October 20, a big event for all competence centers of NUTEK. On the day, Prof. Yuan represented the new center and delivered a speech about its activities today and tomorrow. Project leaders and Ph.D. students demonstrated their projects successfully to the participants. CCCD hosted the 16th Norchip Conference during November 9-10 1998, and five papers from CCCD were presented. Also, CCCD hosted an ADDA Workshop on December 11, 1998, participated by researchers from ERA, EMW, EKA, FOA Linköping, KTH, LiTH and LTH.

There have been personal changes in 1998. Peter Nord resigned from the post of Director and completely left from July 1998. Prof. Jiren Yuan was appointed to the position thereafter. Stina Ahlenius was recruited and works 50% for CCCD to assist the new Director. Assistant Professor Shousheng He worked 20% in CCCD after June 1998. Post-doctoral fellow Wen Chen finished her study in August 1998. Assistant Professor Henrik Floberg finished his employment in November 1998. One Ph.D. student, Magnus Wiklund, graduated in June 1998 and another one, Per Fremrot, terminated his study in November 1998. Four new students were recruited so the number of Ph.D. students was increased from 10 to 12. Four more Ph.D. students decided to join CCCD in the spring of 1999, of which one has already started.

Contents

Executive Summary 2
1 Introduction 4
2 Memberships, Contracts and the Board 4
3 Financial Results 5
4 Personnel 6
5 Operation of the Center 9
6 Research Focus and Scientific Direction 10
7 Research Projects 10
7.1 Analog and Radio Frequency Circuit Design 10
7.2 High Performance Digital Circuit Design 15
7.3 Mixed Signal Circuit Design 21
8 Courses 24
9 Co-operation and Visits 24
10 Conferences and Other Activity 26
11 Budget for 1999 29
12 Publications and Patent 31

Activity Report 1998
Competence Center for Circuit Design
Lund University

1. Introduction

This is the annual report of the Competence Center for Circuit Design (CCCD or the center in the following), covering the center's activities through 1998, year 1 of CCCD being a formal center.

The center was founded July 1, 1995, at the Department of Applied Electronics, Lund University, and became a formal competence center of NUTEK on January 1, 1998, after a two-and-a-half year start-up phase. The center has been motivated to promote the activities in circuit design receiving substantial interests from researchers in universities and industries. The Department of Applied Electronics where the center is located has a unique profile focusing on mobile communication all the way from system development to silicon implementations built up during the last 16 years. The center contains three parts: NUTEK (full member), Lund University (full member) and industrial partners. Agro Vision, Cadence Design Systems, Ericsson Components, Ericsson Mobile Communications, Ericsson Radio Systems, and Telia Research are the full industrial members while Sun Microsystems is an associate part of CCCD. Each member contributes with funding and/or emolument for the center's activities. The National University of Singapore is a partner of Lund University in the center and financially supports the center since the start-up phase.

In 1998, the major activities were concentrated on research, project development, education and co-operation with industry. With the focus on mobile communication and the strategic goal of system-on-chip, all aspects in circuit design from monolithic radio front-end through analog and mixed-signal ASIC to digital and DSP-ASIC are well represented in the center. By addressing the most challenging topics and co-operating closely with industry, the center is to make itself one of the leading research organizations in the world.

This report describes the memberships, contracts and the Board, financial results, personnel, operation of the center, research focus and scientific direction, research projects, courses, co-operation and visits, conferences and other activities, and budget for 1999. Publications and patent are listed in the end of the report. Stina Ahlenius, Peter Nilsson, Lars Sundström and Viktor Öwall have contributed detailed materials essential for this report, which is sincerely acknowledged.

2. Memberships, Contracts and the Board

On the meeting held at NUTEK on December 17, 1997, all CCCD partners agreed to sign a two-year contract for step 1 (980101 – 001231). It, however, took some time to finish the signature procedure. The contract was finally signed in November 1998. In a document

issued on November 10, 1998, NUTEK confirmed that the contract for step 1 was singed by NUTEK, Lund University and six industrial partners: Agro Vision, Cadence Design Systems, Ericsson Components, Ericsson Mobile Communications, Ericsson Radio Systems and Telia Research. Accordingly, they became the full members of CCCD. Sun Microsystems was originally going to be a full member but changed to an associate part of CCCD instead. It was decided that Lund University should sign a separate contract with the National University of Singapore (NUS) to include NUS in the university part.

The contract for step 1 contains 24 articles, covering basic rules from partners' obligations and organizations through activity plan and financial issues to co-operation and judicial issues. There are three appendices (Activity Plan and Finance of Step 1, Industrial Contributions in Emoluments, and NUTEK's Success Criteria) attached to the contract. All these formed the legal bases and guidelines for the co-operation between CCCD members.

The sub-contracts, concerning the distribution and publication of project results, treatment of secret information, and compensations for patent inventions, have not been signed so far but under negotiation. Since a few patent inventions have already emerged, these sub-contracts are in urgent need. Lund University is currently working on the issue along with other members and will finish the negotiation and sign them as soon as possible.

The CCCD Board held four meetings in 1998 (February, May, August and November). Personnel, finance, membership, contract and other important issues were discussed and decisions were made during these meetings. Based on the suggestion from the board, Lund University made a decision on November 2, 1998, concerning the expansion of the board. Three new members joined the board, and the board membership of Stefan Forssman expired from November 26, 1998, as Sun Microsystems became an associate part. According to the decision, the board members are

Per Tjernlund (Chairman), Ericsson Radio Systems,
Johan Wickman, Telia Research
Per Nilsson, Cadence Design Systems
Kin Mun Lye, National University of Singapore
Bengt-Arne Molin (Vice Chairman), Lund University

New board members:
Gunnar Björklund, Ericsson Components
Björn Ekelund, Ericsson Mobile Communications
Peter Egelberg, Agro Vision

Ericsson Radio Systems informed Lund University on February 15, 1999, that Per Tjernlund will be replaced by Peter Olanders. Consequently, a new Chairman will be elected.

3. Financial Results

The financial results 1998 are listed in Table 1.

Table 1 Financial results 1998

	Funds	Emoluments	Emoluments LU	Sum
Incomes				
NUTEK	4000			4000

Ericsson Radio	1000	200		
Ericsson Mobile	1000	500		
Ericsson Components	350	150		
Telia Research	500			
Agro Vision		200		
Cadence		1000		
Nat University of Singapore	334	383		717
Lund University			2900	2900
Sum	7184	2433	2900	12517
Costs				
Salary	2849	1333	1324	5506
Travel	397		68	465
Equipment	317	1100	799	2216
Other costs	80			80
VAT, 8%	254			254
OH-costs: University	513		198	711
OH-costs: Rent	672		273	946
OH-costs: Department	584		237	821
Sum	5666	2433	2900	10999

During 1998, 1 professor and 4.9 assistant professors have been funded by CCCD. Lund University contributed emoluments for 0.8 assistant professors and 3.7 Ph.D. student positions while industrial partners contributed emoluments for 4.7 key personnel. One of the Ph.D. students was recruited from August 1998. Two assistant professors and one Ph.D. student left the center in the autumn of 1998. In the same time, it was difficult to recruit new Ph.D. students. Therefore, the salary costs were lower than planned. In 1999, the center expects to recruit 7-8 new Ph.D. students.

4. Personnel

There were some important personnel changes during 1998.

Director of CCCD

Peter Nord resigned from the Director of CCCD in the beginning of 1998. He worked 100% on the position until February 28, 1998, and 20 % until June 30, 1998. After Peter Nord's resignation, the nomination of new director was carried out within CCCD, and the CCCD Board nominated Prof. Yuan as the new director of CCCD on the board meeting held on February 18, 1998. Lund University later formally appointed Prof. Yuan as the new Director of CCCD from May 1998. On the same board meeting, the representative of the Department of Applied Electronics informed the board that a new first secretary would be hired to assist the new director regarding financial issues.

Senior Administrator

Stina Ahlenius was recruited in the spring of 1998 as a Senior Administrator of the Department of Applied Electronics, working 50% for CCCD to assist the new Director in financial and administrative issues.

Senior Staffs

Staffs employed by the Department of Applied Electronics, Lund University:

Jiren Yuan (Professor 970901-, Docent 931111-, Lecturer 910701-, Ph.D. 890310-) works 100% for CCCD since 970901.

Lars Sundström (Lecturer 951101-, Ph.D. 950929-) works 100% for CCCD until 980701 and 70% since then.

Henrik Floberg (Lecturer 951201-981130, Ph.D. 951124-) worked 100% for CCCD from 951201 to 971130.

Peter Nilsson (Lecturer 960601-, Ph.D. 960524-) works 50% for CCCD since 970701.

Viktor Öwall (Lecturer 960901-, Post-doctor 941215-960831, Ph.D. 941215-) works 50% for CCCD since 970701.

Shousheng He (Lecturer 960401-990331, Ph.D. 960119-) worked 100% during 970701-980630 and 20% since 980701 for CCCD.

Henrik Sjöland (Research Assistant 980201-010131, Ph.D. 971204-) works 100% for CCCD since 980201.

Wen Chen (Post-doctoral Fellow 970901-980831) worked 100% within CCCD during her post-doctoral study.

Three senior persons of CCCD are now employed by one of its industrial partners. Shousheng He has been employed by Ericsson Mobile Communications since 980701 but still works 20% for CCCD at the Department of Applied Electronics. Wen Chen finished her post-doctoral study and has been employed by Ericsson Mobile Communications since 980901. Henrik Floberg finished his three-year employment term at the Department of Applied Electronics and has been employed by Ericsson Mobile Communications since 981201. The changes can be seen as the personnel flow within CCCD members.

Assistant Professor Henrik Sjöland finished his Ph.D. study in the end of 1997 and planned to be a post-doctor abroad. He actually started his post-doctoral study from 990201 at UCLA, Los Angeles USA, under Prof. Assad Abidi.

Staffs employed outside of Lund University:

Sven Mattisson (Adjunct Professor 970701-, Ph.D. 860918-), Ericsson Mobile Communications, works 20% for CCCD since 970701.

Mats Torkelsson (Adjunct Professor 970701-, Ph.D. 900605-), Ericsson Radio Systems, works 20% for CCCD since 970701.

Christian Björk (Ph.D. 941209-), Ericsson Mobile Communications, works 20% for CCCD since 970701.

Thomas Mattsson (Ph.D. 830525-), Ericsson Mobile Communications, works 20% for CCCD since 970701.

Graduate Students

Effort has been made during 1998 to recruit more Ph.D. students. In addition to the ten existing graduate students, Four new Ph.D. students were recruited in 1998. Four more Ph.D. students have decided to join CCCD in the spring of 1999, of which one has already started. All Ph.D. students are listed below.

Magnus Wiklund joined the Analog Integrated Circuit Design group in December 1992. He was financed by the faculty fund.

Pietro Andreani joined the Department of Applied Electronics in May 1990. He is financed by NUTEK through the INWITE program.

Anders Johansson joined the Analog Integrated Circuit Design group in January 1997. He is financed directly by the faculty fund.

Anna-Karin Stenman joined the Monolithic Radio Frequency Circuits group in May 1997. She is financed by Foundation for Strategic Research through the Integrated Electronic Systems program.

Eric Westesson joined the Monolithic Radio Frequency Circuits group in June 1998. He is financed by NUTEK through the INWITE program.

Torbjörn Sandström joined the Monolithic Radio Frequency Circuits group in January 1998. He is financed by Foundation for Strategic Research through the Integrated Electronic Systems program.

Martin Lantz joined the Analog Integrated Circuit Design group in September 1997. He is financed by Foundation for Strategic Research through the PCC program.

Bo Shi, from the Center for Wireless Communication (CWC), National University of Singapore (NUS), joined the Monolithic Radio Frequency Circuits group in September 1997. He is financed by CWC, NUS, through CCCD.

Anders Berkeman joined the ASIC/DSP group in August 1997. He is financed by NUTEK through the Telecommunication program.

Per Fremrot joined the ASIC/DSP group in November 1997 as an industrial Ph.D. student but quit his study in November 1998. He was jointly financed by ECS and Foundation for Strategic Research through the PCC program.

Pontus Åström joined the ASIC/DSP group in May 1995. He is financed by Foundation for Strategic Research through the Integrated Electronic Systems program.

Stefan Johansson joined the ASIC/DSP group in August 1996. He is financed by Foundation for Strategic Research through the Integrated Electronic Systems program.

Thomas Olsson joined the ASIC/DSP group in February 1998. He is financed by Foundation for Strategic Research through the PCC program.

Roland Strandberg joined the Mixed Signal Design group in August 1998. He is directly financed by the faculty fund.

Johan Piper joined the Mixed Signal Design group in June 1998 during his Master thesis work and became a Ph.D. student from February 1, 1999. He is directly financed by the faculty fund.

Karl Thoren will join the ASIC/DSP group in March 1999. He will be financed by Foundation for Strategic Research through the PCC program.

Yijun Zhou, from the Center for Wireless Communication (CWC), National University of Singapore (NUS), will join the Mixed Signal Design group from April 1, 1999. He will be financed by CWC, NUS, through CCCD.

Among them, Magnus Wiklund received his Ph.D. degree in June 1998 and was employed by Ericsson Mobile Communications afterwards. Per Fremrot quit his Ph.D. study in November 1998 and returned to Ericsson Mobile Communications. Pietro Andreani will complete his Ph.D. study in May 1999 and become a senior staff of CCCD. Considering the situation and the available salaries left by the previous senior staffs, it was decided that the priority should be given to recruit more Ph.D. students. Accordingly, 7-8 Ph.D. students will be recruited in 1999, including Johan Piper, Karl Thoren and Yijun Zhou.

5. Operation of the Center

Internal co-operation has been emphasized consistently. Besides daily contacts, the senior staffs meet every two weeks to discuss important issues and policies. Not only the director but also all senior staffs feel that they are leading the organization. Good working relations have been established among the seniors. Weekly meetings were arranged together by Analog/RF and Mixed Signal groups. On the weekly meetings, group leaders announced messages, and Ph.D. students reported their works done in the last week. Informal seminars were arranged once a week on these weekly meetings, given by one of the group members. ASIC/DSP group has its own weekly meetings in the same manner. Large meetings were arranged every month, where all CCCD personnel join together. No matter analog, digital or mixed signal, CCCD is seen as one entity. Ideas, results and news from conferences were exchanged through pre-arranged seminars given by one or two CCCD researchers. All CCCD senior staffs take their responsibilities for these meetings but one of them will be the organizer at each time. Department leaders often join these meetings and sometimes also the senior staff meetings to acquire first-hand information.

The director and the senior administrator worked complementarily to handle different affairs of CCCD, which turned out to be effective. They worked closely with the heads of the department to make important personnel and financial decisions. The department supported the center not only by taking part in the CCCD Board but also by creating a good working environment. The department made great effort in 1998 to prevent the key personnel of CCCD from being recruited by other organizations. The professor and assistant professors worked together more closely in determining the scientific direction and working projects of CCCD. In parallel to the chair of Circuit Design, there are two more chairs in the department, i.e. Signal Processing (currently two professors) and Radio Systems (currently vacant) respectively. The four professors along with the head and the vice head of the department formed a joint meeting to coordinate the research in the department. For example, a number of algorithms formulated by the Signal Processing and Radio Systems divisions are being implemented by the ASIC/DSP group of CCCD.

Contacts with the industrial partners were made at both regular and non-regular bases. The adjunct professors and researchers joined the group meetings of CCCD and helped to formulate industrial projects. CCCD senior staffs also visited the partner industries to exchange information and to discuss new projects. Such contacts are essential to the center's operation and will be further improved in 1999.

6. Research Focus and Scientific Direction

The research focus on mobile communication and the strategic goal of system-on-chip were specified in the activity plan 971017 (see the section of Research Areas) and have not been changed since then. It is important to keep up the world trend in IC design. Higher, and eventually, the full integration will greatly improve the system performance in speed, power consumption, synchronization, production cost, reliability and portability.

The four research areas defined in the activity plan (see Figure 1 in the plan) have not been changed. They are

- System Design Methodology
- Analog and Radio Frequency Circuit Design
- Mixed Signal Circuit Design
- Digital Signal Processing Circuit Design

As indicated in the above mentioned activity plan (see Figure 2 in the plan), the research in the area of system design methodology is distributed and combined with three other areas. Low power and low voltage are considered in all areas and all levels. The performance optimized placement of the interface between analog and digital is considered in all areas, especially in the area of mixed signal circuit design. New system synchronization methods and software-hardware co-design are mainly covered in the area of digital signal processing circuit design. In order to facilitate system-on-chip, all areas are working together at a system level.

The scientific direction has not been changed in general. Low power, low voltage, monolithic design, and embedded solutions, low cost CMOS, sub-micron technologies and system-on-chip are the ways to go. There are however some changes in research projects due to various reasons, which will be described in the next section.

7. Research Projects

The research projects formulated in the activity plan 971017 were further developed in the activity report 1997. In the following, the projects are referred to the ones presented in the activity report 1997. Analog and Radio Frequency Circuit Designs are merged together due to the leaving of Henrik Floberg.

7.1 Analog and Radio Frequency Circuit Design

Designers of integrated analog and RF circuits are meeting new challenges as they are forced into narrowing design boundaries set by decreasing supply voltage and power consumption while performance must be maintained or even improved. Increasingly complex systems are put together on a single chip, system-on-chip, to reduce cost and power consumption. Here digital, mixed-signal and analog functions must co-exist without interfering with each other. Process technology used for such applications is hardly tuned for the analog circuitry. The rapid development of process technology paves the way for higher frequency of operation and, therefore, also low cost implementation of wireless equipment. Here CMOS technology will replace bipolar technology in many applications. The Analog/RF Circuits group carries out research on many different aspects of analog design ranging from transceiver architectures down to the implementation of single circuit

elements like monolithic inductors and circuit theory. Below the activities during 1998 in the Analog/RF Circuits group are summarized.

Monolithic Oscillators and Filters

Definition: High frequency oscillators and RF filters are two of the few remaining building blocks that are still partially or completely implemented off-chip. The objective of this project is to develop design methods for fully integrated oscillators and filters. This is seen as a critical challenge that is associated with implementation of reactive circuit elements whose quality has a large influence on the performance of these building blocks.

Supervisor: Adj. Prof. Mattisson (Ericsson Mobile Communications) and Dr. Sundström.

Ph.D. Student: Pietro Andreani (Lic.).

Funding source: NUTEK through the INWITE program.

Industrial Partners: Ericsson Mobile Communications and Ericsson Radio Systems.

Results: Several VCOs have been designed and measured to be able to make a comparative study of various implementations of reactive components in the resonance circuit. Two 1.8 GHz CMOS VCOs, based on a diode-varicap and a MOS-varicap respectively, were designed and tested in a 0.8µm process. It was found that the diode-varicap resulted in better phase noise characteristics but analysis revealed that MOS-varicaps will be better than diode-varicaps as the technology improves. Also, several alternatives to the regular MOS-varicap are being investigated which will pave the way for even lower power consumption and phase noise. In all these investigations, bond-wire inductors with a high Q value were used so that all losses could be attributed to the varicap alone. However, the use bond-wire inductors is not and may not be a feasible method for creating inductors from a manufacturing point of view and therefore some work has been devoted to the design of monolithic inductive elements as well which will be used for new oscillator solutions during 1999. Measuring phase noise is a difficult task and highly specialized equipment is required to make accurate measurements. Ericsson Radio Systems in Kista has provided experienced personnel as well as suitable equipment several times during 1998.

A very promising method for implementing active band-pass filters has been studied during 1998. A transconductance-C 6th order Chebyshev band-pass filter with 26kHz center frequency and 4kHz pass-band was designed in a 0.8µm CMOS process for signal conditioning for a fluid density sensor. The architecture that was used is insensitive to the parasitic capacitance introduced by the transconductance stages, and it can be used to implement a band-pass transfer function over a very large range of frequencies. The implementation of band-pass filters using this technique at very high frequencies was started in 1998 and results will be reported during 1999.

Pietro Andreani will defend his Ph.D. thesis in May 1999.

Low-Noise Amplifiers and Mixers

Definition: Following the one-chip radio theme of the Mobile Radio Consortium this project solely investigates front-end design in CMOS for cellular wideband systems. The objective is to develop circuit solutions for low supply voltage and power consumption that can be adapted to just enough performance thereby reducing power consumption.

Supervisor: Dr. Sundström.

Students: Anna-Karin Stenman (M.Sc.) and Torbjörn Sandström (M.Sc.).

Funding source: Foundation for Strategic Research (SSF) through the Integrated Electronic Systems (IES) program.

Industrial Partners: Ericsson Mobile Communications and Ericsson Radio Systems.

Results: The work during 1998 has mainly dealt with rigorous analysis of a low-noise amplifier structure with input impedance control using inductive series feedback. The analysis constitutes a tool for robust design of this amplifier structure. The investigated structure is fully symmetrical with respect to supply and ground to be able to adapt performance of this amplifier as necessary. The adaptation is another concept that will be investigated in more detail within this project to be able to save power when maximum performance is not required. In the end of 1998 an investigation and design of mixer topologies were started. As for the low-noise amplifier, the adaptation part and power consumption will become important issues in this work.

Linear High-Efficiency Transmitters

Most of the wireless communication systems that are in the run for the future will require more or less linear transmitters. Current linear transmitter architectures are either complex, voluminous or both. The aim of this project (consisting of a number of subprojects) is to find solutions for fully integrated linear high efficiency transmitters both for handset and base-station transmitters.

Linearization Using Digital Predistortion

Definition: The objective of this project is to build a test system based on digital techniques to be able to emulate and thereby evaluate different predistortion techniques mainly for use in handsets but also base-station transmitters.

Project Leaders: Dr. Sundström and M.Sc. Mannerstråle.

Personnel: Weiyun Shan (M.Sc.), Niklas Karlsson (Master's thesis student), Mikael Svensson (Master's thesis student).

Funding source: Ericsson Mobile Communications, Lund.

Industrial Partners: Ericsson Mobile Communications and Ericsson Radio Systems.

Results: In the end of 1997 a Master's thesis project was initiated together with Ericsson Mobile Communications, Lund, to design a custom digital signal processor tailored for linearization of RF power amplifiers using predistortion. Such DSPs have been designed before to demonstrate required complexity, speed improvements and power consumption reduction when designing a custom chip for this application. In this new project the objective was to design a chip that could be easily and efficiently used in a prototype system. The chip was designed using standard cells from the process vendor. A complex multiplier architecture based on distributed arithmetics constituted the core of the chip. To improve throughput even more the architecture was made systolic. The fabricated chip was fully functional and allowed operation to accommodate a source signal bandwidth of several MHz consuming approximately 1W at 3.3V supply and a few 100KHz with 1.5V supply consuming 35mW. The work was presented at the Norchip'98 conference. In late 1998 it was agreed with Ericsson Mobile Communications, to build a prototype system to be able to evaluate several different predistortion techniques using this chip. Due to the

architecture that was used for this chip it can be used together with a controller to emulate virtually any predistortion technique including analog solutions.

Linearization Using Analog Predistortion

Definition: The objective of this project is to develop simple low voltage/low power linearization systems based on analog techniques primarily for use in handsets with moderate requirements on transmitter linearity.

Supervisor: Dr. Sundström.

Student: Eric Westesson.

Funding source: NUTEK through the INWITE program.

Industrial Partners: Ericsson Mobile Communications and Ericsson Radio Systems.

Results: A master's thesis work was initiated in late 1997 with objective to design an analog predistortion circuit as a complex-valued polynomial using CMOS technology. The thesis work was completed in May 1998 and after that the undergraduate student Mr. Westesson continued his work as a Ph.D. student. The fabricated chip was fully functional and measurement results were in close agreement with simulations. The chip operates with a 3.3V supply consuming some 60mW and can be used for linearizing RF power amplifiers both at base-band and at an IF up to roughly 200MHz with several MHz signal bandwidth. In late 1998 the implementation of a prototype system with a controller was started and preliminary results from this system are very promising.

Linearization Using Analog Circuit Techniques

Definition: The objective of this project is to exploit the properties of analog integrated circuit techniques more efficiently to be able to accommodate new ideas on linearization of RF power amplifiers.

Supervisor: Dr. Sundström.

Student: Bo Shi.

Funding source: Center for Wireless Communication, National University of Singapore, through CCCD.

Industrial Partners: Ericsson Mobile Communications and Ericsson Radio Systems.

Results: During 1998 a partly new linearization scheme, the power feedback technique, was investigated, which reduces what is referred to as the AM-to-AM nonlinearities of RF power amplifiers. The scheme is quite self-sufficient and does not require supervision for proper operation as is the case for many other techniques. Although, the reduction in distortion is limited as well as the bandwidth (limited for all feedback systems). A chip in CMOS technology was designed and fabricated to be able to verify system level simulations. The chip was fully functional and a prototype setup showed a 10dB reduction of close-in distortion when operated with a carrier at 850MHz. The moderate reduction in distortion was predicted from the system level investigation but was still found to be useful in handsets. An alternative to linearize an amplifier for use in an RF transmitter is to synthesize the desired signal directly without having to resort to linear amplifiers. LINC is one such technique. This technique is traditionally associated with DSP techniques because of the needs for accurate and nonlinear signal processing. Within this project a circuit was

designed in BiCMOS technology to implement these function using analog circuit techniques. The chip will be tested in spring 1999.

Monolithic Transceivers

Definition: The objective is to explore the prerequisite and design methods for monolithic transceiver schemes with low cross-talk sensibility. Such efforts require a wider perspective covering circuit, block and system level design. Various transceiver architectures will be designed and measured allowing ideas to be evaluated.

Supervisor: Prof. Yuan and Dr. Sundström.

Student: Martin Lantz.

Funding source: Foundation for Strategic Research (SSF) through the Personal Computing and Communication (PCC) program.

Industrial Partners: Ericsson Mobile Communications and Ericsson Radio Systems.

Results: A novel amplifier circuit topology suitable for low noise amplifiers (LNA) have been developed. This amplifier topology shows a substantial bandwidth improvement, allowing higher linearity. An LNA design is planned for fabrication in July 1999. A 40GHz SiGe BiCMOS process is considered suitable for this experiment. M.Sc. Lantz visited Catena Microelectronics BV, Delft, The Netherlands, during the autumn to investigate design techniques for balanced RF power amplifiers. This collaboration was very successful and several papers are planned. In addition, ideas on how to integrate the time-duplex switch with the monolithic transceiver were spawned during the work in Delft. The monolithic approach interposes severe substrate-coupling problems. Preliminary studies of the phenomena, aided by device simulator, have therefore been performed.

Low Voltage and Low Power Analog Circuits

Definition: The objective is to investigate the use of current mode technologies in low power and low voltage analog ASIC applications. The main application area is communication systems.

Supervisor: Prof. Yuan.

Student: Anders J Johansson.

Funding source: Faculty.

Industrial Partners: Ericsson Mobile Communications and Ericsson Radio Systems.

Results: A random number generator has been designed around a novel concept for the generation of the seed. It gives a very secure random number generation procedure, which is safe for use in cryptography. The seed generator is built around a chaotic oscillator. The design of this is scalable to higher frequencies, and investigation about its usefulness in the different chaotic modulation schemes is being undertaken. Investigations have also been made regarding the influence of novel characteristics in sub-micron processes on the analog performance of integrated circuits. These effects only exist in processes below 0.1 micron, and their effects on digital applications are well known. Evaluation has been made on their characteristics as analog noise sources, and their theoretical power levels have been calculated.

7.2 High Performance Digital Circuit Design

Future system implementations will have an increased demand for digital signal processing capacity, which is especially true for mobile wireless communication applications. At the same time a dramatic reduction of the power consumption compared to what is achievable today will be necessary to increase battery life and reduce the amount of cooling. To be able to achieve the goal of system-on-chip, new strategies on all levels of the design hierarchy have to be investigated, from system to circuit design. As the number of transistors possible to implement on a single die increases, new design methodologies to handle the increased complexity also have to be developed. The research activities within the ASIC/DSP group cover digital circuit and system design, mainly in the area of mobile communication. Today, the group consists of 1 adjunct professor, 2 assistant professors, 1 adjunct lecturer and 8-9 Ph.D. students (3-4 vacant). In 1998, one Assistant Professor (Shousheng He, 83%), one Assistant Professor (Peter Nilsson, 38%), and one Assistant Professor (Viktor Öwall, 30%) were funded by CCCD.

Three main research areas have been identified: System Design, Design Methodologies, and Circuit Design. The main representations of these areas are performed by the three assistant professors: Shousheng He, Viktor Öwall, and Peter Nilsson respectively. However, these areas are not isolated and all of the assistant professors have research interests in all of the areas. The research activities in the field of design methodologies have not received funding from the center during 1997.

Simulation of an OFDM System

Definition: A flexible and detailed simulation model for Orthogonal Frequency Division Multiplexing (OFDM) system has been built upon the design framework Ptolemy, to guide and regulate the hardware development in several concurrent academic/industrial microelectronics projects. The system is targeted on future wideband multi-user applications with up to 20Mbit/s data rate at 2GHz frequency range in a mobile environment.

Researcher: Dr. Shousheng He.

Funding source: Foundation for Strategic Research (SSF) through the Integrated Electronic Systems (IES) program.

Industrial partners: Ericsson Mobile Communications, Ericsson Radio Systems, and Ericsson Components.

Results: Several recent advances in OFDM system research have been accommodated to improve the system performance under the constraints of implementation complexity. These include maximum likelihood estimation for timing and frequency offset utilizing the cyclic prefix, window application and automatic phase control. The number of sub-carriers has been chosen to an optimal value that gives best performance in fading channels. Various digital and analog distortions due to non-ideal components have been also put into consideration, such as non- linearity in power amplifier, mixer miss-match and quantization noise, so that more realistic trade-offs can be made in a “system-on-chip” design. A quantified evaluation of these distortions has been achieved by a recent research progress based on decision point SNR estimation. Specifications for some of the sub-modules, including performance requirement, noise level and interfacing have been worked out and

sent to different hardware research groups for discussion. Future research activities will focus on algorithm/structure reformation for real-time DSP prototyping.

A Demonstrator for Wideband Systems as OFDM and CDMA

Definition: This demonstrator project is a joint project between the members of the Wireless Access Systems i.e. the former Mobile Radio Consortium. Each member will contribute with building blocks for different parts of a high data-rate mobile terminal with very low power consumption.

Project manager: Dr. Peter Nilsson.
Co-Manager: Adj. Prof. Mats Torkelson.

Funding source: Foundation for Strategic Research (SSF) through the Integrated Electronic Systems (IES) program.

Industrial partners: Ericsson Mobile Communications, Ericsson Radio System, and Ericsson Components.

Results: The industrial parts, for a test-bed made of discrete components, are ready. They will be assembled to a complete test-bed, where each research group can exchange their silicon.

FFT-Design

Definition: Implementation of an FFT processor in the direction of VLSI sub-system design. A pipelined FFT processor for real-time processing has made substantial progress. Two designs of the first version silicon implementations were completed.

Researcher: Dr. Shousheng He.

Funding source: Foundation for Strategic Research (SSF) through the Integrated Electronic Systems (IES) program.

Industrial partners: Ericsson Mobile Communications, Ericsson Radio Systems, and Ericsson Components.

Results: A 1024 complex point pipelined FFT for an OFDM system application has been implemented in a 0.5µm CMOS technology and is fully functional. Another processor of an 8192 complex point FFT transform for HDTV application, in cooperation with Nordic VLSI in Norway, is tested and will be used in DVD-prototypes. Dynamic range extension and low-power design will be the future focus.

Signal Processing Algorithms for Adaptive Antenna Arrays

Definition: The concept of adaptive antenna arrays is a very important area to be able to increase the performance and/or capacity of wireless communication systems. The project will study implementation aspects of digital signal processing algorithms for this field. The involved algorithms are very complex to their nature and are very hard to implement on standard processors. Therefore, algorithm/hardware co-optimization has to be performed to reduce the complexity.

Supervisor: Dr. Viktor Öwall.
Co-Supervisor: Adj. Prof. Mats Torkelson.

Ph.D. student: Master's Thesis Student Fredrik Edman.

Funding source: CCCD (Master's Thesis together with ERA, and an application for funding a larger project on adaptive antennas has been submitted to PCC).

Industrial partners: Ericsson Radio Systems, Telia Research.

Results: During 1998 the project has been defined and initial contacts have been taken with several research groups at KTH, Chalmers and Uppsala University. A Master's Thesis project was initiated in September 1998 to be concluded in early 1999. The student will then continue towards a Ph.D. Two algorithms have been studied from an implementation perspective, the MUSIC algorithm and DWILSP. Both these algorithms have been simulated and studied from a complexity perspective. Word-length optimization is performed in the data-flow simulator DSP Canvas.

Implementation of Tailbiting Convolutional Codes

Definition: Tailbiting convolutional codes are a set of codes reducing the size of the trellis and therefore reducing the number of transferred bits. The number of saved bits is limited and therefore the scheme is most suitable for short packages. In packet transmission, small frames of 40-1000 data bits are transmitted through a variety of media that may exhibit time dispersion, multi-path and fading. Protecting these frames with the best possible coding is a special problem because of the channel impairments, the short frames, and the need for efficiency. The type of coding must change with the channel SNR and type (backbone, fading or multi-path), and the coding may also need to be integrated with an ARQ protocol. One promising technique is the convolutional tailbiting codes. The topic of the proposed research is to investigate the area of algorithm/hardware co-optimization by creating an environment with close cooperation between the two groups.

Supervisor: Dr. Viktor Öwall.
Co-Supervisor: Prof. J. B. Anderson (IT).

Ph.D. student: Karl Thoren, to begin in March 1999.

Funding source: Foundation for Strategic Research (SSF) through the Personal Computing and Communication (PCC) program.

Industrial partners: Ericsson Radio Systems.

Results: The project has been defined during late 1998 and contact between the research groups at CCCD and Dept. of Information Technology (John B. Anderson and Rolf Johannesson) has been established.

Implementation of Classification Algorithms in Pacemakers

Definition: The next generation of pacemakers will require more sophisticated classification algorithms to be implemented to detect disturbances in the heartbeats. Since pacemakers run on the same battery for very long time periods, preferably several years, circuits with extremely low power consumption have to be designed. Such challenges require application specific implementations.

Supervisor: Dr. Viktor Öwall.
Co-Supervisor: Dr. Leif Sörnmo.

Ph.D. student: Vacant.

Funding source: Faculty.

Industrial partners: Pacesetter.

Results: During 1998 the project has been defined and contact has been established between the two research groups. Since low power consumption is a key issue for several projects the proposed research fits well into the groups activities. The medical signal-processing group of the Department of Applied Electronics has a very long track record in the theoretical field. The research proposal has been announced both as a Ph.D. and a Master's Thesis project.

Algorithm/Hardware Co-Optimization: Echo Cancellation

Definition: The project will consider co-optimization between algorithm and hardware which is a crucial and underdeveloped field in the area of digital signal processing. As an application example a delay-less echo-cancellation algorithm will be used. The research will be conducted as a collaboration between algorithm and hardware researchers. Cancellation of network echoes is a mature research area while acoustic echo-cancellation is an expanding area becoming increasingly more important in mobile communication and video-conferencing. Due to the delay introduced in mobile systems it is crucial to have a delay-less algorithm. Previous algorithmic development has been performed in a MATLAB environment with no consideration of a fixed-point implementation.

Supervisor: Dr. Viktor Öwall.
Co-Supervisor: Adj. Prof. Mats Torkelson.

Ph.D. student: Anders Berkeman (M.Sc.).

Funding source: NUTEK through the Telecommunication program.

Industrial partners: Ericsson Radio Systems.

Results: During 1998 the algorithm has been studied from an implementation perspective and key parameters have been defined. One such issue is the trade-off between the number of sub-bands and complexity. A thorough understanding of the algorithm has been established. Fixed-point effects will be studied and hardware efficient algorithmic trade-offs were explored. Crucial modules are efficient filter bank structures, adaptive filters and an FFT processor. M.Sc. Anders Berkeman visited IMEC during the fall to investigate if their memory optimization technique is applicable to those algorithms. The results seem promising.

Design Methodologies

Definition: As the complexity of integrated circuits increase, several processors of various types will be located on a single die. The project will study specification and implementation strategies for larger systems on a chip, especially partitioning issues. Other research topics include: bridging the gap between system simulation tools and hardware implementation, needs and trade-offs regarding programmability, and efficient memory management.

Supervisor: Dr. Viktor Öwall.
Co-Supervisor: Adj. Prof. Mats Torkelson.

Ph.D. student: Vacant.

Funding source: CCCD.

Industrial partners: Ericsson Radio Systems.

Results: The project was initiated in November of 1997 as a part of the PCC program. The Ph.D. student Per Fremrot left the department. in November of 1998 to return to ECS. Research within this area is closely linked to all projects conducting larger designs and all such projects will need to establish a common design methodology. Specific research is to continue previous work regarding micro programmed ASIC-DSP's and to look at early estimation strategies.

Hardware Realization of Iterative Decoders

Definition: This project aims at hardware realization of a high data rate channel encoder/decoder which will operate at a very low signal to noise ratio. The decoder utilizes iterative decoding, a recently discovered decoding algorithm, which operates closer to the Shannon limit than any previously reported algorithms. The drawback of the new algorithm is the high decoding complexity and large signal delay. Those are the main problems that have to be solved to make this type of algorithms a competitive alternative.

Supervisor: Dr. Peter Nilsson.
Co-Supervisor: Adj. Prof. Mats Torkelson.

Ph.D. student: Pontus Åström.

Funding source: Foundation for Strategic Research (SSF) through the Integrated Electronic Systems (IES) program.

Industrial partners: Ericsson Mobile Communications, Ericsson Radio Systems, and Ericsson Components.

Results: During 1998 coder/decoder and algorithms were simulated and initial hardware design was performed. The architecture was finally frozen in December 1998. The chosen architecture is a serial iterative decoder, which has shown to have a very good performance, especially in a fading environment. Currently, the topic is a high-level hardware design in C++ with the aid of a design tool named Ocapi, currently under development at IMEC, Belgium. Several generic modules like FIFO buffers, averagers and primitive circuit elements are designed for a library aimed at decoder design. With the aid of this library future decoders of different families can be designed with ease. Some work has also been started to examine the possibility to utilize the codec family in CDMA. Initial research indicates that it might be possible. A co-operation around the Ocapi tool together with IMEC was started with a 2-month visit at IMEC in Belgium in September 1998. The main research here is to find out how to write object oriented reusable libraries for the Ocapi tool.

Hardware Realization of Synchronization Algorithms

Definition: This project concerns the realization of synchronization algorithms in wideband communication systems, especially OFDM systems. To synchronize such systems, two methods are known: to add pilot symbols and to correlate on a copy of the data. The second method is interesting since it can be done without affecting the transmitted data; the copy of

the data is placed in the cyclic prefix, which is a guard interval that can not be used for data.

Supervisor: Dr. Peter Nilsson.
Co-Supervisor: Adj. Prof. Mats Torkelson.

Ph.D. student: Stefan Johansson.

Funding source: Foundation for Strategic Research through the Integrated Electronic Systems (IES) program.

Industrial partners: Ericsson Mobile Communications, Ericsson Radio Systems, and Ericsson Components.

Results: During 1998 simulation and modeling of synchronization algorithms have been focused. Algorithm simplifications and bit optimization have led to a hardware architecture with moderate complexity, even though the algorithm is very computationally heavy. The hardware architecture has been verified using simulations in C and VHDL. During the year, circuit realization work was started. The goals are a full custom ASIC and an implementation in FPGA.

Globally Asynchronous Locally Synchronous Systems – GALS

Definition: Clock frequencies will increase to a level where they are not suitable for centralized distribution over a large silicon die. Global synchronous methods will therefore not be suitable. In this project inter-processor and I/O-communication strategies for large systems on chip will be developed. The idea is to have Globally Asynchronous clock, control, and data distribution using Locally Synchronously clocked processors in self-contained modules, which can be abbreviated as GALS. Of special interest is the system partitioning. The project will answer questions about how to separate a system in different modules, when parallel or serial computing is applicable, and how to transfer data, parameters, variables, interrupts, and control commands. The project will also answer questions about local clocking, both how to handle the handshaking and how to design clock generators.

Supervisor: Dr. Peter Nilsson.
Co-Supervisor: Adj. Prof. Mats Torkelson.

Ph.D. student: Thomas Olsson.

Funding source: Foundation for Strategic Research (SSF) through the Personal Computing and Communication (PCC) program.

Industrial partners: Ericsson Mobile Communications, Ericsson Radio Systems, and Ericsson Components.

Results: The project started in February 1998 with a prestudy of asynchronous/synchronous architectures, handshaking, and clocking. Part of the work was initiated by the multi-user detection project. The main focus so far has been on on-chip clocking of local modules. Good architectures have been found and a circuit realization aiming at a low power digitally controlled on-chip clock generator is in a late development state. Another important issue has been on module partitioning of GALS, which have been in co-operation with a group at KTH.

Hardware Realization of CDMA Multi-User Detector Algorithms

Definition: This is a project on hardware realization of interference cancellers for wide-band multi-user CDMA. The main purpose is to find architectures suitable for silicon implementation. Silicon realization will be considered as applications for GALS.

Supervisor: Dr. Peter Nilsson.
Co-Supervisor: Adj. Prof. Mats Torkelson.

Ph.D. student: Thomas Olsson.

Funding source: Foundation for Strategic Research (SSF) through the Personal Computing and Communication (PCC) program.

Industrial partners: Ericsson Mobile Communications, Ericsson Radio Systems, and Ericsson Components.

Results: A master's thesis work on the subject was finished in January 1998. The result is a comparison of several architectures comparing hardware-mapped solutions to parallel processor solutions. During the work, a new low complexity method for asynchronous multi-user detection in a DS/CDMA system was developed.

Implementation of Complex Multiplier

Definition: Complex multiplication is one key component in several DSP algorithms. A novel multiplier architecture has been defined which has a higher possible clock frequency together with a lower power consumption than previous architectures.

Supervisor: Dr. Viktor Öwall.
Co-Supervisor: Adj. Prof. Mats Torkelson.

Ph.D. student: Anders Berkeman.

Funding source: NUTEK through the Telecommunication program.

Industrial partners: Ericsson Radio Systems.

Results: A tree based complex multiplier has been designed, fabricated and successfully tested. The performance surpasses the one with a regular array structure developed under the exact same circumstances and fabricated in the same process. The results have been presented on International conferences including ESSCIRC'98.

7.3 Mixed Signal Circuit Design

This is a new area for the competence center and also for the Department of Applied Electronics, motivated to bridge analogue and digital and to address critical problems related to system-on-chip.

While digital techniques become increasingly efficient, most of the electronic systems still have to deal with analogue signals, e.g. the radio channel in a wireless system. In the future, it is desirable to digitize the analogue signal as early as possible in order to handle various applications. High performance A/D and D/A converters are therefore inevitably needed. Challenges in speed, dynamic range, area and power consumption must be met. At the same time, for the purpose of system-on-chip, embedded solutions must be found.

To realize system-on-chip, critical problems caused by the mixed signal environment must be handled. In CMOS which is the main technology of system-on-chip, digital circuits emit strong transition noise. Moreover, in a monolithic transceiver, the transmitter emits strong signals as well as harmonics. These will give a serious impact on other on-chip sensitive circuits like the receiver, A/D and D/A converters. The performance of such a chip will to a large extent depend on the design methodology and techniques capable of suppressing and de-coupling unwanted signals and noise.

Mixed Signal IC-Design Methodology

Definition: The aim of the project is to search for robust IC design methodology in a complex mixed signal environment. Three different approaches (techniques) were identified. They are

- Silent (low-noise-emitting) digital circuit techniques
- Layout-based performance prediction technique
- Noise cancellation and noise insensitive circuit techniques

Supervisor: Prof. Yuan.

Ph.D. Student: Roland Strandberg, recruited in August 1998.

Funding source: Faculty.

Industrial partners: Ericsson Radio Systems, Ericsson Mobile Communications, and Ericsson Components.

Results: The research started by looking at silent (low-noise-emitting) digital circuit techniques first. Different circuit techniques were compared in order to identify the circuits emitting less digital noise. Charge Redistribution Differential Logic (CRDL) and Current Sensing Differential Logic (CSDL) were investigated in detail. The results indicated CRDL becomes more silent only when the threshold voltage of p-device is specially deigned. CSDL can produces less noise for a large logic depth, compared with traditional Boolean logic based circuits. Two technical notes were written, and the investigation is currently continuing.

High Performance CMOS A/D Converter Design

Definition: This project is aimed to identify the A/D converters most suitable for the use in a wireless communication system at both architectural level and circuit level, through analyses, simulations, construction and demonstration. The emphases are

- Wide dynamic range at high speed
- High resolution
- Low power, low voltage and small area

Supervisor: Prof. Yuan.

Ph.D. Student: Johan Piper, started in June 1998 as a Master student for the project and became a Ph.D. student at the beginning of 1999.

Funding source: Faculty.

Industrial partners: Ericsson Mobile Communications, Ericsson Radio Systems, Ericsson Components.

Results: A new type of A/D converter, floating-point A/D converter, has been found to realize very wide dynamic range without very high resolution. Prof. Yuan filed a patent application named "Floating-Point Analog-to-Digital Converters" in August 1998 (No. 9802787-3). A detailed investigation for realizing the new converter has been carried out in 1998. A paper, "A Delay-Balanced Binary-Weighted CMOS Amplifier Tree for a Floating-Point A/D Converter", written by Johan Piper and Jiren Yuan was presented at the 16th Norchip Conference, November 1998. Johan Piper produced a Master Thesis named "Investigation of a Floating-Point A/D Converter" in January 1999. Prof. Yuan informed the ADDA-Club Workshop about the new development of floating-point A/D converter in December 1998.The workshop was participated by researchers from Ericsson Radio Systems, Ericsson Microwave Systems, Ericsson Components, FOA Linköping, Royal Institute of Technology, Linköping University and Lund University. Ericsson Mobile Communications expressed its interest in acquiring the patent in December 1998, and finally signed a contract in February 1999 to take over the patent application. The project will go on with more investigations and implementations.

Very Early Sampling and Digitizing Techniques

Definition: This is a new project designed to address one of several key issues for a high performance A/D converter. The sampling speed of a traditional sampling circuit is limited by the demand on increasingly narrow sampling aperture and small jitter for high frequency signals. Sub-sampling only reduces the sampling rate but not the sampling aperture. It is therefore very difficult for a traditional CMOS sampling circuit to accurately sample signals up to a few hundred MHz, even with sub-micron technologies. It makes early sampling and digitizing extremely difficult. In this project, non-traditional sampling techniques will be investigated to facilitate direct sampling at radio frequency.

Supervisor: Prof. Yuan.

Ph.D. Student: announced early 1999.

Funding source: CCCD.

Industrial partners: Ericsson Mobile Communications, Ericsson Radio Systems, Ericsson Components.

Results: Preliminary investigation has shown that it is possible to directly sample high frequency radio signals by using a non-traditional sampling method. In this method, only desired frequencies are sampled. It means that digitizing can be made at very early stage along with desired filtering function. These features make this method very attractive. Detailed investigation will be carried out as soon as the Ph.D. student becomes available.

Low-Glitch Direct D/A Converters

Definition: This is also a new project designed to realize efficient digital-to-analog conversion. Traditionally, a low-pass filter has to be used after a D/A converter to remove the glitches, and an analog amplifier has to be used to amplify the signal to a wanted power level. The amplifier will unfortunately add non-linearity to the signal. If the signal is going to be transmitted, it must be up-converted to a desirable radio frequency. All these steps are complicated and inefficient. A direct D/A converter is aimed to finish all these steps at

once. The key is to reduce the glitches generated in a traditional D/A converter to a negligible level.

Supervisor: Prof. Yuan.

Ph.D. Student: Yijun Zhou, expected to start in the spring of 1999.

Funding source: Center for Wireless Communication, National University of Singapore, through CCCD.

Industrial partners: Ericsson Mobile Communications, Ericsson Radio Systems, Ericsson Components.

Results: The basic approach has been formulated and simulated preliminarily. Higher efficiency and better linearity are among the advantages. However, it needs to be further investigated. The Ph.D. student will further analyze the approach and make a convincing conclusion. The plan is to demonstrate the approach through practical implementations.

8. Courses

Peter Nilsson (the organizer and main lecturer), Jiren Yuan and Viktor Öwall taught a 4-credit graduate course "Advanced Digital Circuit Design" which also open for industry attendants. The course had 20 students with 10 students from industries AXIS and ECS.

Kaushik Roy, Professor of Purdue University, taught a 12-hour course “Low Power IC Design” for both Ph.D. students and industry attendants, organized by Viktor Öwall. The course had 32 registered attendants with 9 attendants from other universities, LiTH, CTH, and KTH, and 13 attendants from industries, ECS and AXIS.

Lars Sundström taught a 6-credits 4-th year undergraduate course "Radio Electronics (ETI032)" in the autumn of 1998.

Viktor Öwall taught a 4-credit 1st-year undergraduate course "Electronic Circuits" in the spring of 1998.

9. Co-operations and Visits

Industrial Co-operations

Agro Vision, Cadence Design Systems, Ericsson Components, Ericsson Mobile Communications, Ericsson Radio Systems, Telia Research, Sun Microsystems.

AXIS Communications, Ericsson Microwave Systems, SAAB Marine Electronics, Angeles Design Systems, Terracom, Nordic VLSI, Frontec, and HD-Divine.

National University Co-operations

Royal Institute of Technology (KTH), Linköping University (LiTH), Chalmers University of Technology (CTH), and Uppsala University (UU).

International Co-operations

UCLA (USA), Oulu University (Finland) and Victoria University (Australia), concerning RF front-end circuitry.

UCLA (USA), Purdue University (USA), UCB (USA), IMEC (Belgium) and SINTEF (Norway), concerning low power and high performance DSP system design.

UCSB (USA), concerning implementation of synchronization algorithms.

Nordic VLSI (Norway) concerning digital video broadcasting.

NUTEK/TEKES-program INWITE, concerning low voltage integrated receiver and transmitter structure in cooperation with Oulu University (Finland), NOKIA (Finland), Ericsson Radio Systems (Sweden) and Ericsson Mobile Communication (Sweden).

National University of Singapore concerning co-training of Ph.D. students.

National Research Programs

SSF-program Mobile Radio Consortium (replaced by SSF-program Integrated Electronics System), co-operating with Ericsson Radio System, Ericsson Components, Ericsson Mobile Communications, ESD Laboratory/Royal Institute of Technology, Department of Electrical Engineering/Linköping University. Prof. Yuan, Dr. Nilsson and Dr. Sundström joined the SSF-program Integrated Electronics System and wrote the Wireless Access Systems section for the program.

SSF-program Personal Computing and Communication, co-operating with Chalmers University of Technology, Royal Institute of Technology, Linköping University and Uppsala University; Ericsson Radio System, Telia Research, Ericsson Mobile Communications and Bornier. Dr. Öwall has taken part in writing a new project proposal regarding adaptive antenna arrays for PCC.

NUTEK-program Competence Center for Circuit Design, co-operating with Agro Vision, Cadence Design Systems, Ericsson Components, Ericsson Mobile Communications, Ericsson Radio Systems, Telia Research, Sun Microsystems, and National University of Singapore

System-on-Chip (SoC) Design Center, a coming national program. Groups of CCCD, Lund University, were well represented in the program. The representative of Invest in Sweden Agency (ISA) visited CCCD in September 1998. Prof. Yuan joined the nine-people working group for preparing the SoC Design Center recently.

Organizing Conferences and Workshops

A CCCD Workshop was hosted by the department of Applied Electronics, Lund University on February 18, 1998, participated by both member and non-member industries. Each industrial member delivered a speech at the workshop. CCCD (Prof. Yuan) presented its visions and views on future direction. Project results were demonstrated during the workshop.

CCCD co-organized the Competence Center Day held in Lund on October 20, a big event for all competence centers of NUTEK. On the day, Prof. Yuan represented the new center and delivered a speech about its activities today and tomorrow. Project leaders and Ph.D. students demonstrated their projects successfully to the participants.

Lund University hosted the 16th Norchip Conference during November 9-10, 1998. Prof. Yuan was the Chairman of Technical Committee, the session Chairman, and the moderator of panel discussion on “Future Wireless Systems on Chips”. He was elected as the member

of the Management Committee of Norchip Conference and the Guest Editor of the Norchip Special Issue of Analog Integrated Circuits and Signal Processing: an International Journal.

CCCD (Prof. Yuan) hosted an ADDA-Club Workshop on December 11, 1998, participated by researchers from Ericsson Radio Systems, Ericsson Microwave Systems, Ericsson Components, FOA Linköping, Royal Institute of Technology, Linköping University and Lund University. Latest research results were exchanged to promote the research in this field.

Visits

Professor Kaushik Roy, Purdue University, USA visited CCCD in November 11-13, 1998.

Ned Bojic, from Victoria University of Technology, Australia, visited us as a guest researcher during the period December 1998 to February 1999. During that time, he designed a chip for antenna diversity calculations.

Dr. Nilsson visited Professor Keshab Parhi at University of Minnesota, Minneapolis in February 2, 1998.

Dr. Nilsson, Adj. Prof. Torkelson, and Dr. Öwall visited IMEC, in Leuven, Belgium, one day during the spring. The reason was to increase the contacts.

In June 1998, Dr. Sundström and M.Sc. Westesson visited Dr. Rahkonen at Oulu University of Technology to discuss the joint INWITE project. Dr. Sundström and M.Sc. Westesson gave presentations on recent activities on linearization of RF power amplifiers respectively.

Dr. Nilsson and Dr. Öwall visited EKA in Kista one day during the summer to increase the contacts.

M.Sc. Åström visited IMEC, in Leuven, Belgium, two months during the fall to increase the contacts and to learn the OCAPI software.

M.Sc. Berkeman visited IMEC, in Leuven, Belgium, five weeks during the fall to increase the contacts and to learn the ATOMIUM software.

Dr. Nilsson and Dr. Öwall visited IMEC, in Leuven, Belgium, two days during the fall to increase the contacts and to visit the IMEC-Days.

M.Sc. Johansson visited Ericsson Components in Kista two weeks during the fall to increase the contacts and to learn the MDSP software.

Dr. Öwall, M.Sc. Berkeman and M.Sc. Fremrot visited Bell Labs (Lucent Technologies), UCLA and UCB during the fall of 1998.

M.Sc. Lantz visited Catena Microelectronics BV, Delft, the Netherlands, from November 9 to December 10 to investigate design techniques for balanced RF power amplifiers together with Dr. Nordholt.

10. Conferences and Other Activities

Conferences and Workshops

Dr. Sundström attended the INWITE workshop in Stockholm in January 1998 to present recent progress within the cooperation project together with Dr. Timo Rahkonen, Oulu University, Finland.

Dr. Floberg attended the NUTEK workshop in Stockholm, January 1998, on Integrated Technologies for Wireless Telecommunication (INWITE), where he presented the activities in the pre-study on "Integrated Voltage Converters for CMOS Radio". He also visited Ericsson Components and Ericsson Radio Systems.

Dr. Floberg, Dr. Sundström, Dr. Nilsson and M.Sc. Johansson attended the IEEE International Solid-State Circuits Conference ISSCC'98 in San Francisco in February 1998. Dr. Floberg and Dr. Sundström also visited Prof. M. Ismail at the Ohio State University, Columbus, Ohio where they gave presentations on the activities in the Analog and RF Circuits group within CCCD.

Dr. Floberg was an invited speaker at the Electronic Design Automation Conference, EDA-98 in Stockholm, April 1998, where he gave a presentation on "Mixed-Signal Noise Coupling Mechanisms in CMOS Integrated Circuits".

Dr. Chen and M.Sc. Johansson attended the AACD'98 Workshop on Advances in Analog Design in Copenhagen, April 1998.

Dr. Sundström and M.Sc. Shi attended the International Symposium on Circuits and Systems, ISCAS'98, in Monterey in May 1998.

Dr. Nilsson, Dr. Sundström and M.Sc. Stenman attended the Mobile Radio Consortium Workshop in Kista, June 1998. Dr. Sundström and M.Sc. Stenman gave presentations on integrated circuits for RF power amplifier linearization and impedance control of low-noise amplifiers in CMOS, respectively.

Dr. Nilsson and M.Sc. Åström attended the Mobile Radio Consortium workshop in Kista, in June 1998, and M.Sc. Åström gave a presentation "Implementation of Turbo Coding Algorithms for Channel Codecs".

Prof. Yuan attended the 18th Nordic Semiconductor Meeting in August 1998 and presented a paper named "Multigigahertz TSPC Circuits in Deep Submicron CMOS" in Linköping in August 1998.

Dr. Sundström, Dr. Nilsson, Dr. Floberg, M.Sc. Sandström and M.Sc. Johansson attended "Mikroelektronik-98" in Uppsala in August 1998, a workshop gathering Swedish research groups within the Micro Electronics research program funded by the Foundation for Strategic Research. This was followed by an evaluation by international experts where the Mobile Radio Consortium was highly rated.

A large number of CCCD personnel attended the Competence Center Day of NUTEK, Lund, October 20, 1998.

Dr. Floberg and Dr. Chen attended the International Workshop on Symbolic Methods and Applications to Circuit Design in Kaiserslautern, Germany, October 1998, where Dr. Chen gave a presentation on "A Unified Symbolic Method for Steady-State Analysis of Nonlinear Circuits and Systems".

Dr. Nilsson and M.Sc. Johansson visited the PATMOS'98 Conference in Lyngby, Denmark.

A large number of CCCD personnel attended the 16th NORCHIP Conference, Lund, November 9-10 1998. Five papers were presented from CCCD.

Dr. Sundström attended the INWITE workshop in Helsinki in December 1998 to present recent progress within the cooperation project together with Dr. Timo Rahkonen, Oulu University, Finland.

Prof. Torkelson and Dr. Öwall visited the DATE'98 Conference in Paris, France.

Dr. Öwall , M.Sc. Berkeman and M.Sc. Fremrot visited ISLPED'98 Conference in Monterey, USA.

Seminars

Prof. Mani Srivastawa from UCLA, USA, visited CCCD June 24-26 and held a seminar on "Low-power and Adaptive Wireless Multimedia Systems" on June 24, 1998.

Dr. Lars Svensson from ECS held a seminar on Adiabatic Circuit Design entitled "AC-1, a Clock-Powered Microprocessor" on March 6, 1998.

Dr. Nilsson held a seminar on "Digital Circuit Design in the Wireless Communication Area", University of Minnesota, USA, February 30, 1998.

Dr. Nilsson held a seminar on "Digital Circuit Design in the ASIC/DSP group at Lund University" at the ATTO Workshop, Ericsson Components, Sweden, April 2, 1998.

Dr. Jennings from LTU, Luleå, and Haifa, Israel, held a seminar "A Compiler for DSP Cores: Is That what is Really Needed?" on June 6, 1998.

Prof. Yuan held a seminar "A/D and D/A for Digitized Software Radio" at Ericsson Component, Kista, on June 16, 1998.

Dr. Nilsson, Dr. Sundström, M.Sc. Nord, M.Sc. Johansson, M.Sc. Åström, M.Sc. Stenman and M.Sc. Sandström presented posters, regarding the research conducted with funding from the SSF Microelectronics Program, in Uppsala, August 1998.

Prof. Yuan held a seminar titled "VLSI-the Heart of Modern Electronics – Today and Tomorrow" at Lund University, September 1998.

Prof. Yuan held a seminar titled "Floating–Point Analog-to-Digital Converter – an Approach to Wide Dynamic Range" at ADDA-Club Workshop, Lund, December 1998.

Dr. Öwall held a presentation regarding the research conducted with funding from the NUTEK Telecommunication Program in Gothenburg.

Other Activities

Dr. Öwall, Dr. Floberg, M.Sc. Fremrot, M.Sc. Olsson, and M.Sc. Lantz attended the PCC Circuit Design Kick off meeting in Arild, March 25-26, 1998. The meeting was arranged by Dr. Öwall.

During 1998, Dr. Floberg supervised two product oriented M.Sc. projects in collaboration with industry: Electronic Radon Meter (Radonanalys-GJAB) and Digital Microphone Interface (Milab Microphones AB). The former project was rewarded a scholarship of 100.000 SEK from Teknikbrostiftelsen in Lund, June 1998.

In June 1998, M.Sc. Westesson, attended a crash course on “RF circuits and radio architectures” in Helsinki, organized by EUROPRACTICE under the special Analog Thematic Training Program.

Prof. Yuan reviewed eight papers, three for IEEE Journal of Solid-State Circuits, four for IEE Electronics Letters, and one for IEE Proceedings–Circuits, Devices and Systems, during 1998.

Dr. Nilsson was a referee for Computers & Electrical Engineering: an international Journal, Pergamon an Imprint of Elsevier Science Ltd.

Dr. Sundström reviewed two papers for IEEE Transactions on Vehicular Technology and one paper for IEE Electronics Letters.

Dr. Nilsson and Dr. Öwall were Session Chairmen at the NRS'98 Symposium.

Dr. Öwall is the project manager in the PCC circuit-design project.

Dr. Nilsson is the project leader for the MRC demonstrator project.

Dr. Öwall, Dr. Nilsson, M.Sc. Olsson, and M.Sc. Lantz attended the PCC Circuit Design meeting at HUT in Esbo, Finland, December 16-17 1998. The meeting was arranged by Dr. Öwall.

11. Budget for 1999

CCCD Budget for 1999 is listed in Tables 2 and 3.

Table 2 CCCD Budget for 1999

CCCD budget for 1999	Funds	Emoluments Lunds Univ	Emoluments other	Sum
Incomes				
Ericsson Radio	1000		200	1200
Ericsson Mobile	1000		500	1500
Ericsson Components	350		150	500
Telia Research	500			500
Agro Vision			200	200
Cadence			1000	1000
Nat University of Singapore	334		766	1100
Lund University		2900		2900
NUTEK	4000			4000
Sum	7184	2900	2816	12900
Costs				

Salary	3043	965	1716	5724
Travel	409	102		511
Equipment	426	1120	1100	2646
VAT 8% external funds 1)	255			255
OH-costs; University	717	253		970
OH-costs; Rent	547	193		740
OH-costs; Department	623	220		843
Sum	6020	2853	2816	11689

1) 8% VAT is automatically deducted from all non-governmental funds by Swedish universities.

Table 3 Detailed Budget of CCCD for 1999

	%	Salary	Travel	Equipment	OH Costs	Sum
Senior						
Jiren Yuan	100					
Viktor Öwall	30					
Peter Nilsson	45					
Lars Sundström	70					
Henrik Sjöland	100					
He Shousheng 2)	20					
Piero Andreani	40					
Sum	405	2047	267	201	1175	3689
Ph.D. students						
Anders J Johansson	80					
Roland Strandberg	80					
Johan Piper	80					
Shi Bo	100					
Vacant	100					
Vacant	80					
Vacant	80					
Vacant	80					
Sum	680	1455	204	340	1106	3105
Administration/Technical						
Stina Ahlenius	50					
Lizette Arfvidsson/C Hollingby	25					
Qualified tech staff	60					
Sum		506	40	105	271	922
Emoluments						
Staff Ericsson Radio 1)		200				200
Staff Ericsson Mobile 2)		500				500

Staff Ericsson Comp 3)		150				150
Lund University 4)				900		900
Agro Vision		100		100		200
Cadence				1000		1000
Nat university of Singapore 5)		766				766
Sum		1716	0	2000	0	3716
VAT 8%						255
Total sum		5724	511	2646	2552	11687

1) Estimated costs from Ericsson Radio employee working at the department (Torkelsson).
2) Estimated costs for Ericsson Mobile employees working at the department (Mattisson, Mattsson, Björk and Shousheng).
3) Estimated costs for Ericsson Components employees working at the department (ASIC-DSP staff).
4) Other estimated costs for Lunds University (1952kkr) can be found in salaries, travel-, equipment-, and OH-costs for Ph.D. students and technical staffs.
5) Estimated costs for the Ph.D. students from National University of Singapore working at the department (Shi Bo and one vacant).

12. Publications and Patent

Ph.D. Thesis

Magnus Wiklund, "Electrothermal Simulation in a Concurrent Waveform Relaxation Based Circuit Simulator," Department of Applied Electronics, Lund University, Sweden, No. 5, ISSN 1402-8662, May 1998.

Book

Henrik Sjöland, "Highly Linear Integrated Wide-Band Amplifiers, Design and Analysis Techniques for Frequencies from Audio to RF," Kluwer Academic Publications, ISBN: 0-7923-8407-5, accepted in 1998 and published in January 1999.

Patent Application

Jiren Yuan, "Floating-Point Analog-to-Digital Converter," filed at PRV of Sweden, No. 9802787-3, August 21, 1998. The patent application has been transferred to Ericsson Mobile Communications in February 1999.

Journal Papers and Letters

H. Floberg and S. Mattisson, "Symbolic Analysis of Switched-Capacitor, Networks Using Compacted Nodal Analysis in the s-Domain," *IEEE Transactions on Computer-Aided Design*, 16(10), pp. 1196-1199, October 1997, printed in the spring of 1998.

H. Sjöland and S. Mattisson, "A 100MHz CMOS Wideband IF Amplifier," IEEE Journal of Solid State Circuits, 33(4), pp. 631-634, April 1998.

P. Andreani, F. Bigongiari, R. Roncella, R. Saletti, P. Terreni, A. Bigongiari, and M. Lippi, "Multi-hit Multi-channel Time-to-Digital Converter with +-1% Differential Nonlinearity

and Near-optimal Time Resolution," *IEEE Journal of Solid State Circuits*, 33(4), pp. 650-656, April 1998.

P. Andreani and S. Mattisson, "Characteristic Polynomail and Zero Polynomial with the Cochrun-Grabel Method," *Int. J. Circ. Theor. Appl*., 26, pp. 267-292, 1998.

H. Sjöland and S. Mattisson, "Intermodulation Noise Related to THD in Dynamic Nonlinear Wideband Amplifiers," *IEEE Transactions on Circuits and Systems*, 45(7), pp. 873-875, July 1998.

H. Sjöland and S. Mattisson, "A 160MHz Bipolar Wideband IF Amplifier," *IEEE Journal of Solid State Circuits*, 33(10), pp. 1555-1558, October 1998.

B. Shi and L. Sundström, "Chip for Linearization of RF Power Amplifiers Using Power Feedback," *Electronics Letters*, vol. 34, no. 22, pp. 2117-2119, October 1998.

Jiren Yuan and Christer Svensson, "Multigigahertz TSPC Circuits in Deep submicron CMOS," to appear in *Physica Scripta, An International Journal for Experimental and Theoretical Physics*, accepted in October 1998.

Pontus Åström, Peter Nilsson, and Mats Torkelson, "Power Reduction in Custom CMOS Digital Filter Structures," *Analog Integrated Circuits and Signal Processing: an International Journal,* Kluwer Academic Publishers, pp. 97-105, January 1999.

W. Chen, H. Floberg and S. Qiu, "A New Analytical Method for Analysis and Design of Class E Amplifiers Taking into Account Switching Device ON Resistance," *International Journal of Circuit Theory and Applications*, submitted in March 1998 and accepted after revision.

H. Sjöland, "An Inductorless 300MHz Wideband CMOS Power Amplifier," *Analog Integrated Circuits and Signal Processing,* accepted in 1998 for publication.

International Conference Papers

W. Chen, M. Wiklund, and H. Floberg, "Mixed-Signal Noise Coupling Mechanisms in CMOS Integrated Circuits," *EDA-98, Electronic Design Automation Conference*, April 1998.

Shousheng He, and Mats Torkelson, "Design and Implementation of a 1024-point Pipeline FFT Processor," *Proceedings of the IEEE 1998 Custom Integrated Circuits Conference (CICC'98),* pp. 131-134, May 11-14, 1998, Santa Clara, California, USA.

Shousheng He, and Mats Torkelson, "Simulation of Wideband Mobile OFDM System for Hardware Implementation," *Proceedings of the 48th IEEE Vehicular Technology Conference (VTC'98),* pp. 2311-2315, May 18-21, 1998, Ottawa, Canada.

Thomas Meincke, Ahmed Hemani, Shashi Kumar, Peter Ellervee, Johnny Öberg, Thomas Olsson, Peter Nilsson, Dan Lindqvist, and Hannu Tenhunen, "Globally Asynchronous Locally Synchronous VLSI Architecture for large high-performance ASICs," Accepted for Publication in the *Proceedings of ISCAS'99*, May 30-June 2, 1999, Orlando, Florida, USA.

Jiren Yuan and Christer Svensson, "Multigigahertz TSPC Circuits in Deep submicron CMOS," *Proceedings of the 18th Nordic Semiconductor Meeting*, pp. C-42, June 7-10, 1998.

Anders Berkeman, Viktor Öwall, and Mats Torkelson, "A Low Logic Depth Complex Multiplier," *Proc. of the 24th IEEE European Solid-State Circuits Conference (ESSCIRC)*, pp. 204-207, September 22-24, 1998, The Hague, The Netherlands.

Thomas Olsson, Carl-Magnus Jönsson, Viktor Öwall and Peter Nilsson, "Hardware Implementation aspects of a detector based on Successive Interference cancellation in a DS/CDMA system," *Proceedings of the PIMRC'98 Conference*, pp. 391-395, September 8-11, 1998, Boston, USA.

Anders Berkeman, Viktor Öwall, and Mats Torkelson, "A Complex Multiplier with Low Logic Depth," *Proc. of the 5th IEEE International Conference on Electronics, Circuits and Systems (ICECS)*, pp. 47-50, September 7-10, 1998, Lisbon, Portugal.

P. Andreani, "A Comparison between Two 1.8GHz CMOS VCOs Tuned by Different Varactors," *Proc. ESSCIRC '98*, pp.380-383, September 1998.

W. Chen, H. Floberg and S. Qiu, "A Unified Symbolic Method for Steady-State Analysis of Nonlinear Circuits and Systems," *SMACD-98, International Workshop on Symbolic Methods and Applications to Circuit Design*, Kaiserslautern, Germany, October 1998.

Shousheng He, and Mats Torkelson, "Designing Pipeline FFT Processor for OFDM (de)Modulation," *Proceedings of the URSI International Symposium on Signals, Systems, and Electronics (ISSSE'98)*, pp. 257-262, September 29 - October 2, 1998, Pisa, Italy.

Shousheng He, and Mats Torkelson, "Effective SNR Estimation in OFDM System Simulation," *Proceedings of the IEEE Global Telecommunications Conference (GLOBECOM'98)*, pp. 945-950, November 8-12, 1998, Sidney, Australia.

Thomas Olsson, Carl-Magnus Jönsson, Viktor Öwall and Peter Nilsson, "Interference Cancellation Detectors in a Hardware Implementation Perspective," *Proceedings of the 16th Norchip Conference*, pp. 58-65, November 9-10, 1998, Lund, Sweden.

Johan Piper and Jiren Yuan, "A Delay-balanced binary-weighted CMOS Amplifier Tree for a Floating-Point A/D Converter," *Proceedings of the 16th Norchip Conference*, pp. 131-138, November 9-10, 1998, Lund, Sweden.

Johan Piper and Pietro Andreani, "A CMOS Current Amplifier for biological Sensors," *Proceedings of the 16th Norchip Conference*, pp. 296-301, November 9-10, 1998, Lund, Sweden.

P. Andreani and S. Mattisson, "A 2.4-GHz CMOS Monolithic VCO with an MOS Varactor," *Proceedings of the 16th Norchip Conference*, pp. 79-85, November 1998, also to appear at ISCAS 1999.

N. Karlsson, M. Svensson, P. Andreani and L. Sundström, "A Chip for Linearization of RF power Amplifiers Using Predistortion Based on a Bit-Parallel Complex Multiplier," *Proceedings of the 16th Norchip Conference*, pp. 66-72, November 1998.

P. Andreani, "A Parasitic Insensitive Transconductance-C Bandpass Filter," *Proceedings of the 16th Norchip Conference*, pp. 34-41, November 1998.

National Conference Papers

Thomas Olsson, Carl-Magnus Jönsson, Viktor Öwall, and Peter Nilsson, "Detectors based on Non-Decision Directed Interference cancellation in a Hardware Implementation

Perspective," *Proceedings of the NRS'98 Symposium,* pp. 219-226, October 19-22, 1998, Saltsjöbaden, Sweden.

Stefan Johansson, Shousheng He, and Peter Nilsson, "Wordlength optimization of an 8K Points FFT," *Proceedings of the NRS'98 Symposium,* pp. 175-178, October 19-22, 1998, Saltsjöbaden, Sweden.

Shousheng He and Mats Torkelson, "Quantitative Distortion Assessment with SNR Estimation in OFDM System Simulation," Proceedings of the NRS'98 Symposium, pp. 179-186, October 19-22, 1998, Saltsjöbaden, Sweden.

Thomas Olsson and Peter Nilsson, "Distributed Asynchronous Custom DSP Systems Applied on Successive Interference Cancellation," *Proceedings of the PCC Workshop,* pp. 57-61, November 2-3, 1998, Upplands Väsby, Sweden.

Per Fremrot and Viktor Öwall, "Architectural Partitioning for Embedded Systems," *Proceedings of the PCC Workshop,* pp. 62-63, November 2-3, 1998, Upplands Väsby, Sweden.

Matin Lantz and Henrik Floberg, "Bipolar Wide-Band High Impedance Bias," *Proceedings of the PCC Workshop,* pp. 69-71, November 2-3, 1998, Upplands Väsby, Sweden.

Jiren Yuan, "High Performance CMOS A/D Converters for Future Wireless access Systems," to appear on *Proceeding of Radio Science and Communication 99*, Karlskrona, Sweden, accepted in December 1998..

Technical Reports

W. Chen and H. Floberg, "Substrate Noise in Mixed-Signal ICs - Modelling, Measurement and Reduction Techniques," Department of Applied Electronics, Lund University, Lund, March 1998.

Jiren Yuan, "A/D Converter Presenting Constant Resolution for Input signals with Very Large Dynamic Range," Department of Applied Electronics, Lund University, July 1998.

Peter Nilsson, Lars Sundström, Jiren Yuan, and Viktor Öwall, "Feasibility Study," SAAB Marine Electronics, October 29, 1998, Gothenburg, Sweden.

Master Theses

We have been coordinators for several master thesis projects carried out at Ericsson Mobile Communications. A number of the master theses below are the results of these projects.

Thomas Olsson and Carl Magnus Jönsson, "Hardware Implementation Aspects of a Detector Based on Successive Interference Cancellation," Master´s thesis, Department of Applied Electronics, Lund University, January 1998.

N. Karlsson and M. Svensson, "An RF Power Amplifier Predistorter Chip Based on a Bit-Parallel Complex Multiplier," Master´s thesis, Department of Applied Electronics, Lund University, February 20, 1998.

Carl Christian Lamm, "Improved Spectral Estimation in Speech Coding," Master´s thesis, Department of Applied Electronics, Lund University, April 1998.

E. Westesson, “Design of Integrated CMOS Polynomial Distorter for RF Applications,” Master´s thesis, Department of Applied Electronics, Lund University, May 18, 1998.

Magnus Israelsson, “An ASDSP Implementation of a GSM Correlator using MDSP Methodology,” Master´s thesis, Department of Applied Electronics, Lund University, June 1998.

S. Tzikas and I. Zamudio, “Integrated Circuit Design of a Continuous-Time Bandpass Filter,” Master´s thesis, Department of Applied Electronics, Lund University, September 9, 1998.

Johan Piper, “Investigation of a Floating-Point A/D Converter,” Mater´s Thesis, Department of Applied Electronics, Lund University, January 18,1999.

Jiren Yuan
Professor and Director of CCCD
Activity Report 1998, CCCD
Lund, March 2, 1999