

CERES

Centre for Research on
Embedded Systems

Presentation and
Activity Report 2014-2015



HALMSTAD
UNIVERSITY

CERES

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Embedded Systems

Presentation and
Activity Report 2014-2015

Knowledge Foundation ><



Cover Photo

NAO is a humanoid robot being used in research and education worldwide. At Halmstad University it is most used by the group's working with Model-based Methods for Cyber-Physical Systems. The nice and photogenic robot has as a result of the groups work, been visible in several TV shows during the last years. A good Ambassador for CERES!

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CERES

Centre for Research on Embedded Systems

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Preface

Welcome to the activity report of the Centre for Research on Embedded Systems (CERES) for the period of 2014 to 2015!

From 2003 to 2013, CERES had been generously supported by profile grants from the Knowledge Foundation with the goal of establishing a stand-alone research center. We are now excited to inform you through this report that this goal has been fulfilled and CERES has become a center of excellence in research with a stable profile of research, co-production with industry, and a balanced portfolio of funding sources.

In this report, we give an overview of our broader research environment on Embedded Intelligent Systems (EIS), an overview of CERES in retrospect and a summary of our vision and mission for the future of CERES. We then provide an outline of our research profile and research collaboration.

Throughout the years, CERES has established and maintained an extensive network of industrial contacts. In this report you see a glimpse of the most prominent examples of such contacts and testimonials from some key people in our partner institutes.

CERES is a research center but has vigorous contributions to our educational profile. Hence, we dedicated part of this report to our contribution to the educational programs at the School of Information Technology.

CERES builds upon a growing team of strong researchers; we devote a part of this report to introduce our new colleagues.

As stated at the outset, we believe that CERES is now stand-

ing firmly and is growing vigorously. We extend our warmest invitations to you to visit us and to collaborate with us in order to create a wider and deeper network of alliance in the area of cooperative embedded systems. Together we become much stronger.

Enjoy reading our report and welcome to CERES!



Mohammad Mousavi,
Professor and theme leader for
Cooperative Embedded Systems

CERES – 12 years of Excellence and Counting

CERES was established 12 years ago (in 2003) with the vision to create a center of excellence on cooperative embedded systems. Throughout these years, CERES has become such a center of excellence gathering an international team of renowned researchers covering the different subfields of embedded systems research. CERES has now become a point of strength in the international embedded systems research landscape. It has also become a major player in the profile and strategic development of Halmstad University, for example by hosting a major part of the PhD education in Information Technology and by being a leading player in the University's strategic research initiative, Research for Innovation. Also, with its strong record of spin-off companies from the embedded systems area, CERES is considered vitally important for the University's profiling as an innovation-driven university.

Figure 1 depicts the increasing trend in the research funding for CERES as an indication of its steady growth since its establishment. The increase in funding has been coupled with sustained development in expertise both in terms of the number of researchers and the research areas covered by them. We have focused on internationalization for the past few years and due to that, we could also expand our network of international academic collaborators and partner companies extensively.

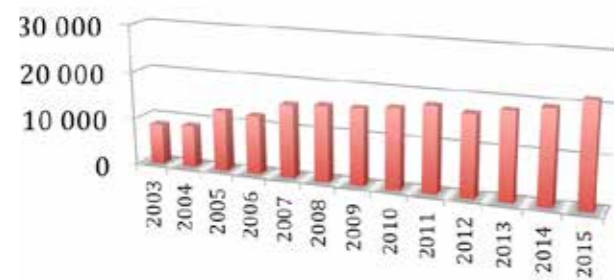


Figure 1: Research Funding in Thousand Swedish Kronor

CERES has moved in the recent years to diversify its funding portfolio in order to ensure a robust and sustainable growth. Figure 2 and Figure 3 provide an overview of our different sources of funding in 2014 and 2015, respectively. As it can be seen, CERES has come a long way from being solely dependent on Knowledge Foundation research funding and

currently secures close to 50 percent of its research funding from other sources. This is even more remarkable, once we consider that the total research funding of CERES has almost tripled since 12 years ago. Building upon a successful past, we are looking forward to a bright future!

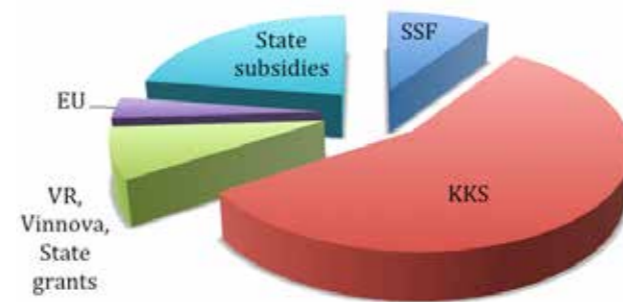


Figure 2: Distribution of Funding Sources in 2014



Figure 3: Distribution of Funding Sources in 2015 (Prognosis)

” Building upon a successful past, we are looking forward to a bright future!



CERES – Vision and Strategy

Vision

CERES will be among the top five European centers of excellence in cooperative embedded systems. It will provide innovative system-level and multi-disciplinary solutions to societal challenges in close collaboration and co-production with its industrial and academic partners.

Strategy

To implement this vision, we have identified the following classes of strategic activities, which are briefly explained below and are elaborated throughout this report:

- **Excellence in Research:** we carry out research at the highest international level in close collaboration with our partners, both at Halmstad University and worldwide. We publish our results in the best academic outlets, with a particular emphasis on publishing in journals with high quality standard. We cover a broad spectrum of research from fundamental areas contributing to embedded systems to applied technological research that can lead to new products by our industrial partners.
- **Coproduction with Industry:** Our research, even the most fundamental part, is motivated by societal and industrial challenges and has the prospect of applicability. Our industrial partners play a key role in providing us with their challenges and we develop our applied research in full collaboration with them. Our network of industrial partners is a key asset and we maintain and extend this invaluable resource through coproduction that leads to tangible added value for them.
- **Competence Development:** We bank on the expertise provided by our colleagues and collaborators. We plan to help our existing colleagues develop their expertise even further through both inbound and outbound guest researchers at various levels and extend our pool of expertise by strategic recruitments. We constantly develop leadership skills at CERES by organizing and participating in management and leadership workshops.

- **Research-Based Education:** One of the key functionalities of our institution is to serve as a knowledge-base and disseminate this knowledge through educational programs. We constantly innovate our educational programs and develop programs that meet societal needs in our areas of expertise.

Research Agenda

CERES aims at covering a broad spectrum of research areas within cooperative embedded systems in order to offer holistic and system-level solutions. To have sufficient impact, however, we also need to have a critical mass and sufficient depth in each of the sub-areas present at CERES. Hence, we have decided to put particular emphasis on the following three research areas:

- Model-based Methods for Cyber-Physical Systems,
- Parallel Architectures and Tools, and
- Real-time Communication.

In addition, we participate in a number of interdisciplinary research areas, such as Internet of Things and Health Technology. Another exciting carrier for our research and coproduction with industry is the brand new Electronics Centre, which celebrates its grand opening in September 2015.

In the remainder of this report, we first present an overview of the general research landscape at our research school's environment, called Embedded Intelligent Systems (EIS). Subsequently, we offer a detailed introduction to our three main research areas. Finally, we provide a glimpse of our interdisciplinary research areas, our research collaborations, and our brand new Electronics Centre.

EIS - Halmstad Embedded and Intelligent Systems Research

The overall mission of School of ITE and its research environment EIS (Halmstad Embedded and Intelligent Systems Research) is to provide knowledge (solutions, theories, methods, tools) and competence (graduates) relevant to the creation of innovative IT products and services. The knowledge and competence range from enabling technologies, via systems solutions and applications, to valuable IT use. By this, ITE/EIS intends to contribute to increased competitiveness of Swedish industry and increased quality and relevance of the university education. The disciplinary coverage of IDE/EIS is visualized in Figure 1. Through our joint competences we can be an attractive partner and deal with projects where the whole range is treated, from enabling technologies, like low-power technologies and semiconductor sensors, to value-adding IT use, considering user aspects. In between, system and application aspects are treated, e.g. intelligent algorithms, application-specific computer architectures and languages, and efficient communication technologies. Rather than covering everything, our focus is on cooperating embedded systems for intelligent applications.



Magnus Jonsson, professor and chairman of EIS steering group.

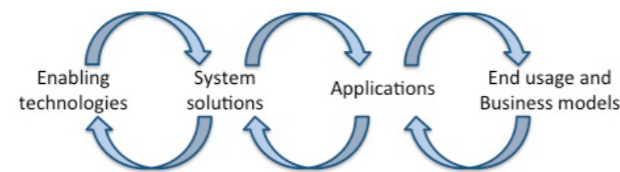


Figure 4. Embedded and intelligent systems research, ranging from enabling technologies, via systems solutions and applications, to business models.

The vision of ITE/EIS is to be:

- a preferred partner in research projects,
- an internationally recognized research environment
- an attractive environment for education
- well-known for our innovation profile in research
- a working environment characterized by equality and diversity

The overall goal is to, within the area of embedded and intelligent systems, make ITE/EIS a nationally leading and internationally recognized environment for research and education, characterized by well-developed cooperation with industry and society. ITE/EIS shall be considered a leading centre of excellence on embedded and intelligent systems within Europe.

One of the general strategies of EIS is to remain and further strengthen as a complete academic environment. We shall not only be a complete academic environment from the perspective of the whole school, but also for the different parts. By building strengths in selected research themes and application areas, we shall be an attractive partner. In addition to offering education on all levels, the school shall be characterized by components typical for a strong, complete academic environment, e.g. with a strong international touch, with a good balance of staff at different levels, and having at least parts with research at an excellent international level. As a strong and profiled research environment, we should also be able to attract funding in terms of large research programs.

Model-based Methods for Cyber-Physical Systems

There is growing consensus that many of the most important future innovations will involve closely coupled computational (or “cyber”) and physical components, often in a networked or distributed setting. Cyber-Physical Systems (CPSs) is a term coined by Helen Gill in 2006 to describe such systems, and has served as a flag for a large community of researchers working in this area. At Halmstad this flag has so far been carried by Professors Mousavi and Taha, both of whom develop model-based methods that enable innovation in CPSs.

New methods are being developed for specification, simulation, and testing. Specification is the process of creating the models, which serve as the central artifact in model-based methods. Simulation provides a mechanism for “animating” or “running” models, and provides a fundamental tool for understanding the dynamics of a given model. At Halmstad, focus has been on rigorous simulation methods which take into account round, discretization, and quantization errors and are guaranteed to produce correct results. Research on testing focuses on developing notions of conformance of software product lines and hybrid systems, as well as test-case generation. Application areas include robotics, automotive, and healthcare systems.



Senior staff members:

Veronica Gaspes, associate professor
Wojciech Mostowski, assistant professor
Mohammad Mousavi, professor
Walid Taha, professor

Junior members:

Ferenc Bartha, postdoctoral researcher, Rice University
Adam Duracz, Ph.D. Student
Xu Fei, research assistant
Sebastian Kunze, Ph.D. Student
Masoumeh Taromirad, postdoctoral researcher
Mahsa Varshosaz, Ph.D. student
Yingfu Zeng, Ph.D. Student, Rice University

To the left: Professor Walid Taha and the humanoid Jonson

Research Project

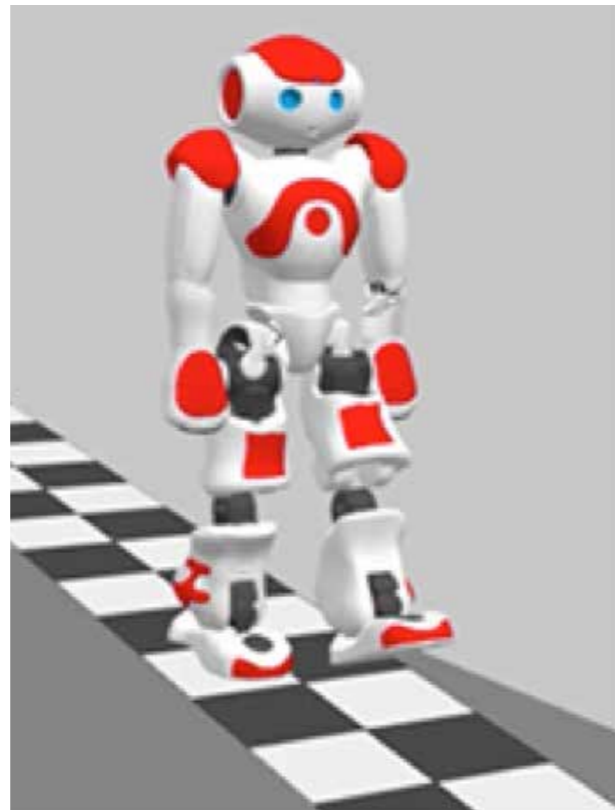
Model-based Methods for Cyber-Physical Systems

A Cyber-Physical Approach to Robot Design

In many important situations, analytically predicting the behavior of physical systems is not possible. For example, the three dimensional nature of physical systems makes it provably impossible to express closed-form analytical solutions for even the simplest systems. This has made experimentation the primary modality for designing new cyber-physical systems (CPS). Since physical prototyping and experiments are typically costly and hard to conduct, "virtual experiments" in the form of modeling and simulation can dramatically accelerate innovation in CPS. Unfortunately, major technical challenges often impede the effectiveness of modeling and simulation. The project develops foundations and tools for overcoming these challenges. The project focuses on robotics as an important, archetypical class of CPS, and consists of four key tasks:

1. Compiling and analyzing a benchmark suite for modeling and simulating robots,
2. Developing a meta-theory for relating cyber physical models, as well tools and a test bed for robot modeling and simulation,
3. Validating the research results of the project using two state-of-the-art robot platforms that incorporate novel control technologies and will require novel programming techniques to fully realize their potential
4. Developing course materials incorporating the project's research results and test bed.

With the aim of accelerating innovation in a wide range of domains including stroke rehabilitation and prosthetic limbs, the project is developing new control concepts and modeling and simulation technologies for robotics. In addition to new mathematical foundations, models, and validation methods, the project will also develop software tools and systematic methods for using them. The project trains four doctoral students; develops a new course on modeling and simulation for cyber physical systems that balances both control and programming concepts; and includes an outreach component to the public and to minority-serving K-12 programs.



Partners:

Rice University, Texas A&M, The MathWorks

Funding:

United States National Science Foundation and Halmstad University

” Unfortunately, major technical challenges often impede the effectiveness of modeling and simulation.

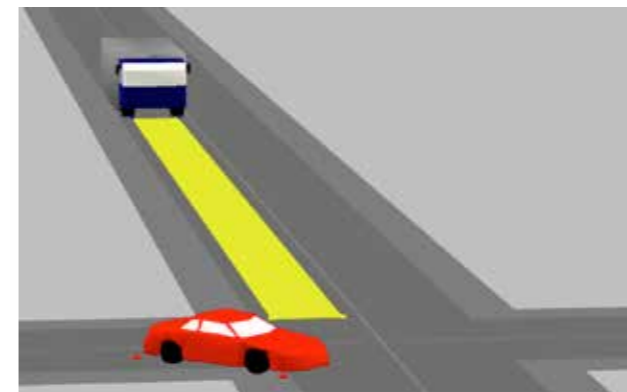


Research Project

Model-based Methods for Cyber-Physical Systems

Next Generation Test Methods for Active Safety Functions

The NG-Test is supported by Vinnova under the Strategic Vehicle Research Partnership (FFI) initiative. The goal of the project is to develop next-generation methods to address the challenge of safety testing for advanced driving functions, such as automatic collision avoidance and similar active safety functions.



Partners:

Volvo AB, SP, Volvo Cars, Autoliv, VTI, Chalmers

Funding:

Vinnova under the Strategic Vehicle Research Partnership (FFI)

The project explored several different approaches to next-generation testing, including the use of robotic drivers, balloon cars (which reduce damage from collisions in physical tests), immersive car simulators, virtual reality, and rigorous simulation. The latter, which was a significant area for Halmstad's work, focused on developing tools (inside Acumen) that enabled rigorous simulation of systems with uncertainty. A central case study in this work (depicted in the visualization above) was to study how rigorous simulation can be used to determine upper bounds on the severity and/or damage caused by a collision in certain scenarios, taking into account the variability in the performance of obstacle sensors and in brake actuation. Halmstad's involvement led in NG-Test to the consideration of formal verification tools (such as rigorous simulation) as part of the possible future tools to enable next-generation testing. The project also helped Halmstad's researchers better understanding the computation costs involved in rigorous simulation, as well as the limits on the complexity of systems that can be analyzed today using rigorous simulation.

In addition to Halmstad University, the project involved several partners, including Volvo AB, SP, Volvo Cars, Autoliv, VTI, and Chalmers. From Halmstad, Dr. Philippsen (now at Google Technologies), Professor Taha, Professor Larsson, Dr. Jawad Massood, and Doctoral student Adam Duracz were involved. The Halmstad team collaborated most closely with Henrik Eriksson from SP and Christian Grante from Volvo AB.



Research Project

Model-based Methods for Cyber-Physical Systems

AUTO-CAAS - Automated Consequence Analysis for Automotive Standards

The Automotive Open System Architecture (AUTOSAR) standard is gaining momentum with several automotive manufacturers and there is a growing trend towards new vehicle platforms based on the latest versions of this standard. The standard enables manufacturers to allow Tier-1 suppliers to contract arbitrary Tier-2 software developer for ECUs, as long as the developed software conforms to the specified behavior according to AUTOSAR. This is in clear contrast to earlier situation, in which a preferred Tier-2 developer was appointed to develop software for all Tier-1 hardware suppliers. This paradigm shift brings about economical and financial benefits (both for suppliers and manufacturers). However, it also introduces certain risks and challenges.

The AUTOSAR standard is complex and does leave room for interpretation and optimizations. In order to be competitive, Tier-2 developers strive after implementing several optimizations and utilizing room for interpretation of the standard to make their product out-perform the competition.

The goal of this project is to exploit the technology of model-based testing in order to detect deviations from the AUTOSAR standard and furthermore trace the consequences of such deviations into visible deviating behavior (failures). To this end, we will use and enhance the model-based testing framework developed at QuviQ to detect deviations from the AUTOSAR standard. This framework is, for example, used by SP (Technical Research Institute of Sweden) to certify software delivered to Volvo Car Corporation. As noted before, one of the major obstacles in using the current model-based framework is the different interpretations of the standard. Unless the consequences of these interpretations are properly analyzed, such variations are justified by the developers. This poses a major challenge for the widespread application of the standard as a model for certifying components, modules, ECUs and vehicle functions.



Members:

Thomas Arts, Co-Founder and CTO of QuviQ AB
 John Hughes, Co-Founder and CEO of QuviQ AB, Professor at Chalmers University of Technology
 Wojciech Mostowski, Assistant Professor, AUTO-CAAS Project
 Mohammad Mousavi, Group Leader, Principal Investigator for AUTO-CAAS Project
 Michael Svenstam, ArcCore AB

Partners:

ArcCore AB
 QuviQ AB
 Halmstad University



Research Project

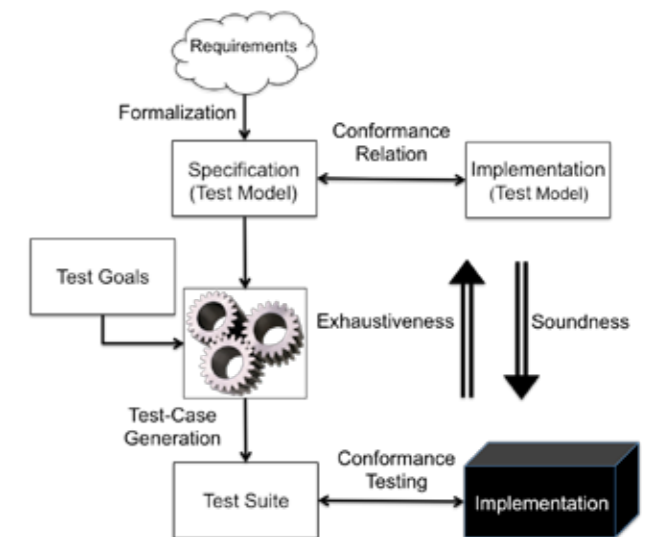
Model-based Methods for Cyber-Physical Systems

EFFEMBAC - Effective Model-Based Testing of Concurrent Systems

A promising solution to testing issues lies in automated Model-Based Testing processes. A major obstacle in widespread application of Model-Based Testing is the lack of abstract yet accurate models in industrial practise. Therefore, we would like to use domain-specific languages to create an abstract system model and augment this model with information from the implementation to steer the test-case selection and generation algorithms.

The general objectives of our research goals include:

- Integrating domain-specific models into a Model-Based Testing process.
- Augmenting domain-specific models with structural information.
- Devising mechanised test-selection criteria.
- Enabling compositional testing.
- Defining practically sensible notion for test-adequacy.
- Devising concrete design for testability guidelines.



Members:

Sebastian Kunze, Ph.D. Student
 Mohammad Reza Mousavi, Principal Investigator
 Masoumeh Taromi Rad, Postdoctoral Researcher

Partners:

University of Illinois, USA
 Reykjavik University, Iceland
 Radouboud University Nijmegen, The Netherlands
 Embedded Systems by TNO, The Netherlands
 Halmstad University

Funding and duration:

A 5-year project funded by the Swedish Research Council





Towards a **Parallel** Future

The embedded computing future is parallel. In the devices and infrastructure around us, be it for communication, transport, health, security, manufacturing or entertainment, high performance computers for signal processing do a critical job – often with very low power budgets. Increased parallelism is the only way ahead for providing significant performance improvement while keeping the energy use and heat dissipation under control. Manycore processor architectures offer scalable parallelism and the performance needed for implementation of the required functionality. However, the increasing programming complexity of such highly parallel devices is a challenge. Industry need to take a jump in terms of re-targeting from existing software development solutions to solutions compatible with evolving manycore platforms, i.e., not just one parallel platform but a sequence of ever more parallel architectures. In the world after the jump-to-parallelism, software portability, program correctness and programmer productivity demand that programs are written in a high-level language capable of expressing application-level parallelism, while abstracting away platform dependent physical parallelism.

A number of projects within the CERES sub-area Embedded Parallel Computing have been set up to address these challenges.

Two projects, which finished already in 2013, laid the foundation for our research in this area:

The Knowledge Foundation funded project **Jump to Manycore Platforms** (JUMP) (2012-2013) identified future challenges in advanced signal processing systems. The research analysed how these challenges match with future hardware development and which programming methods and tools need to be developed to bridge the gap to the expected future. The project **Smart Embedded Multicore Systems** (SME-CY) (2010-2013) engaged Halmstad University and 28 other academic and industrial partners from nine European countries as part of the European strategic research programme ARTEMIS. The project developed multi-core technologies in the form of new parallel architectures and, in particular, associated supporting tools in order to master complete system design.

Senior staff members:

Tomas Nordström, Prof.
 Bertil Svensson, Prof.
 Verónica Gaspes, Associate Prof.
 Amin Farjudian, Assistant Prof.
 Zain Ul-Abdin, Assistant Prof.

Junior staff members:

Erik Hertz, PhD Student
 Essayas Gebrewahid, PhD Student
 Sebastian Raase, PhD Student
 Süleyman Savaş, PhD Student



Research Projects

Parallel Architecture

High Performance Embedded Computing (HiPEC)

The project High Performance Embedded Computing (HiPEC) (local project leader, Verónica Gaspes) is funded by the Foundation for Strategic Research (SSF) and is run jointly with the two ELLIIT partners Lund University and Linköping University during 2011-2016. The project addresses reconfigurable array processor architectures as well as software tools for their programming. Two massively parallel execution platforms with powerful computing nodes and hierarchical interconnection structures suitable for streaming applications are developed and studied. The software development approach is based on using the CAL actor language for application programming as well as the development and use of tools for timing and energy analysis at early design stages. Combining both hardware and software experts in the same project provides a strong basis for covering the whole spectrum of this new technology. The group from CERES works on developing the code generation parts of the tool-chain, starting from the CAL actor machine intermediate representation and creating backends for the developed architectures but also for commercial architectures. The work usually ends up generating code that the native tools of the target architectures can handle; in general this is C code for each individual core and using special libraries for communication and coordination of the cores. Working with intermediate representations on several levels is one way to increase portability of the tools.

Streaming Applications on Embedded High-Performance Commercial Platforms (STAMP)

The project Streaming Applications on Embedded High-Performance Commercial Platforms (STAMP) (local project leader, Zain Ul-Abdin), 2013-2014 is an ELLIIT-sponsored project in collaboration with the Computer Science department at Lund and can be seen as a spinoff of the HiPEC project. While the HiPEC project has a focus on the design

of new hardware architectures and efficient mapping of applications on these, STAMP has a focus on the efficient use of architectures that are emerging on the commercial market at an increasing pace. The STAMP project aims to complete the design flow for compiling and executing CAL applications targeting selected emerging commercial architectures, thus leveraging the tool-chain developed in HiPEC. Currently we have developed backends for Adapteva's Epiphany and Ambric manycore architectures.

Embedded Streaming Computations on Heterogeneous Energy-efficient aRchitectures (ESCHER)

The project Embedded Streaming Computations on Heterogeneous Energy-efficient aRchitectures (ESCHER) (project leader, Tomas Nordström), 2014-2016, is a Knowledge Foundation funded project run in collaboration with the companies SAAB, Xcube, ImaComp, and Adarate. It aims to develop a tool framework that can support programmer productivity and program portability for streaming applications running on heterogeneous manycore architectures while maintaining state-of-the-art performance and power efficiency. The design and implementation of such a framework needs a coordinated effort to co-develop both the hardware architectures and the application development environment. With regard to hardware, the focus is on how parallel heterogeneous architectures should be organized, designed and evaluated, as well as how they should interface with the application development tools and frameworks. The software aspect will focus on how to develop real-time streaming applications at a high level of abstraction, develop a single application source that can target a multitude of heterogeneous architectures, utilize domain knowledge to better target a diverse set of architectures, and support an efficient design process taking into account resource efficiency and real-time aspects.

Real-time Communication

This research group has contributed extensively to the communication area, especially real-time communication. Our main research areas are on communication methods and protocols, channel coding and diversity, timing analysis as well as network architectures for communication within and between embedded systems, utilizing either wired or wireless communication. We have been contributing to wireless industrial real-time communication already in the late 90s. We founded the concept of deadline-dependent coding, and later a framework for reliable real-time communication, later adapted for, e.g. multi-channel networks using IEEE 802.15.4. Within the field of wireless communication for cooperative traffic safety applications, we have contributed with results on both centralized and decentralized solutions improving the real-time performance compared to standard IEEE 802.11p. The group is performing research on how to support hard real-time traffic over switched Ethernet – since early 2000, with the first publications in 2002.

Senior Members

Annette Bohm, post doctoral researcher
Magnus Jonsson, professor
Kristina Kunert, assistant professor
Tony Larsson, professor
Alexey Vinel, professor

Junior members

Le-Nam Hoang, Ph.D. student
Marcus Larsson, Ph.D. student
Nikita Lyamin, Ph.D. student
Hawar Ramazanal, Ph.D. student
Benjamin Vedder, Ph.D. student

“We have been contributing to wireless industrial real-time communication already in the late 90s.”

ACDC "Autonomous Cooperative Driving: Communication Issues" (2014-2016)

Vehicular communication using wireless technology is a cornerstone in the design of many important cooperative safety or convenience services offered in today's vehicles, as e.g. lane change assistance or blind spot warnings. A growing application is vehicle platooning, where a caravan of vehicles on the highway can automatically follow a leading vehicle (controlled by a human driver). The next step in the evolution of this application area is fully autonomous driving, which is considered as a strategically important development direction by numerous leading car and truck manufacturers. Although the introduction of fully autonomous vehicles into ordinary city environments still lies far ahead, the automatic operation of vehicles in restricted areas, as e.g. in harbours, storage facilities, or mines, is feasible to some extent already today. However, cooperation between vehicles using wireless communication can enhance the possibilities to a great extent. Autonomous cooperative driving enabled by intervehicle communication has highly demanding operating conditions and generates delay-sensitive data traffic with requirements on high reliability regarding correct data delivery. Achieving this high data reliability within a given time frame is particularly difficult in vehicular networks due to the highly dynamic radio environment encountered by the communicating cars or trucks. There are two main application scenarios under investigation: platooning (road trains) and fully autonomous driving in restricted area like a construction site, a harbor, or a mine. Two main research questions are considered: how can wireless communication enable/enhance autonomous cooperative driving and what application requirements on the communication will there exist in such applications? How can we design and configure communication protocols and methods to fulfill the requirements on dependable wireless real-time communications?

Partners:

Volvo GTT, Volvo Cars, Scania, Kapsch TrafficCom, Qamcom

Research Projects

Real-time Communication

Platooning: Safe and Efficient Integration into the C-ITS Environment

Due to its expected environmental and economic benefits, platooning of trucks is a C-ITS (Cooperative Intelligent Transport Systems) application of particular interest. A platoon is led by a dedicated vehicle operated by a driver, while other platoon vehicles follow the leading vehicle at inter-vehicle gaps of merely a few meters, significantly reducing the fuel consumption. Platooning is considered to be the first viable step towards fully automated driving on our roads and is therefore the focus of various research projects involving major car and truck manufacturers. The published and ongoing work on platooning often treats the platoon as an isolated entity, focusing on intra-platoon communication requirements, while a platoon's interaction with surrounding traffic participants and its effect on and integration into other types of C-ITS applications is not considered. The aim of this project is therefore to investigate the challenges and communication needs of a safe and efficient integration of the platoon into a broader C-ITS context. With an implementation of platooning on our highways just around the corner and other C-ITS safety applications to follow in the near future, an investigation of these issues is of very high interest to vehicle manufacturers.

Partner:

Volvo GTT



Platooning. Illustration from Volvo Car Group.

DEWI

The EU project "DEWI-Dependable Embedded Wireless Infrastructure" with 58 partners from 11 countries deals with the development of wireless sensor networks and applications. It is part of the EU joint undertaking program ECSEL. DEWI deals with more than 20 industry driven application cases for citizens and professional users. The worked out results shall in conclusion be introduced to the public in all of Europe by using clear practical demonstrations in the areas of aeronautics, automobile, railroad and building automation. Furthermore DEWI provides essential contributions to interoperability, standardization and certification of wireless sensor networks and wireless communication.



DEWI consists of 58 partners from 11 countries

Internet of Things

The integration of “intelligence” in ordinary things gives a substantial added value and a competitive advantage that represents an important opportunity for a renewal of traditional Swedish Industry and a possible increase of its global competitiveness. The pervasive computing vision, first stated by Mark Weiser, in which smart objects form an Internet of things (IoT), creates an emerging market with a potential growth that is enormous; Ericsson is predicting 50 billion connected devices in year 2020 and further on CISCO is expecting 200 billion devices in year 2025. The expected market value is predicted by McKinsey to be more than 10 trillion U.S. dollar before 2025, this technology evolution can be the bandwagon that will bring Sweden’s industry into next generation of industrialism. However, the introduction of integrated electronics in traditional products requires a large transformation of competence, and completely new areas of knowledge must be integrated in organizations. The ongoing IoT revolution is transforming Internet into a sensory system (sensors for types of physical variables, temperature, pressure, vibration, light, moisture, stress). It evolves Internet from operating as purely cyber-systems to cyber physical systems (CPS), i.e. connects the physical domain to the cyber domain. The pervasiveness of embedded systems, smart objects and IoT introduce a number of challenges, for example: electromagnetic interference (EMI)/electromagnetic compatibility (EMC)/radio resource allocation/assignment, electronic building practice/integration/system packaging for next generation embedded systems, low power electronic design, network/device management and security. To realize the full potential of IoT, multidisciplinary application-oriented



Internet of Things might require circuits downscaled in many aspects. NB the transmitter the toy lady keeps in her hand.

research is needed, and the research areas within Halmstad University embody a major part of necessary IoT enabling technologies. The IoT research theme at Halmstad University includes: design, modelling, simulation, fabrication, characterization and verification of novel low-cost, highly integrated, low-power computing and communicating devices, sen-

sors and circuits for IoT. In the ongoing project “Electromagnetic Compatibility for Next Generation (EMC NG) of Embedded Devices”, the focus is to conduct a comprehensive assessment, from an EMC perspective, of using additive manufacturing for integration of embedded electronics. Electromagnetic properties of the materials used in additive manufacturing are investigated and performed in the context of issues such as: applicable additive production methods and their spatial resolution, mechanical stability, and aging properties of materials. Secondary goals are: develop or improve laboratory measurement methods that more accurately reflect new requirements related to the pervasive computing vision; and develop best practice and recommendations for implementing these techniques into new EMC test standards. In a proposed sister project, “Computational models for improved EMC design - eMC Hammer”, the power of numerical computation in product development will be investigated. The focus is on numerical electromagnetic modelling methods for component model-based design and the use of these models for EMC troubleshooting. The goals are to develop models for individual components that are easily integrated and parameterized to system models, enable EMC modelling of electronic systems at early design stage and to identify the cause of EMC problems. This gives an opportunity to significantly speed up the design cycle for embedded systems and thereby reduce costs and increase competitiveness of Swedish industry. The long term goal of the IoT theme within CERES is to conduct high level research in coproduction with industry so that Sweden continues to be a world leading nation in next generation of industrialism.

“However, the introduction of integrated electronics in traditional products requires a large transformation of competence, and completely new areas of knowledge must be integrated in organizations.”



Electronics Centre in Halmstad

The new facilities of Electronics Centre in Halmstad (ECH) are now operational and were inaugurated the 11th of September, at the yearly “Research for Innovation Conference” at Halmstad University. ECH is an arena for regional cooperation in the field of electronics, where regional small and medium-sized companies with common technological challenges are forming a regional knowledge/resource cluster in collaboration with the University and the public sector in the region.

The new facilities include resources such as advanced electronics labs for HF and RF measurements, and especially a new EMC testing facility with a 3 meter test range. The new EMC test facilities will give the local electronics industry an opportunity to speed up their development cycles, development team can get access to the EMC/radio test range for fast evaluation of their designs and get EMC/ R&TTE compliance feedback at early design stages. This new facility will also strengthen CERES in the area of embedded electronics, and complement previous orientation towards dependable systems, test and verification.

The ongoing digital revolution requires that traditional industry add intelligence to their products. This transformation of traditional industry elevates the technical design challenges and requires that new knowledge and skills are added to old organisations. ECH’s goal is to be an excellence/resource centre for the regional industry especially focusing on applied research, innovation and knowledge-building in the field of integration, compliance and design of electronics. Our belief is that ECH can be an important actor to strengthen the regional industry and strong incitement for new industries to settle down in the region.

“This new facility will also strengthen CERES in the area of embedded electronics, and complement previous orientation towards dependable systems, test and verification.”
Urban Bilstrup



Urban Bilstrup, ECH project manager

Standards

Some of the measuring standards possible to test according to at the new 3 meter test range at ECH.

EN 61000-4-2	ESD +/-16kV
EN 61000-4-3	RF 80MHz-2.0GHz 10V/m, 2.0GHz-2.7GHz 3V/m
EN 61000-4-4	Burst max +/-4kV
EN 61000-4-5	Surge max +/-3kV
EN 61000-4-6	RF 150kHz-80MHz max 10Vrms
EN 61000-4-11	Dips
EN 55011	30MHz-6GHz
EN 55022	30MHz-6GHz
EN 55016-2-3	30MHz-6GHz

Research Collaboration

ELLIIT - Strategic Research for Sweden

CERES position as a leading actor in embedded systems research has attracted cooperation on the national level in the so called ELLIIT consortium. In addition to Halmstad University, the universities in Linköping and Lund, as well as Blekinge Institute of Technology are members of this consortium. After a careful international scientific evaluation of competing proposals from Swedish universities, the initiative of these four universities was selected by the Swedish Government (in 2009) to achieve long-term extra funding of research that is considered to be of particular strategic importance to Sweden. Within the area of information and communication technology (ICT), two such long-term grants were given - the other was given to the Royal Institute (KTH).

Since 2010 CERES has therefore performed joint, strategic research projects together with the other ELLIIT partners. The collaboration has also led to winning other research grants, such as the grant for the HiPEC project from SSF. The ELLIIT funding has also enabled and co-funded the recruitment of two new professors at CERES: Walid Taha in Computer Science, and Mohammad Mousavi in Computer Systems Engineering.

To Halmstad University it is strategically important that CERES continues to develop additional strength in order to qualify for maintaining this role in the national investment in information and communication technology.

International collaboration - University of Erlangen

CERES has been collaborating with Prof. Dietmar Fey (Chair of Computer Architecture) at the Friedrich-Alexander University of Erlangen-Nurnberg (FAU). One of our former MS thesis students, Konrad Haublein, is now carrying on his PhD studies at FAU under Prof. Fey supervision. In addition, our collaboration with Prof. Fey's group involves developing the compilation support for actor languages to heterogeneous

platforms using LLVM. The said support is being developed as an extension to our in-house CAL compiler framework and we will be using image-processing applications as experimental case studies.

International collaboration - Eindhoven University of Technology

CERES maintains a stable collaboration with Eindhoven University of Technology, particularly with the Embedded Systems research group of prof.dr.ir Jan Friso Groote. This collaboration is mainly in the area of testing and verification of embedded systems and has, among others, led to a joint Ph.D. graduate and a textbook entitled "Modeling and Analysis of Concurrent Systems" published in this area by the MIT press in 2014.

The Japanese Connection

Starting with a visit to Halmstad University in Spring of 2014, Professor Taha's group has been in regular contact with two groups in Japan working on modeling languages for hybrid systems: Professor Ueda from Waseda University, and Dr. Daisuke Ishii from the Tokyo Institute of Technology. Professor Waseda was a key participant in Japan's influential Fifth Generation Languages program, and is the principal designer of the HydLa hybrid systems modeling language. Dr. Ishii is a leader in the emerging area of reachability analysis for hybrid systems. Partly because there is only a small number of programming researchers around the world who are also interested in hybrid systems, there was an instant connection between the Swedish and Japanese groups. Since the first visit, the two have met via skype approximately once a month, and the colleagues from Japan visited once again in Spring 2015. Most recently, the two groups are working together to organize Shonan meeting on the topic of "Validated Numerics Meets Reachability Analysis for CPS", which will take place at the Shonan Village Center from September 28th to October 1st.

Health Technology - Collaboration with CAISR

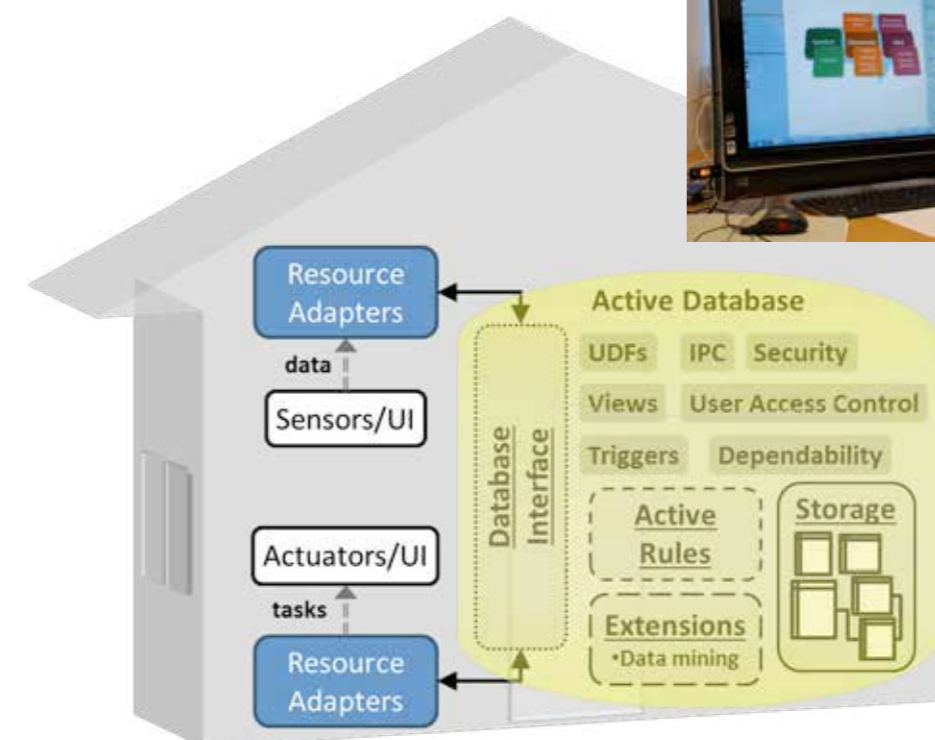
The elderly population is growing, living longer and susceptible to age-related diseases and problems. As a consequence, demand for health and social care will increase dramatically in the years to come. However, as they current stand, healthcare systems are not prepared to address such a challenge because there are not enough facilities and professionals specialized in geriatric care. Information and communication technologies therefore play an important role in bridging the gap between future healthcare demands and available healthcare resources.

Researchers and students at CERES and CAISR (Center for Applied Intelligent Systems Research) are continuously collaborating in projects that aim at improving the comfort, independence and continuous care of older individuals living alone, as well as enhancing and complementing the services of those delivering care. For example, a joint project between CERES and CAISR explored the questions of how

active in-database processing could support the development of services to support night-time caregiving and how active in-database processing could improve the security of collected sensor data. Another joint project investigated the integration of an autonomous robot into a database-centric architecture supporting ambient intelligent (AmI). The project also explored how ambient intelligence and the robot could complement one another to support ambient assisted living application, such as using the AmI to detect anomalies and the robot as a first-aid agent. The collaboration between CERES and CAISR also involved the development of a portable smart home demonstrator that aims at assisting researchers and developers to foresee issues before full-scale experiments are performed. All three joint projects make use of a database-centric system architecture developed at CERES. In the architecture, a modern database management system functions as platform for smart home environments and AAL applications.



Above: Wagner Ourique de Morais working with the interface for The Intelligent Bed, a demonstrator used for development of services for elderly people.



To the left: System architecture for a database management system that can work together with smart home environments and AAL applications

Coproduction with Industry

Saab AB

Saab is a world leader in the design of advanced radar systems. Saab is a leading provider of sensor systems encompassing advanced airborne, ground-based and naval radar, as well as an extensive range of services. With more than 50 years of experience in sensor development and more than 3000 sensors delivered worldwide, Saab is today a world-leading competence-centre for microwave and antenna technology. Saab has an established relationship to Halmstad University dating back to the early 1990-s, and over the years the cooperation has broadened and deepened. The cooperation with the researchers at Halmstad University in different joint projects has been summarized in Figure 1. Saab has benefited from the cooperation with the researchers in early-stage design-space exploration of technology choices to evaluate their possible impact on future products and services. Halmstad University is also seen as a resource for dialogue, for active learning and for knowledge sharing related to ongoing research also in areas in which Saab is not actively involved. This has the potential to lead to new avenues of cooperation in future research.

Saab also acknowledges the advantage of such a cooperation to identify the gaps in skills of its existing environment, such as the understanding of new models of computation that can be the basis of future software tools, and to bridge this knowledge gap in time. Doctoral and Master students working in the projects have also been a source of qualified human resources for the company. In particular, the opportunity to hire people with a PhD degree in an area perfectly matching the need of Saab is seen as an advantage.

In the words of Per M Ericsson (Senior Specialist):
 “CERES is a way for us to get new influences from the research community, but also to strengthen the competence of our engineering personnel by actual participation in the research projects. We appreciate the long-term focus in the research. Yet we have already got results that can be used, and partly have influenced our roadmaps and designs.”

<http://www.saabgroup.com/>

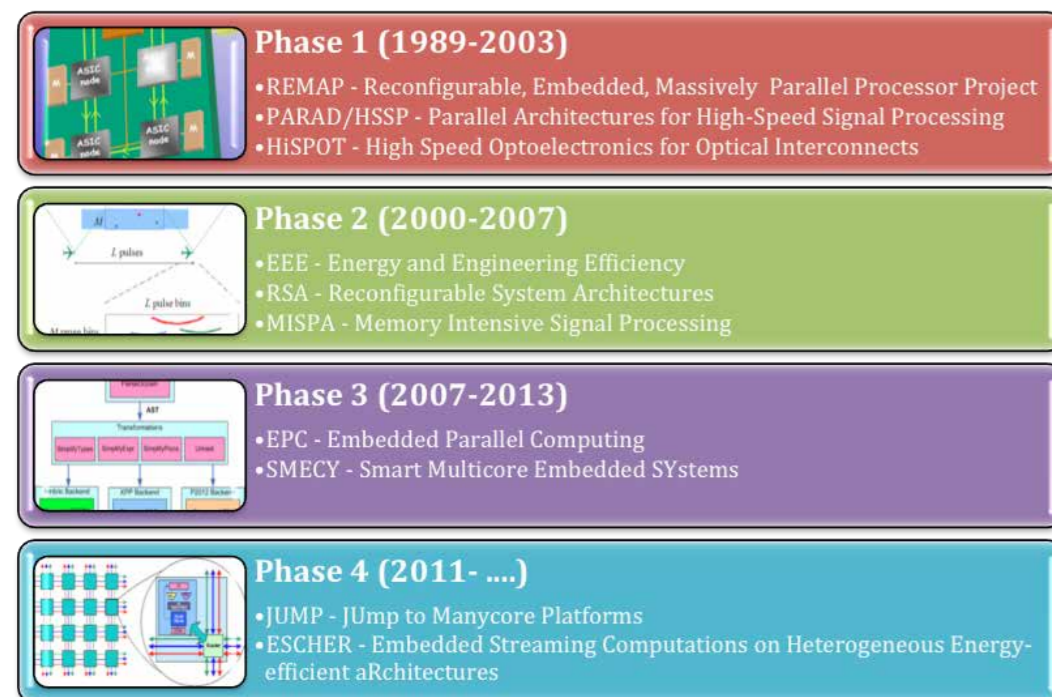


Figure 5. Projects landscape corresponding to various phases.

SP Technical Research Institute

SP Technical Research Institute of Sweden is the national institute for research, testing, certification, metrology and calibration and is working closely with large and small companies, universities, institutes and other organizations. International research and cooperation plays an important role. SP’s mission is to contribute to growth and competitiveness of industry as well as to safety, conservation of resources and a good environment in society. SP does this through applied research and a wide range of services in technical evaluation and metrology. With a staff of 1400, SP is one of Sweden’s largest research institutes. The main customers are industry, research councils, the European commission and the Swedish state. SP performs certification of products and quality control systems. SP Technical Research Institute of Sweden was one of the partners when the Centre for Research on Embedded Systems (CERES) was started at Halmstad in 2005. SP participated in several projects during the six-year “profile funding” by KK-Stiftelsen and has continued the cooperation with Halmstad Högskola (HH) within the CERES+ initiative

which started 2011. HH and SP are both members of SAFER, the Vehicle and Traffic Safety Centre hosted by Chalmers, and of the Competence and Innovation Node for Automotive Electronics (Vehicle ICT Arena) hosted by Lindholmen Science Park. Common research interests include V2x communication and dependable networked systems. SPs PhD student Benjamin Vedder is enrolled at the EISIGS research school with Magnus Jonsson (HH) as main supervisor and Jonny Vinter (SP) as assistant supervisor. This collaboration has been very fruitful and has, during the last two years, resulted in three publications and a licentiate degree for Benjamin. SP (Jan Jacobson) is also engaged in EISIGS by acting as leader for the reference group. SP is looking forward to a long-term collaboration with HH and the EISIGS research school and plan to employ a new PhD student for the second batch of EISIGS students.

<http://www.sp.se/>



A car used in the SAFER project, in which both SP and Halmstad University are members.



Volvo Group Advanced Technology & Research

The Volvo Group is one of the world's leading manufacturers of trucks, buses, construction equipment and marine and industrial engines. The main assignment of Advanced Technology & Research, part of the Volvo Group division Group Trucks Technology (GTT), is to drive research, development and advanced engineering for the long term competitiveness of the Volvo Group products and services, but includes also innovation, business engineering, and corporate services.

For almost a decade, Volvo Group Advanced Technology & Research has participated in several research projects and programs hosted and driven by Halmstad University. It is a fruitful collaboration where the Volvo Group Advanced Technology & Research has gained new insights in especially what wireless real-time communication can facilitate for the vehicular environment. Currently, we are part of the Autonomous Cooperative Driving Enabled by Dependable Wireless Real-Time Communication (ACDC) project, which focuses

much on road trains (a.k.a. platooning) where wireless communication is the enabler for reducing the distance between vehicles. Wireless communication between vehicles enables new applications contributing to a better road traffic safety and efficiency.

<http://www.volvogroup.com/>



Equipment for data collection during skidpan driving



Skidpan driving in Halmstad. The test was a part of a student project conducted by exchange students from the Netherlands within the EU exchange program ERASMUS.

Adapteva

Adapteva Inc has been at the forefront of introducing the Epiphany manycore processor, which is a supremely scalable shared memory architecture featuring up to 4096 processors on a single chip interconnected with a high-bandwidth on-chip network. Each node in the chip contains a fully functional floating-point unit. Adapteva and CERES have been collaborating since the launch of the first product based on the Epiphany architecture, a tiny 16-core 32 GFLOPS chip (E16G301) implemented in 65nm. CERES researchers have been actively involved in developing high-level programming support for the Epiphany architecture. In this regard, we have implemented a backend code generator in our in-house CAL tool-chain for CAL dataflow language compilation targeting the Epiphany architecture. CERES and Adapteva has been co-publishing the findings of our research in top-tiered conferences and we are also collaborating in getting research funding from international funding agencies.

In the words of Andreas Olofsson, CEO/Founder at Adapteva:

“We have been collaborating with CERES on programming the Epiphany since 2010 with great results. It has been a pleasure working with Professors Svensson, Nordstrom, and Abdin and I look forward to many more years of productive research. The Epiphany technology is now available at over 200 Universities worldwide and CERES has the distinction of being Adapteva's first academic research partner and the most prolific publisher of high quality Epiphany related research to date.”



Andreas Olofsson giving a talk at Halmstad University





Shared knowledge creates opportunities – “For the future of electronics in Halmstad”

For the future of electronics in Halmstad” is a collaboration between business, academia and research institutes together with the municipality, region and industry associations Swedish Electronics and Halmstads Electronics Association. Together we create resources and develop skills and research collaboration that will not only boost the area but also increase interest and knowledge about electronics in general. The University is taking a leading role in Future Electronics in Halmstad via its long-term investment in Electronics Center in Halmstad (ECH).

Four larger meetings have been organized during 2014/2015, but also a number of meetings in small groups focused on specific areas. It has been about improving education and developing new courses but also the development of electronics center and research projects.



The picture is from a meeting session where students and companies met to talk about projects, work place training and future work

Members

Companies:

- 3M
- AES Nordic AB
- Anritsu, Armeka AB
- Artektron AB
- Celsicom AB
- Comfort Audio AB
- Etteplan AB
- Free2move AB
- Getinge Sterilization AB
- Gutec AB
- Harry Sjögren AB
- HMS Industrial Networks AB
- J&D Assisting Systems AB
- Lansen Systems AB
- Mobile Integrator AB
- MPQ Consulting AB
- Neat Electronics
- NIBE Energy Systems
- Phoniro Systems AB
- Propoint AB
- Saab AB
- Rohde & Schwarz
- Sensor Communications Sweden AB
- Structab AB
- Swedish Adrenaline AB
- Triacon Scientific AB

Organizations:

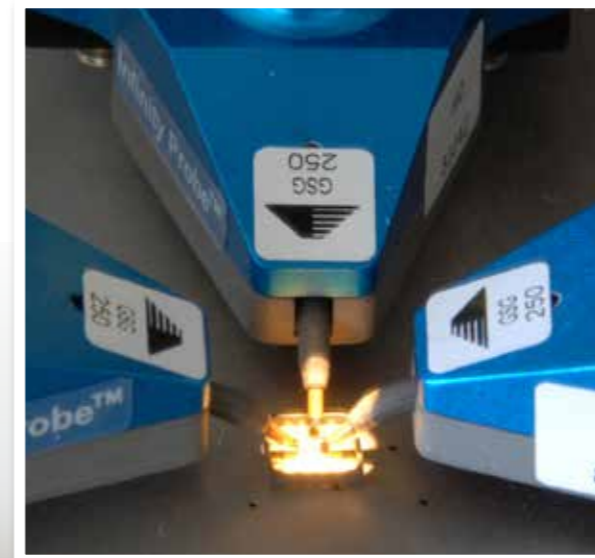
- Halmstad University
- SP Technical Research Institute of Sweden
- The Swedish Electronics Trade Association
- Halmstads elektronikförening
- Science Park Halmstad AB
- Region Halland
- Halmstad Municipality
- Halmstads näringslivs AB

Application Areas

Advanced Sensing and Communication Systems



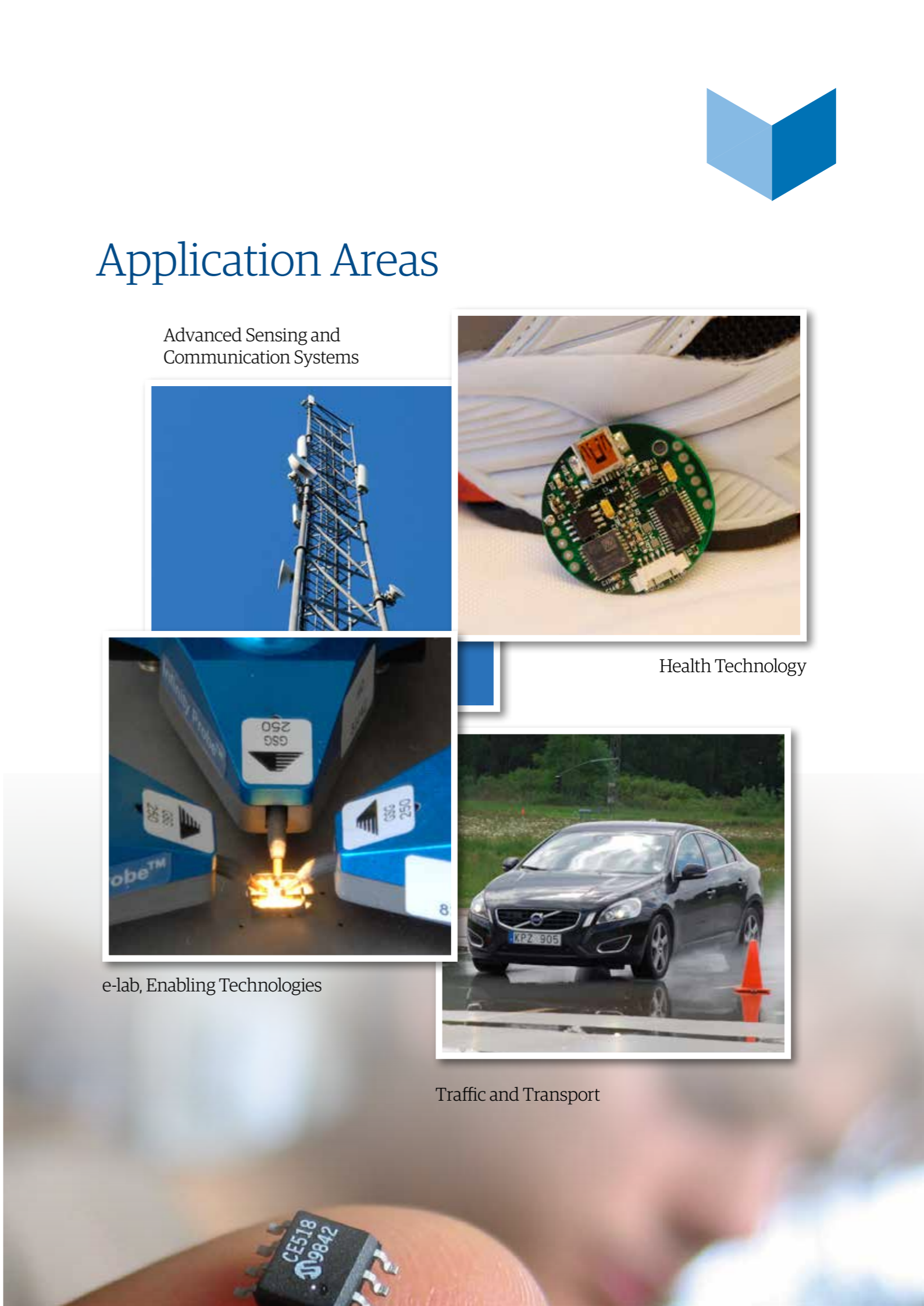
Health Technology



e-lab, Enabling Technologies



Traffic and Transport





Research oriented Education

CERES, together with CAISR, constitute the research environments that serve as a basis for Halmstad University's first and second cycle education programs in Computer Science and Engineering. The same holds for PhD education in the subjects Computer Science and Engineering and Signals and Systems Engineering.

CERES staff is involved in education at all levels, contributing with project ideas, theses proposals and supervision as well as teaching courses and developing education programmes. PhD students are encouraged to co-supervise master theses related to their PhD projects.

Second cycle programs

The master's program on Embedded and Intelligent Systems (EIS) is the result of integration of the following two research areas:

- Cooperating Embedded Systems, represented by areas such as cyber-physical systems, parallel architectures, real-time systems and wireless communication and
- Applied Intelligent Systems, represented by areas such as signal processing, artificial intelligence, and data mining.

This integration provides enormous opportunities for combining methods and techniques for inter-disciplinary solutions for Embedded Intelligent Systems.

The program offers courses on the fundamental bodies of knowledge underlying the above-mentioned two research fields. It also features a design project, in which the students experience the design of a substantial embedded intelligent system in teams. The program is concluded by a final project clearly relating to one of the active research areas at CERES or CAISR. The program has been running successfully since 2007. By now, the EIS Masters has a stable intake of 35 students per year, of which 80 percent are international students.

As a measure of quality control and to ensure sustained update and renewal, a group of researchers from CERES and CAISR performed a review of the EIS masters program in 2014. They produced a self assessment containing obser-



Veronica Gaspes, Chair of the research and education board

ations and suggestions at three levels: program level, track level, and course level. In 2015, the self evaluation has been presented to involved research centers and the team got the task of implementing the suggestions and the received feedback into a revised curriculum for the EIS masters program. For this purpose, the team studied various similar programs at other universities and research institutes, as well as guidelines for curricula by groups of researchers and international organizations. The result is proposed to take effect in the EIS master's program as of September 2016.

In 2013 Halmstad University was granted the right to award the degree Master of Science in Engineering (Civilingenjör in Swedish). The first group of 38 students was admitted in the fall of 2014. Civilingenjör has been for the last 100 years the most prestigious professional degree in engineering in Sweden. It is a five-year education, offered at 14 different Swedish universities. At Halmstad University we offer it with the technical specialization Computer Science and Engineering. This deliberately connects to the strong research and industry connections of CERES and CAISR. For the final two years of study the programme offers the choice between the two profiles cooperating embedded systems and intelligent systems. The first of these is given by researchers within CERES.

Civilingenjör

Advanced technical work in industry needs a solid base in mathematics and natural sciences, a technical specialisation and also an entrepreneurial and socially skilled way of working. To achieve this, all the five years of a *civilingenjör* education are needed. Already in the first semester of the programme at Halmstad students are given perspectives of computer science and engineering with project work in groups and industry visits. The first three years include 52.5 credits of mathematics, courses in physics, electrical engineering and the fundamentals of computer science and engineering. They also include an optional 15 credits course done as work placement at a company. Most technical courses are done in a project based manner, to train different aspects of project work.

The final two years give a specialisation in either embedded or intelligent systems, or a combination of the two, with half of the credits being optional.

To the right: Matilda Bengtsson, Civilingenjör student at School of Information Technology, Halmstad University



Future developments

The School of Information Technology, host of CERES, is currently developing an international Master program in Network Forensics and Computer Security to be started in the Fall of 2016. The program is meant to be an extension and continuation of the Bachelor program IT Forensics and Information Security already offered by the school. The goal of the program is to further strengthen the student's abilities in the area of digital forensics with the emphasis on network security, large data analysis (data mining), and biometrics. The program is meant to be oriented towards the research activities of CERES and CAISR, in particular on data acquisition and processing. More generally, the program is meant to be interdisciplinary, crossing the areas of IT, computer security, law, and social sciences. The particular courses and subjects that are planned to be part of this program include Advanced Computer Networks and Security, Cybercrime, and Applied Data Mining.

The school is also developing, in collaboration with industry, the final part of a Master of Science in Engineering program (Civilingenjör) with the technical specialization Electronics. This is part of CERES involvement with the electronics industry in the region that includes the Electronics Centre in Halmstad (ECH) and a research project on 3D-printing of electronics funded by the Knowledge Foundation (Electromagnetic Compatibility for Next Generation Embedded Devices). Students of this new program will have the opportunity to develop a thorough knowledge of the design and development of new electronics, sensors and materials. They will have the opportunity to work in a collaborative environment together with researchers from CERES and companies involved in ECH. Part of the development of the program is financed by the KK-foundation as an AVANS project.

International collaboration in education

The master's programmes at the School of Information Technology are offered in English and a majority of the students are recruited internationally. The international students come both from partner universities and as regularly admitted students. Agreements with other universities include two which have been running for many years: one is a double degree arrangement in Computer Science and Engineering with Fachhochschule Salzburg where students spend one year at each

university and do a master's thesis which is examined at both universities. Another is a mobility scheme within the master's programme in Information Technology where students move between Halmstad, Wrocław University in Poland and Ostwestfalen-Lippe University of Applied Sciences in Germany.

In recent years, with the growing importance of several Asian countries both in electronic engineering and generally in education and world economy, collaboration has focused on that region. Study-abroad agreements with several universities in China help recruit students from China. Also in China, teacher exchange and summer courses for groups from partner universities have started during the last two years. Students from the School of Information Technology are now going, if still in quite small numbers, to partner universities in Japan, Singapore, South Korea and Taiwan. Efforts are made particularly to increase the number of students and teachers going for exchange to the countries mentioned. Besides direct education we now also regularly have students from partner universities, including those from France, Holland, Turkey, who come for internships included in or related to their education. They then typically spend three or four months working in one of our research projects.

PhD education

CERES has been involved in PhD education from its very start. During 2013 and 2014 the school of Information Technology started EISIGS, the Industrial Graduate School in Embedded and Intelligent Systems. In the spring of 2014 8 PhD students were affiliated with the school. A kick-off workshop was arranged on March 31 to April 1, 2014, with participants from the industrial partners, the university and the Knowledge Foundation, which co-funds EISIGS.

The goal of EISIGS is to provide the right environment for producing qualified, independent researchers (PhDs) that understand, advance, and champion embedded and intelligent systems research. We aim to strengthen Swedish industry by training doctoral-level researchers that have both technical depth and a broad understanding of industrial requirements, the innovation process and which innovations that can lead to business opportunities. In contrast to traditional graduate programs in science and technology, the school will therefore place special emphasis on the larger context wherein technical expertise is applied to produce commercially successful innovations. In particular, recognizing the importance of a firm's ability to innovate and transform innovation to new business opportunities, emphasis on innovation pervades the entire

school's program. We believe that this emphasis will produce a new breed of researchers that can recognize, utilize and develop the innovation potential of an industrial context.

All the PhD students have got started well and are productive. A number of international conference papers have been submitted and published. We have also stated that EISIGS shall lead to new externally funded research projects sprung from some of the PhD student projects. One such project is approved with funding from Vinnova/FFI, which has sprung from the collaboration between HH and VTI connected to one of the PhD student projects. Moreover, we have already submitted several other applications for funding of new research projects.

There are examples of results or effects for the companies already at this point. Regarding the HEM Nät PhD student project, we had some effects on HEM's monitoring system. In this case, HEM Nät has started working on development of monitoring and control of low voltage distribution network according to suggestions from the project. This is based on more efficiently using already existing smart meters, and also adding new meters in secondary substations. Regarding the SP PhD student project, a quadcopter system has been developed, which has got good demonstration visibility in related projects at the company and externally.

In the near future, we hope to be able to start another batch of PhD students within EISIGS.

” The master's programmes at the School of Information Technology are offered in English and a majority of the students are recruited internationally.
Veronica Gaspes, Chair of the research and education board

To the right: Hassan Nemati, industrial PhD student at Hem Nät in Halmstad, sharing his time between Halmstad University and the company. Hassan is a former master student at the university.



Competence development



Amin Farjudian,
Assistant Professor

I obtained my BSc in pure mathematics from Sharif University of Technology in 2000, where I wrote my undergraduate dissertation "Modeling information change using non-well founded set-theory" under the supervision of Prof. Mohammad Ardeshir. In 2004, I obtained my PhD in theoretical computer science under the supervision of Prof. Achim Jung, from the University of Birmingham (UK). My PhD thesis was titled "Sequentiality in Real Number Computation". Since 2004, I have been working as a lecturer and researcher in computer science and mathematics in Sharif University of Technology (Iran), Aston University (UK), and The University of Nottingham Ningbo (China). Though the common theme of most of my research has been computable analysis, I have carried out research in a number of areas of computer science and mathematics and have published on ordinary and partial differential equations, algorithmic randomness, semantics of programming languages (mainly Domain Theory), semantics of concurrency, verification of floating point software, data mining, set theory, and philosophy of language. Since May 2015, I have started working in Halmstad University with Prof. Tomas Nordström on the ESCHER project where the aim is to design domain specific languages for signal processing on heterogeneous architectures.



Alexey Vinel,
Professor

I was born in 1983 in Leningrad, Russia. I received the bachelor's (Hons.) and masters' (Hons.) degrees in information systems from Saint-Petersburg State University of Aerospace Instrumentation, Saint Petersburg, Russia, in 2003 and 2005, respectively. Subsequently, I obtained my Ph.D. degrees in technology from the Institute for Information Transmission Problems, Moscow, Russia, in 2007, and the Tampere University of Technology (TUT), Tampere, Finland, in 2013. Since 2015, I am a professor of data communications at the Centre for Research on Embedded Systems at Halmstad University, Halmstad, Sweden. Prior to that, I have been a Researcher at TUT during the period 2010 of 2013 and a guest professor at Halmstad University during the period of 2013 to 2015. I have been involved in research projects on vehicular networking standards, advanced driver assistance systems, and autonomous driving. I have been an associate editor for the IEEE Communications Letters since 2012. I am a Senior Member of IEEE.



Dietmar Fey,
Professor

Prof. Dietmar Fey from Friedrich-Alexander University of Erlangen –Nurnberg visited CERES during June 2014 and spent two weeks as part of his sabbaticals. He is the chair of computer architecture with research interests spanning from design of parallel computer architectures to nano technologies. During his stay he has given a keynote talk at the HiPEC project workshop titled "Parallel embedded computing – from multicore to heterogeneous architectures using virtualization and future nano technologies". We have also identified some concrete tasks for our research collaboration such as using our CAL compilation tool-chain for implementing image processing applications on heterogeneous platforms consisting of GPUs and FPGAs.



Eugenio Moggi,
Visiting Professor

In 1983 I received a MSc in Computer Science from Pisa University (supervisor Prof. Giuseppe Longo) and at the same time a Diploma from Scuola Normale Superiore. In 1988 I received a PhD in Computer Science from Edinburgh University by defending a thesis on "The Partial Lambda-Calculus" (supervisor Prof. Gordon Plotkin). Before moving to Genova University in 1990 as Full Professor, I worked as Research Associate in Cambridge (with Prof. Martin Hyland and Andrew Pitts), Edinburgh (in the Laboratory for Foundations of Computer Science) and Pisa University. My most significant research contributions are: categorical semantics of polymorphic types, the study of formal systems for partial functions, notions of computations as monads, metalanguages for computational monads and evaluation logic, categorical semantics of program modules, and type systems and operational semantics for multi-stage programming languages.



Masoumeh Taramirad,
Postdoctoral researcher

I have completed my PhD (2015) in the Enterprise Systems Research Group in the Department of Computer Science, University of York, UK. My PhD thesis research introduces a systematic model-based approach to recover trace links in projects that span multiple engineering domains (such as safety-critical systems). Currently, I am working on a "Unified Symbolic Testing Framework", as part of the Effective Model-Based Testing of Concurrent Systems (EFFEMBAC) project. I am also interested in traceability, model-driven engineering (in particular, model evolution and model transformation), requirements engineering, and software development methodologies. Before commencing my PhD, I was involved in a project to develop an Enterprise Resource Planning (ERP) system, as a senior programmer and senior software designer and architect



Sebastian Kunze,
Ph.D. Student

I started a master's programme in Informatics at Hochschule Darmstadt in Germany and finished it at Mälardalens University in Sweden specialising in Software Engineering. Within my master's thesis I focused on automated test case generation for Function Block Diagrams using Java Path Finder and symbolic execution. At Halmstad University I am working on the Effective Model-Based Testing on Concurrent System project.



Wojciech Mostowski,
Assistant Professor

I have started my position as an assistant professor at Halmstad University in April 2015. Previously, I worked in the Netherlands, most recently at the University of Twente. My research interests are generally understood as formal methods, security sensitive smart card applications, and in embedded systems for automotive applications (until very recently the last item being mostly my private hobby). I authored and co-authored over 30 peer-reviewed papers and book chapters on the above subjects and participated in numerous national and EU funded research projects. Furthermore, I am an experienced university teacher, and have recently received the official Dutch University Teaching Qualifications certificate from the University of Twente. During my appointment at CERES, I am going to work on the Knowledge Foundation project AUTO-CAAS, which is concerned with applying and extending model-based testing techniques in the context of the automotive standard AUTOSAR.

Presentation PhD Students



Adam Duracz

I studied Mathematics and Computer Science at Stockholm University and obtained my MSc with a thesis on the "Derivation of Probability Distributions for Risk Assessment". Following my university education I spent four years as a consultant at IBM, working on projects involving all aspects of software delivery, including development, design and requirements elicitation. I joined CERES and the Effective Modeling Group at Halmstad University in 2012, where I am developing a rigorous semantics for the Acumen language. The work is done under the supervision of Prof. Walid Taha and Assoc. Prof. Verónica Gaspes.



Benjamin Vedder
SP Technical Research Institute of Sweden

In 2007 I started studying at Chalmers University of Technology in the programme Automation and Mechatronics. I got my bachelors degree in 2010 and in 2012 I got my masters degree in the masters programme Communication Engineering at Chalmers. As my masters thesis I made the major part in the construction of a miniature autonomous vehicular platform with 1:8 scale cars. In 2012 I started working at SP Technical Research Institute of Sweden and in 2013 I started my industrial PhD studies at SP together with Halmstad University in the area of computer science and testing. In my spare time I spend a lot of time on the construction and programming of embedded intelligent systems. I have published many hardware and software designs on my personal homepage. I have also won the Swedish national robot competition several times and got second place in one of Europe's biggest competitions for self-made, autonomous and mobile robots.



Erik Hertz

After receiving my MSc degree in Electrical Engineering from Lund University I worked in industry for a few years. My research career started with the Swedish Defense Research Agency (radar), continued with Ericsson Research (mobile phones), and then Cargine (within Koenigsegg) (combustion engines). In my spare time when I worked at Cargine I was pursuing my PhD on a self-developed methodology for performing approximations of unary functions in digital hardware. The advantages with the methodology are high chip area efficiency, very fast computation, very low power consumption, and a favorable error behavior compared to comparable methodologies. Possible applications for the methodology are applications where high computation rates and high resolution are needed, such as signal and image processing, robotics and so on. My status today is that I have received my Licentiate degree from Lund University and am now at Halmstad University to finish my Doctor degree.



Essayas Gebrewahid

I have done my BSc in Computer Science and Information Technology in Haramay University, Ethiopia. I got my MSc in Embedded and Intelligent Systems from Halmstad University. After graduation, I joined CERES as Research Engineer. As Research Engineer, I contributed in the ELLIIT national research initiative and the SMECY European Artemis project. Currently, I am a Ph.D. student at Halmstad University under the supervision of Bertil Svensson, Veronica Gaspes and Zain-ul-Abdin. My Ph.D. focus is on developing compilation tools for massively parallel, high-performance, low-power coarse-grain reconfigurable platforms. My research interests are mainly in compilers, parallel and reconfigurable computer architecture and embedded systems. I have defended my licentiate thesis--"Compiling Concurrent Programs for Manycores"--on March 20, 2015.



Presentation PhD Students



Le-Nam Hoang

I received my BSc in Electronics and Telecommunications at Hanoi University of Technology, Vietnam and my M.Sc in Electrical Engineering, with specialization on Radio Communications, at Blekinge Institute of Technology, Sweden. Before being a PhD at Halmstad University, I worked at the Research Centre of Vietnamese Post and Telecommunications Institute of Technology. Currently, under the supervision of Assoc. Prof. Elisabeth Uhlemann and Prof. Magnus Jonsson, my research mainly focuses on applying wireless communications for Distributed Control Systems. In June 2015, I finished my Licentiate degree with the thesis titled "Relaying for Timely and Reliable Message Dissemination in Wireless Distributed Control Systems".



Marcus Larsson
Qamcom Research and Technology

After spending five years at Chalmers University of Technology at the Automation and Mechatronics program with focus on mechatronics, I ended up in the automotive industry at the Swedish west coast (2008). The coming five years I spent developing and implementing embedded software, e.g. software for exhaust after treatment control and Human Machine Interface. In 2013 I joined Qamcom Research & Technology and Halmstad University and began my PhD studies aiming for a PhD in Information Technology with focus on communication. My main interest lies within vehicular communication (V2X) and Intelligent Transportation System. Currently I am investigating dissemination strategies in V2V communications in a platooning scenario in order to increase the Packet Success Rate (PSR). With a high PSR in platooning the vehicles could potentially drive with smaller inter-vehicle distance and hence save more fuel.



Mahsa Varshosaz

I received my MSc degree in Computer Engineering from University of Tehran. As my MSc thesis, I worked on probabilistic model checking of actor systems, which is still one of the major research topics that I am interested in. I joined the Ph.D. program in CERES at Halmstad University in 2014. Currently, I am working on model-based testing of software product lines under supervision of Prof. Mohammad Reza Mousavi and Prof. Gerardo Schneider. In my research, I am considering the adaption of conventional testing techniques, aiming for testing software product lines more efficiently.



Mahboobeh Parsapoor

Mahboobeh Parsapoor has a licentiate degree of information technology from Halmstad University where she was a member of Center for Research on Embedded Systems (CERES). She has started a project named "iEiAi", integrating Emotions in Artificial intelligence since 2007.

In this project, she has worked on different aspects of emotions and emotional systems to develop prediction models, intelligent controller, decision making, system identification, and optimization. She has successfully developed brain emotional learning inspired models (BELIMs), inspired models from emotional systems. Furthermore, she has introduced ELIE, Emotional Learning Inspired Engine that can be utilized as a learning engine in an autonomous system.

She is interested in conducting research on various topics include computational intelligence, nonlinear system identification, prediction, radio and wireless communication, neuroscience, and cognitive science. She is a member of IEEE, INNS, and AAAC. She is a member of technical program committee of several conferences such as IJCNN. She is in the reviewer panel of some ISI journals, IEEE communication letter and Neural Networks Journal, IEEE Transaction on Neural Network and Machine Learning and so forth.

Presentation PhD Students



Maytheewat Aramrattana
The Swedish National Road and Transport Research Institute (VTI)

I received the B.Eng. degree in Electrical Engineering from Kasetsart University, Thailand in 2010. After that, I worked as a hardware engineer in a company in Thailand for about one year. In 2011, I started the MSc program in Embedded and Intelligent Systems at Halmstad University. After finishing the master's degree, I joined the Embedded and Intelligent Systems Industrial Graduate School (EISIGS) in December 2013, working in a project called "Vehicle ICT Innovation Methodology" together with The Swedish National Road and Transport Research Institute (VTI). My research interests are in simulation, verification and testing of cooperative intelligent transport systems (C-ITS).



Sebastian Raase

I received my BSc in Information and Micro System Technology from Magdeburg University, Germany in 2012. Following that, I studied Embedded and Intelligent Systems at Halmstad University. In 2015, I received my MSc after defending my master thesis, which was about fluid simulation on the Epiphany manycore architecture. Afterwards, instead of working in the industry, I started in Halmstad as a PhD student under the supervision of Tomas Nordström and Zain-ul-Abdin, where I continue to work with the Epiphany system. Currently, I do research on virtual machine abstractions suitable for heterogeneous manycore architectures.



Nikita Lyamin

I received BS'11 and MSc'13 (both with honors) in telecommunications from Siberian State University of Telecommunications and Information Sciences, Novosibirsk, Russia. I have started my research activity in Novosibirsk being a bachelor student. That time I was focused on various domains of telecommunications. In 2013 I had two research visits at Halmstad University in scope of COST WiNeMO Action IC0906. During these visits I was working on the development of the real-time DoS attacks detection method for VANETs.

Starting from the beginning of 2014 I was a research engineer at CC-lab at CERES for 6 month. In August 2014 I was enrolled as a PhD student under supervision of prof. Vinel and prof. Jonsson within the same department. My current research focuses on a vehicular ad-hoc networks (VANETs). In particular, I'm interested in performance evaluation of various VANETs mechanisms and security issues in certain VANETs applications.



Süleyman Savas

My interest in computers started with games. I got my bachelor degrees from Halmstad University and Karadeniz Technical University (Turkey) in Computer Science and Computer Engineering respectively (2008 and 2009). Later, in 2011, I got my masters degree on Embedded and Intelligent Systems in Halmstad University.

After getting the master's degree I first worked three months as a research engineer in the university and then, for two years in the industry, mostly with embedded systems using bluetooth communication. Then I got the opportunity to start PhD studies in my interest area which is parallel computer architectures. The focus of my research is heterogeneous parallel architectures. I am interested in artificial intelligence and information security as well. And if I can find time I still play computer games.



Presentation PhD Students



Wagner De Morais

I received my BSc. in Computer Science from Federal University of Santa Maria, Brazil in 2002 and my MSc. degree in Information and Communication Sciences and Technologies from University of Nice Sophia Antipolis, France in 2005. I joined CERES as Ph.D. student in 2007. From 2009 to 2012 I worked as research engineer at Centre for Health Technology Halland (HCH, www.hh.se/hch) at Halmstad University and my work involved the development of serious games, measurement systems and smart home demonstrators, in particular for healthcare applications. My research focuses on software architectures for smart home environments and ambient assisted living systems and I'm defending my Ph.D. thesis in September 2015.

Mahboobeh Parsapoor

Licentiate thesis

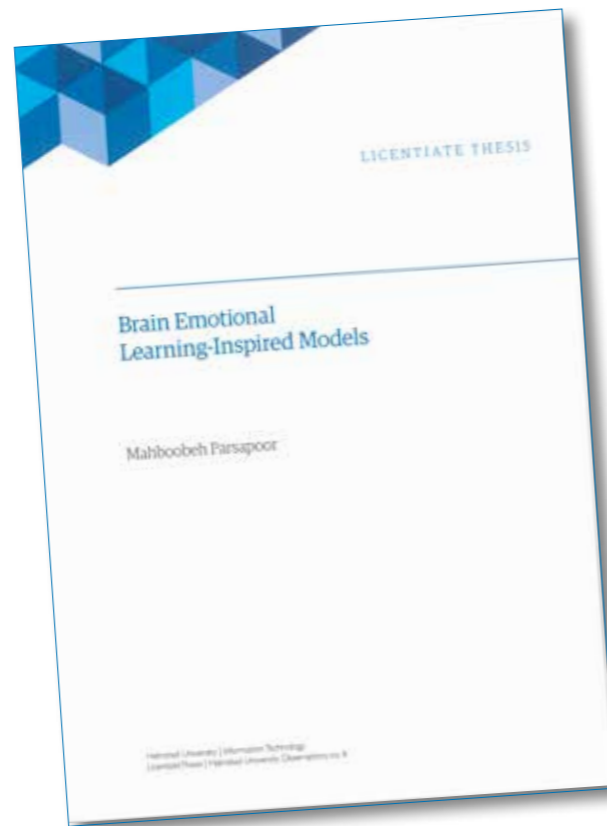


Brain Emotional Learning-Inspired Models

Licentiate thesis, Halmstad University
 Main supervisor: Professor Bertil Svensson
 Co-supervisor: Dr Urban Bilstrup
 Discussion leader: Professor Christian Balkenius
 Examiner: Professor Antanas Verikas

In this thesis the mammalian nervous system and mammalian brain have been used as inspiration to develop a computational intelligence model based on the neural structure of fearconditioning and to extend the structure of the previous proposed amygdala-orbitofrontal model.

The proposed model can be seen as a framework for developing general computational intelligence based on the emotional system instead of traditional models on the rational system of the human brain. The suggested model can be referred to as the brain emotional learning-inspired model (BELIM). Structurally, a BELIM consists of four main parts to mimic those parts of the brain's emotional system that are responsible for activating the fear response. In this thesis the model is initially investigated for prediction and classification. The performance has been evaluated using various benchmark data sets from prediction applications, e.g. sunspot numbers from solar activity prediction, auroral electroject (AE) index from geomagnetic storms prediction, Lorenz time series. Furthermore, the performance of BELIM has also been evaluated for classification, by classifying binary and multiclass benchmark data sets.



Essayas Gebrewahid

Licentiate thesis

Gebrewahid



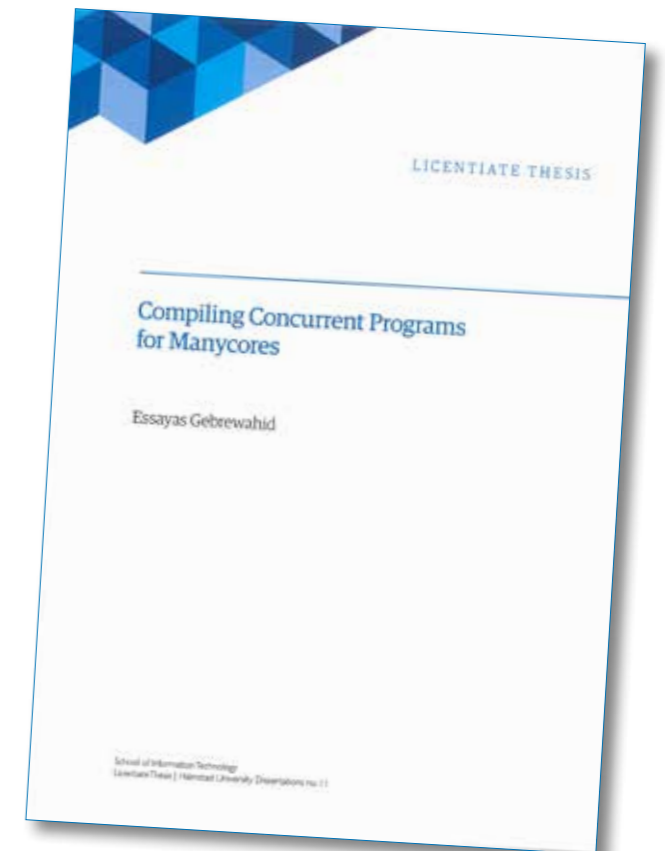
Compiling Concurrent Programs for Manycores

Licentiate thesis, Halmstad University
 Main supervisor: Professor Bertil Svensson, Halmstad University
 Co-supervisors: Dr. Veronica Gaspes and Dr. Zain-ul-Abdin, Halmstad University
 Opponent: Professor Johan Eker, Ericsson Research, adjunct professor at Lund University
 Examiner: Professor Mohammad Mousavi, Halmstad University

The arrival of manycore systems enforces new approaches for developing applications in order to exploit the available hardware resources. Developing applications for manycores requires programmers to partition the application into subtasks, consider the dependence between the subtasks, understand the underlying hardware and select an appropriate programming model. This is complex, time-consuming and prone to error.

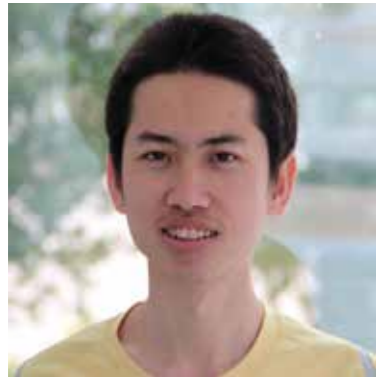
In this thesis, we identify and implement abstraction layers in compilation tools to decrease the burden of the programmer, increase programming productivity and program portability for manycores and to analyze their impact on performance and efficiency. We present compilation frameworks for two concurrent programming languages, occam-pi and CAL Actor Language, and demonstrate the applicability of the approach with application case-studies targeting these different manycore architectures: STHorm, Epiphany and Ambric.

For occam-pi, we have extended the Tock compiler and added a backend for STHorm. We evaluate the approach using a fault tolerance model for a four stage 1D-DCT algorithm implemented by using occam-pi's constructs for dynamic reconfiguration, and the FAST corner detection algorithm which demonstrates the suitability of occam-pi and the compilation framework for data-intensive applications. We also present a new CAL compilation framework which has a front end, two intermediate representations and three backends: for a uniprocessor, Epiphany, and Ambric. We show the feasibility of our approach by compiling a CAL implementation of the 2D-IDCT for the three backends. We also present an evaluation and optimization of code generation for Epiphany by comparing the code generated from CAL with a hand-written C code implementation of 2D-IDCT.



Le-Nam Hoang

Licentiate thesis



Relaying for Timely and Reliable Message Dissemination in Wireless Distributed Control Systems

Licentiate thesis, Halmstad University
 Main supervisor: Docent Elisabeth Uhlemann, Halmstad University
 Co-supervisor: Professor Magnus Jonsson, Halmstad University
 Discussion leader: Docent Fredrik Brännström, Chalmers University of Technology
 Examiner: Professor Antanas Verikas, Halmstad University

Distributed control applications enabled by wireless networks are becoming more and more frequent. The advantages of wireless access are many, as control systems become mobile, autonomous and connected. Examples include platooning and automated factories. However, distributed control systems have stringent requirement on both reliability and timeliness, the latter in terms of deadlines. If the deadline is missed, the packet is considered useless, similarly to a lost or erroneous packet in a system without deadlines. In addition, wireless channels are, by nature, more exposed to noise and interference than their wired counterparts. Consequently, it implies a considerable challenge to fulfill the deadline requirements with sufficient reliability for proper functionality of distributed control applications. However, by taking advantage of cooperative communications, increased reliability can be achieved with little or no additional delay.

Reducing the delay until a message is successfully received is a two-fold problem: providing channel access with a predictable maximum delay and maximizing the reliability of each transmission, once granted by the medium access method. To this end, this thesis proposes a framework that provides a bounded channel access delay and handles the co-existence of both time-triggered and event-driven messages encountered in distributed control applications. In addition, the thesis proposes and evaluates an efficient message dissemination technique based on relaying that maximizes the reliability given a certain deadline, or alternatively determines the delay required to achieve a certain reliability threshold for both unicast and broadcast scenarios. Numerical results, which are verified by Monte-Carlo simulations, show significant improvements with the proposed relaying scheme as compared to a conventional scheme without cooperation, providing more reliable message delivery given a fixed number of available time-slots. It also becomes clear in which si-

tuations relaying is preferable and in which situations pure retransmissions are preferable, as the relay selection algorithm will always pick the best option. The relay selection algorithm has a reasonable complexity and can be used by both routing algorithms and relaying scenarios in any time-critical application as long as it is used together with a framework that enables predictable channel access. In addition, it can be implemented on top of commercially available transceivers.



Benjamin Vedder

Licentiate thesis

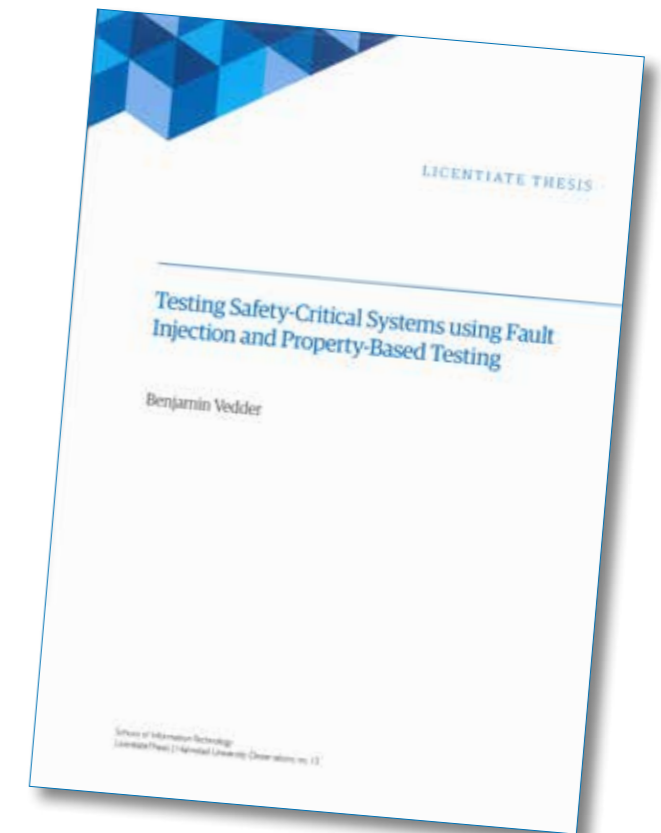


Testing Safety-Critical Systems Using Fault Injection and Property-Based Testing

Licentiate thesis, Halmstad University
 Main supervisor: Professor Magnus Jonsson, Halmstad University
 Co-supervisor: Dr. Jonny Vinter, SP
 Discussion leader: Dr. Andreas Johansson, Conmore Ingenjörbyrå, Hyssna
 Examiner: Docent Nicholas Wickström, Halmstad University

Testing software-intensive systems can be challenging, especially when safety requirements are involved. Property-Based Testing (PBT) is a software testing technique where properties about software are specified and thousands of test cases with a wide range of inputs are automatically generated based on these properties. PBT does not formally prove that the software fulfils its specification, but it is an efficient way to identify deviations from the specification. Safety-critical systems that must be able to deal with faults, without causing damage or injuries, are often tested using Fault Injection (FI) at several abstraction levels. The purpose of FI is to inject faults into a system in order to exercise and evaluate fault handling mechanisms. The aim of this thesis is to investigate how knowledge and techniques from the areas of FI and PBT can be used together to test functional and safety requirements simultaneously.

We have developed a FI tool named FaultCheck that enables PBT tools to use common FI-techniques directly on source code. In order to evaluate and demonstrate our approach, we have applied our tool FaultCheck together with the commercially available PBT tool QuickCheck on a simple and on a complex system. The simple system is the AUTOSAR End-to-End (E2E) library and the complex system is a quadcopter simulator that we developed ourselves. The quadcopter simulator is based on a hardware quadcopter platform that we also developed, and the fault models that we inject into the simulator using FaultCheck are derived from the hardware quadcopter platform. We were able to efficiently apply FaultCheck together with QuickCheck on both the E2E library and the quadcopter simulator, which gives us confidence that FI together with PBT can be used to test and evaluate a wide range of simple and complex safety-critical software.



Some highlights

Doctoral and Licentiate defence to come:

September 16, 2015

Wagner Ourique de Morais will defend his ph.d. thesis: "Architecting Smart Home Environments for Healthcare: A Database-centric Approach"

September 21, 2015

Hawar Ramazanali will defend his licentiate thesis: "Resource Handling for Military Training Networks"



The Halmstad Summer School on Testing provides an overview of the state of the art in testing, including theory, industrial cases, tools and hands-on tutorials by internationally-renowned researchers.

Prof. Walid Taha organized the HyML 2015 meeting at Rice University. The meeting brought internationally renowned academic and industry experts together to facilitate collaborations on research and education related to the hybrid systems modelling and simulation, validated numerics and formal semantics. Speakers included: Aaron Ames (Texas A&M University), Molham Aref (LogicBlox), Ferenc Bartha (Rice University), Albert Cheng (University of Houston), Jyotirmoy Deshmukh (Toyota), Franz Franchetti (Carnegie Mellon University), Walid Gomaa (Egypt-Japan University of Science and Technology), Gopal Gupta (University of Texas at Dallas), Vlad Kreinovich (University of Texas at El-Paso), Eugenio Moggi (University of Genova), Roland Philippsen and Gabor Simko (Google), Sriram Sankaranarayanan (University of Colorado), and Walid Taha (Halmstad University and Rice University).



Halmstad Colloquium

The Halmstad Colloquium is a distinguished speaker series. The prominent speakers are invited from universities around the world to talk about topics of interest for the researchers within our research environment Halmstad Embedded and Intelligent systems research. The Halmstad Colloquium is hosted by the School of Information Technology. Guest 2014-2015 invited by CERES:

Manfred Broy, professor in Informatics at Technical University of München, Germany. "Seamless Modeling in the Development of Cyber-Physical Systems"

Professor Kazunori Ueda, Department of Computer Science and Engineering Waseda University, Tokyo, Japan. "A Hybrid Constraint Language HydLa and Its Implementation"

Professor Giorgio Buttazzo, RETIS lab Scuola Superiore Sant'Anna, Pisa, Italy. "Real-time Support for Multicore Platforms"

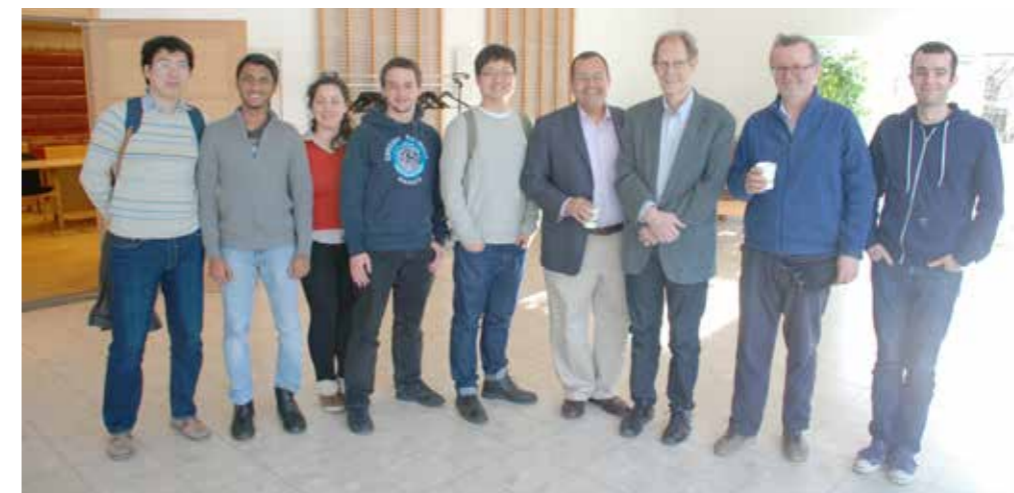
Neil Jones, professor emeritus at DIKU (Department of Computer Science), Copenhagen University, Denmark. "Programs = Data = First-class Citizens in a Computational World"

Eugenio Moggi, Professor, Univ. di Genova, Italy. "Hybrid System Trajectories as Partial Continuous Maps"

Dr. Elisabeth Uhlemann from CERES organized a Workshop on Wireless Vehicular Communications at Halmstad University, Sweden on November 11, 2014 with around 40 participants. The workshop featured an invited speaker, Dr. Thomas Zemen from FTW Telecommunications Research Center Vienna, Austria, funded by the IEEE VTS as well as presentations by researchers from Chalmers, Lund and Halmstad Universities. Participants came from Lund, Chalmers, Halmstad, and Linköping Universities as well as SP Technical Research Institute of Sweden, Viktoria Swedish ICT, Volvo Group Trucks Technology, Volvo Cars, Ericsson, Qamcom Research and Technology, WSN Consults Ltd, Noventus Systems, Advanced Circuit Design & Wireless Technology and Kristensson Konsult AB.



Dr. Thomas Zemen from FTW Telecommunications Research Center Vienna, Austria at the CERES workshop



Neil Jones (seven from left), and part of the audience at the Halmstad Colloquium, February 26, 2015

embedded conference **scandinavia** SCANDINAVIA'S LEADING EVENT IN EMBEDDED TECHNOLOGY

embedded conference **scandinavia syd**

CERES was, as in previous years, an important actor in Embedded Conference 2014. CERES personnel led one session and gave two talks. CERES also contributed with two demos in the Action Area; one Quadcopter demo given by a PhD student at SP Technical Research Institute of Sweden in collaboration with Halmstad University, and one demo of Nao robots given by two students from Halmstad University. The CERES stand had a focus on Electronics Center in Halmstad, an arena for regional cooperation in the field of electronics.

The Robot hand

Six students at the School of Information Technology developed the "Robot hand", a nice example of cooperation between students with different skills. The hand imitates the movement of a human hand in front of a camera by using image analysis, a control system, servo motors and precision mechanical solutions.



CERES

Presentation and Activity Report 2014-2015

Guests from Rice University



In 2008, I have received my MSc at the University of Szeged, Hungary in theoretical mathematics. My thesis concentrated on the qualitative properties of delay differential equations. I have obtained my PHD in 2012 at the University of Bergen, Norway under the supervision of Prof. Walid Tucker from the University of Uppsala, Sweden. Our research was centered around validated numerics, in particular we investigated global attractors of difference equations and stationary solutions of a certain class of partial differential equations using rigorous computations. Now I am working in the Effective Modeling Group with Prof. Walid Taha as a Post-doc at Rice University, Houston. The goals of our project are to improve and develop further the rigorous computations of the software Acumen, thus, making state of the art validated numerics easily accessible to the Hybrid Systems community.



Ferenc Bartha

I received my BSc in electronic engineering from XiDian University, China in 2010, and my MSc degree in embedded and intelligent systems in Halmstad University, Sweden in 2012. I'm currently a Ph.D student in computer science at Rice University, and working with Effective Modeling Group at Halmstad University, where I am applying programming language techniques like partial evaluation and binding time analysis to increase the expressiveness of the Acumen language. The work is done under the supervision of Prof. Walid Taha.



Yingfu Zeng

Dr. Zain-ul-Abdin has been arranging the special track on Coarse-Grained Reconfigurable Computing since 2013 held in conjunction with the International Conference on ReConfigurable Computing and FPGAs (ReConFig- www.reconfig.org), Cancun, Mexico. The track focuses on Coarse-Grained Reconfigurable Architectures (CGRA), which offer massive parallelism coupled with the capability of undergoing runtime reconfiguration to meet the increased computational demands of high-performance embedded systems.

Dr. Zain-ul-Abdin has been the Co-Chair of Self-Adaptive and Reconfigurable Computing track held in conjunction with the 12th IEEE/IFIP International Conference on Embedded and Ubiquitous Computing (EUC) (<http://euc14.necst.it>) Milan, Italy in August, 2014. The focus of the track was self-adaptive and self-healing systems, reconfiguration management techniques, and novel applications for reconfigurable computing.



CERES

Presentation and Activity Report 2014-2015

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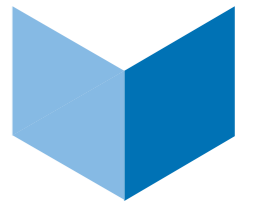
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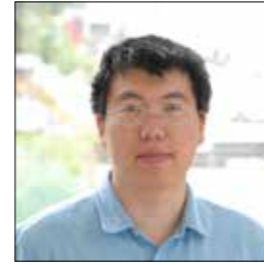
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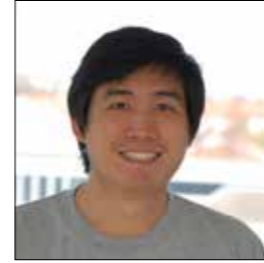
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CERES Publications 2014-2015

(updated August 2015)

International full-paper reviewed journal papers

2015 (including papers accepted for publication 2015 or later)

Belyaev, E., A. Vinel, A. Surak, M. Gabbouj, M. Jonsson, and K. Egiastian, "Robust vehicle-to-infrastructure video transmission for road surveillance applications," *IEEE Transactions on Vehicular Technology*, vol. 64, no. 7, pp. 2991-3003, July 2015.

Beohar, H., M. Varshosaz, and M. R. Mousavi, "Basic behavioral models for software product lines: Expressiveness and testing pre-orders," *Science of Computer Programming*, online July 9, 2015.

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CERES, the Centre for Research on Embedded Systems, is a long-term research programme established by Halmstad University with support from The Knowledge Foundation and Swedish industry. The focus is on cooperating embedded systems, with applications in areas such as traffic and transport, health care, and sensing and communication systems. The industrial partners include multinational companies as well as research-based growing companies.



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