



Certus

Centre for Software Verification & Validation

Newsletter
June | 2016

Certus is a research-based innovation centre that unites some of the brightest heads in software validation and verification research.

The Certus centre has established a body of methods and tools for the validation and verification of software-intensive systems, and focuses on three types of systems:

- Real-time embedded software systems
- Highly configurable software systems
- Data-intensive software systems

The Centre's objective is to deliver research results within the field of software testing at a high international standard.

Certus at a glance

6 collaborating partners:

- ABB
- Cancer Registry of Norway
- Cisco
- Esito
- Kongsberg Maritime
- Simula Research Laboratory
- Norwegian Customs

People involved (2015):

- 56 people

Budget (2016)

- 21 420 000,- NOK



The Certus User Partner Workshop

The User Partner Workshop of the spring of 2016 took place April 28-29, kindly hosted by the Cancer Registry of Norway, which has recently joined the ranks of the user partners.

The event was conjointly organised with OKONI, a French consultancy agency specialised in the creation of innovative laboratory work and education, and the partners of the Certus consortium. The format of the two day workshop deviated from a standard seminar event, as OKONI had laid out two tables full of various creative utilities, including building blocks, markers, spray paint, and small-scale electrical engineering equipment.

UPW Spring 2016:

- April 28-29
- At the Cancer Registry of Norway

Attendees:

- ABB Robotics: 4
- Cancer Registry: 5
- Cisco: 5
- ESITO: 3
- Kongsberg Maritime: 3
- Norwegian Customs: 3
- Simula: 12





The workshop aimed at creating physical exhibitions around Certus' two mainstream technologies, namely CRYSTAL and DEPICT. For that purpose, OKONI helped both the researchers and engineers in creating concrete presentations of these technologies. The goal was to facilitate a shared understanding of their potential and purposes.

Arnaud Gottlieb, leader of Certus Centre, says that "Innovative use cases of CRYSTAL and DEPICT were proposed and directions for further collaborations emerged naturally from this workshop."

"I am delighted to see that we managed to create this level of trust and understanding which permits us to co-create and co-innovate altogether, and look at the future of Certus with great confidence," Centre leader Arnaud Gottlieb continues.

The input and feedback received during and after the event has been a beneficial learning experience for Certus, and we hope that this feeling extends to the consortium.



New member of the Certus consortium

CANCER Registry of Norway



Director of CRN
Jan Nygård

In 2016, Certus expanded the consortium to include the Cancer Registry of Norway (CRN). Software systems are an integral part for the effective functioning of any medium to large-sized organisation such as CRN, but CRN is in a unique position due to the amount of medical data that must be processed confidentially and always be kept up to date.

This is where a partnership with Certus may produce interesting results. “Having CRN as a partner of Certus opens up the door to perform collaborative research in data quality assessment, and software testing”, says Research scientist Sagar Sen, who works closely with CRN. He continues: “As a contributing user-partner, CRN now drives forward the research activities undertaken by researchers of the center, and it can expect the Certus center to develop research ideas and produce research results (i.e., prototype tools, methodologies, knowledge transfer) in mobile social computing and information systems reliability dedicated to its very specific needs. We believe that joining hands to exploit interdisciplinary expertise is an uncharted territory and with this partnership we will set sail towards unprecedented breakthroughs.”

This is the Cancer Registry of Norway:

- Organisation that maps cancer cases in Norway
- Performs clinical, screening-based and etiological research
- 160 employees
- They receive around 140 000 notifications related to cancer illness each year.

What's new with Certus?

January

On January 1st, Are Magnus Bruaset of Simula stood down as the Leader of the Board, and passed the torch to Jan Christian Kerlefsen of ABB.

Mr. Kerlefsen, who has considerable experience with applied research, is excited to contribute to the development of Certus in its final phase. "Coming from an applied research background, I am excited about the SFI instrument and the possibilities to leverage on the cooperation between world class research and world class industrial software development. I am proud to serve as the chair of the board, and I am looking forward to continue the success of the centre," he states.

Certus has been active since 2011, and is now well past the midway point, where it is natural to focus on the continuation of the work after the SFI project has run its term. Mr. Kerlefsen says, "During the lifetime of the centre, we produce research, we arrange workshops and we run value-creating projects for the partners. With all the public funding given to the centre, I also feel a strong obligation to create something that will continue to deliver value after the SFI period."

The discussions on the post-SFI potential for Certus have already begun. "For the exit strategy, we are discussing a Certus Testing Laboratory. The discussion is ongoing in the consortium, and we begin to see the outlines of how we can leverage on the results of the centre to create something that is sustainable and can outlive the SFI period," Kerlefsen states.

Resumé, in brief:

- 2012 – present: Head of ABB Robotics Norway, ABB Robotics, Bryne
- 2012 – present: R&D Manager, ABB Robotics, Bryne
- 2005 – 2012: R&D Manager Software, ABB Robotics, Bryne
- 2002 – 2005: R&D Engineer, ABB Robotics, Bryne
- 1999 – 2002: Senior Software Designer, Sony Corporation, Tokyo
- 1993 – 1999: Research Scientist, Norsk Regnesentral, Oslo
- 1993: Sivilingeniør, Computing Science University of Newcastle-upon-Tyne/NTH



What's new with Certus?

Certus researchers actively participate in international workshops and conferences. In the spring of 2016, our researchers have attended several conferences .

February

Innovative Applications of Artificial Intelligence (IAAI)

From February 12 to February 17, Centre leader Arnaud Gotlieb attended **The Innovative Applications of Artificial Intelligence (IAAI)** conference, which is a track of the **Association for the Advancement of Artificial Intelligence Conference (AAAI'16)**, at the Phoenix Convention Center in Arizona, USA.

AAAI is the premium venue for publishing new and astonishing results in Artificial Intelligence. Centre leader Arnaud Gotlieb represented Certus at the conference for the first time this year, presenting results from collaborative research between Simula, Cisco and ABB.

The presentation of the paper “Automated regression testing using constraint programming”, was very well received and attracted a broad audience. The paper was co-authored with Mats Carlsson from SICS (Sweden), Marius Liaaen from Cisco, and Dusica Marijan and Alexandre Petillon from Simula.

By attending the conference, a first step has been taken towards the inclusion of more artificial intelligence in the exciting challenges and new application areas brought by Certus industrial partners.



What's new with Certus?

May

The International Conference on Software Engineering (ICSE)

May 14 - 22: **The International Conference on Software Engineering (ICSE)** is the most prestigious software engineering conference. It aims at publishing high quality works covering the entire lifecycle of software development from requirement to testing. This year, Certus SFI contributed to ICSE by producing two papers based on the joint work between researchers in Certus (postdoctoral researcher Shuai Wang, senior research scientist Shaukat Ali and chief research scientist Tao Yue) and our industrial partners (Cisco).

Dr. Wang participated the conference located in Austin, USA and presented the two papers, which are “A Practical Guide to Select Quality Indicators for Assessing Pareto-Based Search Algorithms in Search-Based Software Engineering” in main technical track and “Enhancing Test Case Prioritization in an Industrial Setting with Resource Awareness and Multi-Objective Search” in Software Engineering In Practice (SEIP) track. Both of the presentations triggered interesting discussions and received inspiring questions and helpful feedback. This will prove fruitful for our future work.



What's new with Certus?

International Conference on Mining Software Repositories (MSR)

On May 14 - 15, researchers of Certus Project 9 (Smarter Testing of Evolving Systems) attended the 13th **International Conference on Mining Software Repositories (MSR)** to present their work on aggregating evidence from software analytics to improve change impact analysis and eventually testing recommendations. MSR is the premier conference on the use of software analytics and machine learning techniques to analyze the rich body of data that is produced during the software engineering process, and uncover interesting and actionable information for the evolution and management of software systems and projects.

The work presented by the Certus researchers is based on the observation that existing approaches for building recommendation engines generally only use the strongest piece of evidence even if multiple pieces of evidence exist, whereas better recommendations may be obtained by combining all existing evidence. The paper investigates various approaches for combining evidence and evaluates them on two large industrial systems (from Certus partners Kongsberg Maritime and Cisco) and four large open source systems. The evaluation results show that their proposed aggregation of evidence indeed leads to a significant improvement in the resulting recommendations.

Future events

Conferences to Attend:

- Genetic and Evolutionary Computation Conference (GECCO), 2016
- International Systems and Software Product Line Conference, 2016



Published journal articles

R. Bagnara, M. Carlier, R. Gori, and A. Gottlieb
Exploiting Binary Floating-Point Representations for Constraint Propagation
INFORMS Journal of Computing (JoC) 28, no. 1

A. Hervieu, D. Marijan, and A. Gottlieb
Practical Minimization of Pairwise-Covering Test Configurations Using Constraint Programming
Information and Software Technology 71 (2016): 129-146.

J. De La Vara, M. Borg, K. Whuk, and L. Moonen
An Industrial Survey of Safety Evidence Change Impact Analysis Practice
IEEE Transactions on Software Engineering 99 (2016)

L. Moonen and A. R. Yazdanshenas
Analyzing and Visualizing Information Flow in Heterogeneous Component-Based Software Systems
Information and Software Technology 77 (2016): 34-55

Published refereed proceedings

T. Rolfsnes, S. Di Alesio, R. Behjati, L. Moonen and D. Binkley
Generalizing the Analysis of Evolutionary Coupling for Software Change Impact Analysis
In 23rd IEEE International Conference on Software Analysis, Evolution, and Reengineering (SANER). IEEE, 2016.

A. Gottlieb, M. Carlsson, M. Liaaen, D. Marijan and A. Petillon
Automated Regression Testing Using Constraint Programming
In Twenty-Eighth Conference on Innovative Applications of Artificial Intelligence (IAAI-16), Phoenix, AZ, USA, Feb. 2016.

M. Mossige, A. Gottlieb and H. Meling
Generating Tests for Robotized Painting Using Constraint Programming
In Int. Joint Conf. on Artificial Intelligence (IJCAI-16) - Sister Conference Best Paper Track. New York City, 2016.

S. Wang, S. Ali, T. Yue, Y. Li and M. Liaaen.
A Practical Guide to Select Quality Indicators for Assessing Pareto-Based Search Algorithms in Search-Based Software Engineering.
In the 38th International Conference on Software Engineering (ICSE), pp. 631-642, 2016.

S. Wang, S. Ali T. Yue, Ø. Bakkeli, and M. Liaaen.
Enhancing Test Case Prioritization in an Industrial Setting with Resource Awareness and Multi-Objective Search.
In the 38th International Conference on Software Engineering (ICSE), Software Engineering in Practice (SEIP) track, pp. 182-191, 2016.

T. Rolfsnes, L. Moonen, S. Di Alesio, R. Behjati, and D. Binkley
Improving Change Recommendation using Aggregated Association Rules
13th International Conference on Mining Software Repositories (MSR), pp. 73-84, 2016