SIMULA ANNUAL REPORT | 2011

[simula . research laboratory]

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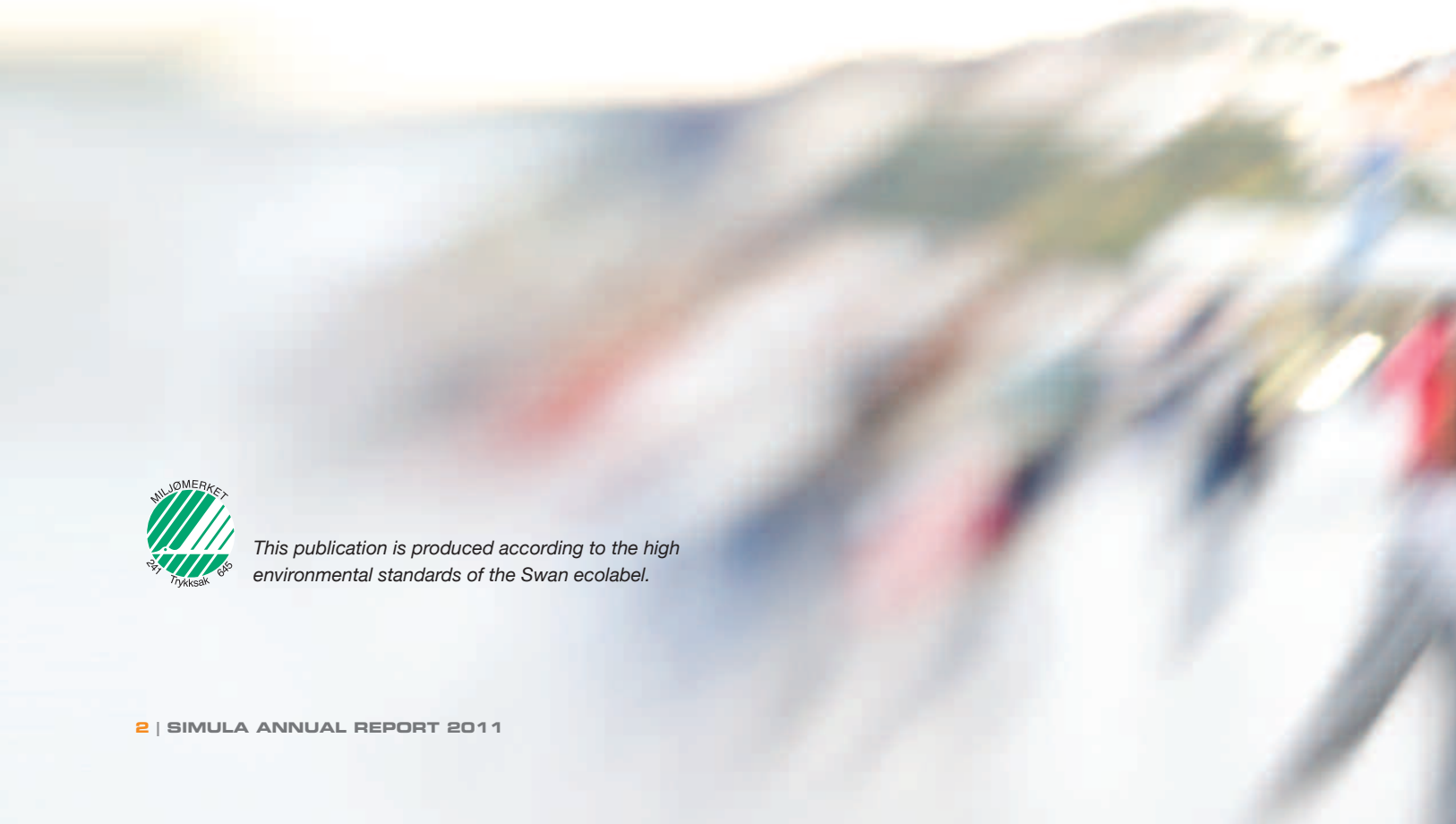

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CONTENTS

Simula is on a path toward being a completely international and multi-cultural organization.

Simula is the proud host of a Centre of Excellence and a Centre for Research-based Innovation.

THIS IS SIMULA RESEARCH LABORATORY

Dedicated to tackling scientific challenges with long-term impact and of genuine importance to real life, Simula offers an environment that emphasises and promotes basic research while still covering the broader landscape from postgraduate education to application-driven innovation and commercialisation.

SIMULA RESEARCH LABORATORY

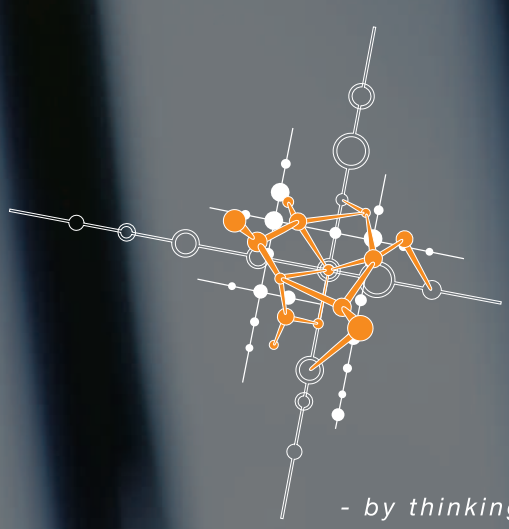
- A non-profit, public utility enterprise organised as a limited company owned by the Norwegian Ministry of Education and Research.
- Performing research at a top international level, conducting research education in collaboration with the University of Oslo, and fostering innovation based on conducted research.
- Established in 2001 and headed by Professor Aslak Tveito since 2002.

- Conducting basic research in the fields of communication systems, scientific computing, and software engineering.
- Proud of its international environment and cultural diversity, employing 126 exceptional minds from 25 different countries.
- Ranked by the Journal of Systems and Software as the world's most productive institution in systems and software research.
- Host for the Center of Biomedical Computing, which is a Centre of Excellence (SFF) awarded by the Research Council of Norway.

- Host for the Certus Center for Software Verification and Validation, which is a Centre for Research-based Innovation (SFI), awarded by the Research Council of Norway.
- Main research partner in the Centre for Cardiological Innovation (SFI), awarded by the Research Council of Norway and hosted by Oslo University Hospital.
- Cooperating with industry in order to provide solutions and increase the research's relevance. The largest stand-alone industry collaboration is with Statoil, and is worth 125 million NOK (2005-2015)

- Funded by the Ministry of Transport and Communications for the Resilient Networks Project, which is working to understand the vulnerability of network infrastructure in Norway.
- Since its inception in 2001, Simula researchers have supervised 54 PhDs and 227 master's degrees to completion.

KEY FIGURES 2011	2011
Operating Revenue	NOK 121 mill
Operating Result	NOK 5.8 mill
Basic Allowance	NOK 55 mill
Employees year-end	126
Active PhD students	32



- by thinking constantly about it

SIMULA BECOMES AN INTERNATIONAL MULTICULTURAL ORGANISATION

Over 40 years ago, the Norwegian Prime minister at the time, Lars Korvald[1], once opened an address to the Parliament by stating that "Norway is a country in the world". That observation was obviously true at the time and even more so today. Research has of course always been international by nature; real knowledge doesn't see borders. But the way research is performed has changed over this period; both research and higher education have to a large degree become international undertakings.

Internationalization seems to be accelerating, and we see the effects of this at Simula. When I took over as leader of Simula in 2002, one year after its inception, we had employees from six countries, and 12% of our employees were non-Norwegian. Today, 25 countries are represented, 47% of our staff is non-Norwegian, and 50% of our department managers are non-Norwegian. Clearly, Simula relies heavily on researchers hired from abroad. In part, this is due to the general trend of internationalization of research, but it is also a firm result of our strategy to hire the best researchers we can find. Over the last couple of years, Simula has been extremely successful in attaining new funding. (For an overview of new projects, see page 33.) Furthermore, our production has increased significantly and we have received favourable evaluations. Many – if not all – of these results rely heavily on the excellent contributions of our non-Norwegian employees. Simula has clearly benefited from the internationalization of research.

At the end of 2011, we announced an open post-doc position and we received applications from 36 very well qualified candidates; two of them were Norwegian, and we ended up hiring a candidate from India with a PhD from the US. This illustrates the ongoing process of internationalization; Simula is on a path toward being a completely international and multicultural organization. This path is fully aligned with our overall strategy of becoming an internationally leading organization in our fields of interest.

A strong force in the internationalization of research is clustering around very strong groups. Researchers always want to be part of the leading groups within their fields. This force has important implications for organizations active in research and higher education. In Prime Minister Korvald's time, it was an adequate goal for an institution to lead at the national level. Today, leading at the national level – at least in Norway – is of little interest, since students and researchers seem to discard national boundaries and gravitate toward internationally prominent groups. Therefore,

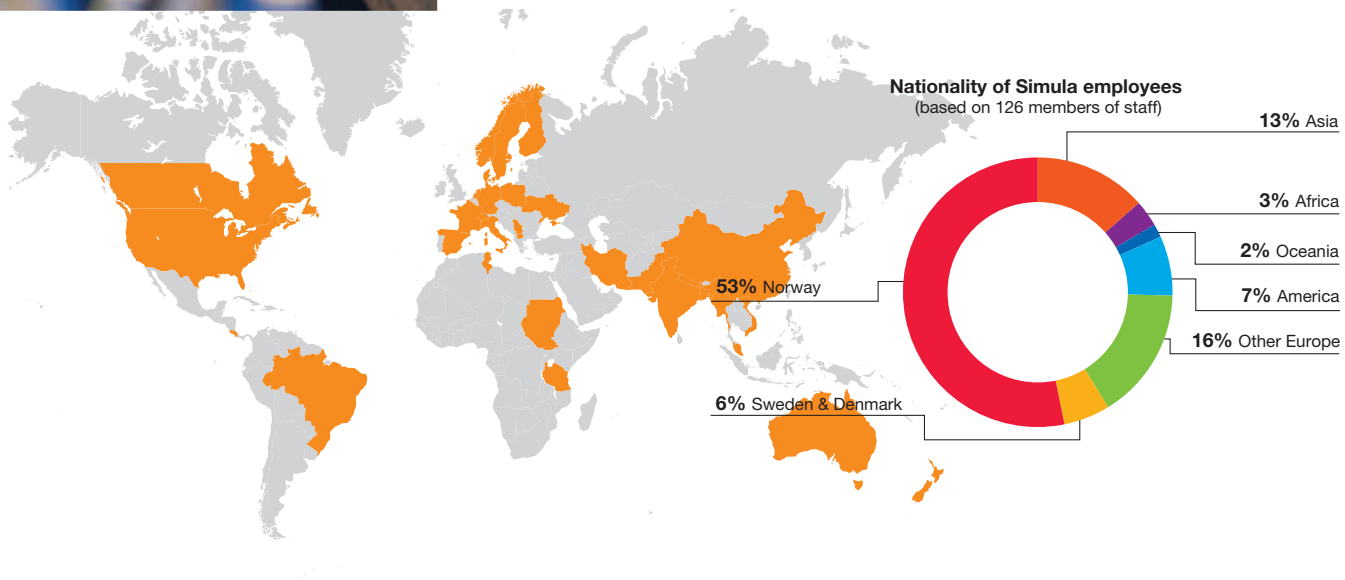
[1] *Lars Korvald (29 April 1916 – 4 July 2006) was the Prime Minister of Norway for one year beginning October 1972 in the wake of the first referendum over membership in the EU; see http://en.wikipedia.org/wiki/Lars_Korvald.*

institutions need to define a strategy that concentrates on specific fields, and they must focus their efforts and resources accordingly. Within these fields, they can become influential internationally, achieve better funding, attract the best employees, and do great science. Institutions that do not realize and accept this will become marginalized and eventually decline, and perhaps even disappear. The education market follows the same trend; why should a brilliant student follow a mediocre program in one place, if another place has excellent opportunities?

There is every reason to believe that internationalization of research and higher education will continue with full intensity. It is therefore of great importance for Norway to focus its resources spent on research and education such that it develops and maintains research groups of the highest quality, along with educational programs that can compete among the best around the world. In order to attract researchers from around the world, it is essential to offer conditions that compete with other institutions. Simula – and other research organizations in Norway – compete very well regarding conditions such as salary and infrastructure for their researchers. However, Simula has until recently suffered on one decisive point: we have not been able to assure long-term contracts for excellent researchers. This is because our basic funding has not been adjusted for inflation. We are therefore extremely pleased with the recent decision by the Ministry of Research and Higher Education to adjust our basic allowance starting with the next fiscal year. Therefore, Simula is now well positioned to fully compete in the global market for research and education.

We have kept our focus on three specific fields of research over 10 years, and there are no plans to change this. Further, we are well staffed with excellent researchers from many countries, we have identified strong international partners, and we have systematically increased our collaboration with them. As a result of this policy, I am writing this little piece sitting in my temporary home in La Jolla, California, where I am spending the year as a guest researcher at the University of California, San Diego.

Professor Aslak Tveito
Managing Director



THE CERTUS CENTRE

Model-Driven Software Engineering and extensive industry collaboration is the primary strategy of the Certus Centre. As in other engineering disciplines, models in software engineering should play a central role to enable abstraction, separation of concerns, and early analysis of requirements, architecture, and design. In our experience this is the most effective way to provide automated, scalable support for Verification and Validation (V&V).

Certus, initaited in 2007, is the only research group in Norway that has a strong focus on model-based software V&V. Industry collaboration is a primary focus of Certus in order to identify relevant research questions and to develop applicable solutions.

Certus partners span both the commercial and governmental sectors, and include entities such as FMC Kongsberg Subsea, Cisco, and the Norwegian Customs and Excise department. In January 2011, the Research Council of Norway awarded Certus the status as Centre for Research-based Innovation.

sfi Centre for Research-based Innovation

The maiden flight of Ariane 5 on 4 June 1996 failed, with the rocket self-destructing after 37 seconds, because of a malfunction in the control software. History is full of such software failure examples: airplanes have crashed, patients have died from incorrect medication, financial systems have broken down, and cars have been recalled from the market due to software bugs.

In 2002, the US National Institute for Standards and Technologies (NIST) estimated that the direct cost of software failures in the American economy reached USD 60 Billion annually. Today, this cost is probably much higher. NIST claimed that most software verification and validation activities are poorly managed and not supported by appropriate, scalable technologies that would be necessary to increase system dependability. The Certus Centre has the ambition to improve this situation, which has remained mostly unchanged over the last decade.

SOFTWARE VERIFICATION AND VALIDATION

Software is pervasive in all areas of society. Business and safety critical systems are increasingly using software to improve productivity, enable more sophisticated operations, and provide flexibility in handling evolving needs. To ensure successful delivery of its function and to avoid posing undue risks to its users or the environment, software must be reliable, robust, efficient, safe, and secure. All these properties are facets of a more general property often known as dependability. Improving system dependability first and foremost relies on the ability to verify and validate (V&V) software systems in a cost-effective manner. In the current state of practice, software V&V is costly, laborious, and often incomplete due to the lack of practical, automated, and scalable technologies.

INDUSTRIAL IMPACT

Despite the existence of commercial environments for test scripting and execution and a handful of tools for model-based testing, little of the V&V research has ever made it to industrial practice. Further, little is known about the cost-effectiveness of most V&V technologies because limited empirical evidence exists regarding their benefits and cost. Scalability is a particularly acute issue because many proposed analysis techniques and software testing strategies often do not scale up to the size and complexity of modern systems.

These shortcomings are not only the result of inadequate technologies and management techniques, but they are also due to a lack of technology transfer from the research community to industrial practice as well as a superficial understanding of industrial V&V challenges by many academic researchers. To have impact, one must strike a balance between rigor and effort, such that software artefacts can be analysed effectively, without being too expensive to build and evolve.

CERTUS PEOPLE*

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BETTER ESTIMATION OF SOFTWARE TASKS

The Better Estimation of Software Tasks department conducts multi-disciplinary research. We build on theories from software engineering, forecasting, program comprehension and reverse engineering, architecture and project management. There is a strong link to psychology, which is the background of several of our researchers. Our research in software quality assessment builds on expertise in automated software analysis and software repository mining. Experience and understanding of project management in very large projects is required, and strengthened through industrial collaboration.

We have made important steps in improving the understanding of the mental steps of expert estimation, including a better understanding when we can trust experts' judgments. This work has lead to improved estimation practices related to how to select proper project analogies, why and how to avoid unwanted impact from irrelevant information, and how to select proper estimation experts. We have also contributed processes that lead to more realism in the assessment of the uncertainty of the effort estimates, improved learning from experience and improved software bidding processes.

A MATTER OF JUDGEMENT

The ability of software customers to base investment decisions on accurate cost estimates is strongly tied to the ability of software providers to estimate the effort accurately. Similarly, the ability of project managers to plan a project, ensure efficient development work, and avoid failures frequently depends on accurate effort estimates. For continued development of existing software, estimations ideally build on quality assessment of the existing parts.

The potential to improve these estimations is believed to be high. First, a strong bias currently exists towards over-optimism in the cost estimates. Second, estimates suffer from a high degree of inconsistency. Third, the use of historical data and knowledge gathered from existing artifacts is limited.

Fourth, there is a lack of evidence-based selection of estimation methods. Finally, automated software inspection can correct problems early, when changes are still relatively inexpensive.

EVIDENCE-BASED EXPERT ESTIMATION

The understanding of how estimates for the cost and effort to develop software are derived is not well understood. Over the past 30 years, the software industry has been unable to improve its capability to accurately plan and estimate the cost of software projects, and the level of cost overrun and poorly managed projects remains high. Our department aims at developing an evidence-based theory of expert estimation.

MORE ACCURATE EFFORT ESTIMATES

We aim to construct new methods for effort estimation by combining the advantages of models and judgments, and improving the selection of estimation methods. We take a multi-disciplinary approach to this challenge, applying results from software engineering, psychology, forecasting, and project management.

EVIDENCE-BASED SOFTWARE INSPECTION AND ASSESSMENT

Building on research in city planning and architecture, we are investigating how a map metaphor can help software engineers explore and assess software systems. The aim is to develop novel techniques and tools that will improve the cost-effectiveness and efficiency of automated software inspection techniques, and advance the state-of-the-art in software assessments.

Our current focus is on the planning, cost estimation and quality assessment of very large projects in industry. Some of these projects have cost overruns of billions of dollars and waste huge amounts of scarce resources.

The development of the Flexus ticketing system took very long time, had a large budget overrun, and was delivered with much less functionality than planned.

BEST PEOPLE*

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* at end of 2011

CARDIAC MODELLING

In recent years, computational cardiac modeling and simulation have matured and may now contribute significantly to understanding heart disease. Researchers work collaboratively with both experimentalists and clinicians to create models with significant predictive power, from investigation of subcellular cardiac cell ion channel phenomena to multi-scale analysis of the whole heart.

The Cardiac Modeling department's research aims to elucidate mechanisms behind cardiac pathologies and to identify targetable processes, thus contributing to both a better understanding of cardiac arrhythmias and mechanical dysfunction, and improved long-term prevention and intervention. Recently, our department has focused on the role of several factors modulating arrhythmias and cardiac disease.

An ultimate goal is to harness clinical and industrial feedback, employ developed models via advanced techniques to assist in clinical practice, and inspire further elucidative experimental studies, resulting in an iterative and integrative research pipeline.

The department is associated with a Norwegian Center of Excellence, the Center for Biomedical Computing (CBC). Cardiac Modeling is also a main research partner in the new Center for Cardiological Innovation (CCI), a Norwegian Centre for Research-based Innovation hosted by Oslo University Hospital and partnered by GE Vingmed Ultrasound.

sfi Centre for Research-based Innovation

SFI-partner with Oslo University Hospital

WE NEED SAFE, EFFECTIVE, AND ACCESSIBLE THERAPIES

Despite the vast number of available pharmacological therapies to combat cardiac electrical and mechanical dysfunction, few have significant therapeutic effect. Novel strategies for drug therapy in cardiac disease are urgently required. This subfield is ripe for contributions and insight from modeling and simulation, which can not only provide novel understanding, but decrease costs associated with traditional experimental development.

Our research has focused on cardiac cell- and tissue-level electrophysiological models. For instance, we have successfully employed detailed Markov and Hodgkin-Huxley-based models to predict how drugs targeting mutations of the SCN5A gene affect global electrophysiology.

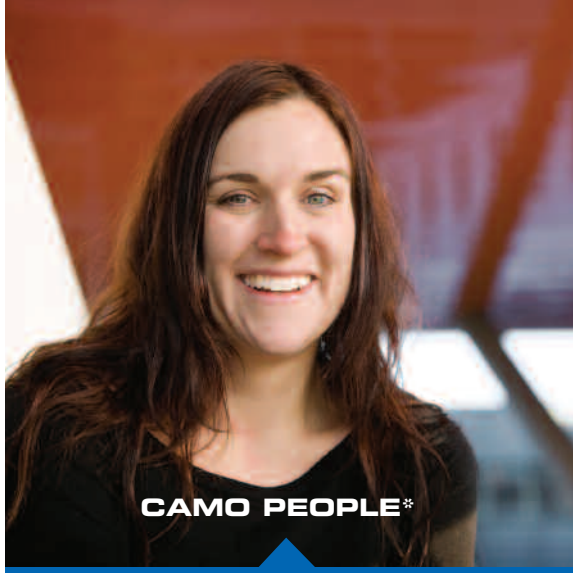
WE NEED TO CLOSE THE GAP BETWEEN VIRTUALITY AND REALITY

"Patient-specific simulation" has been a buzzword in personalized medicine. Generally, this refers to use of advanced medical imaging and techniques to create biophysically-based models offering increased insights in diagnostics, intervention, and treatment planning.

Traditionally, triage for cardiac care comes from evaluating patient measurements (e.g. echocardiography, ECG, MRI) against derived statistics of outcomes. However, individual humans are extremely complex and show great diversity. The need to treat the patient, rather than the disease, represents a substantial challenge and motivates increased use of mathematical models and computer simulations in clinical cardiology.

For example, one modern clinical treatment for heart failure is pacemaker-based cardiac resynchronization therapy (CRT). However, diagnostic methods for determining who will benefit from CRT are poor. To exploit CRT's full potential, better tools are clearly needed. A system that could predict patient-specific cardiac function directly from echocardiography and ECG measurements would be a potent and innovative clinical tool. We propose to achieve this via patient-specific computer simulations prior to pacemaker implantation, optimizing metrics that lead to a positive pacing response. Creating such a tool is a substantial challenge that requires expertise from the clinic as well as industry, but one that will allow clinicians to personalize CRT with a higher level of confidence in its success for the patient.

There is good news: all the pieces are there. We just need to close the gap.



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* at end of 2011
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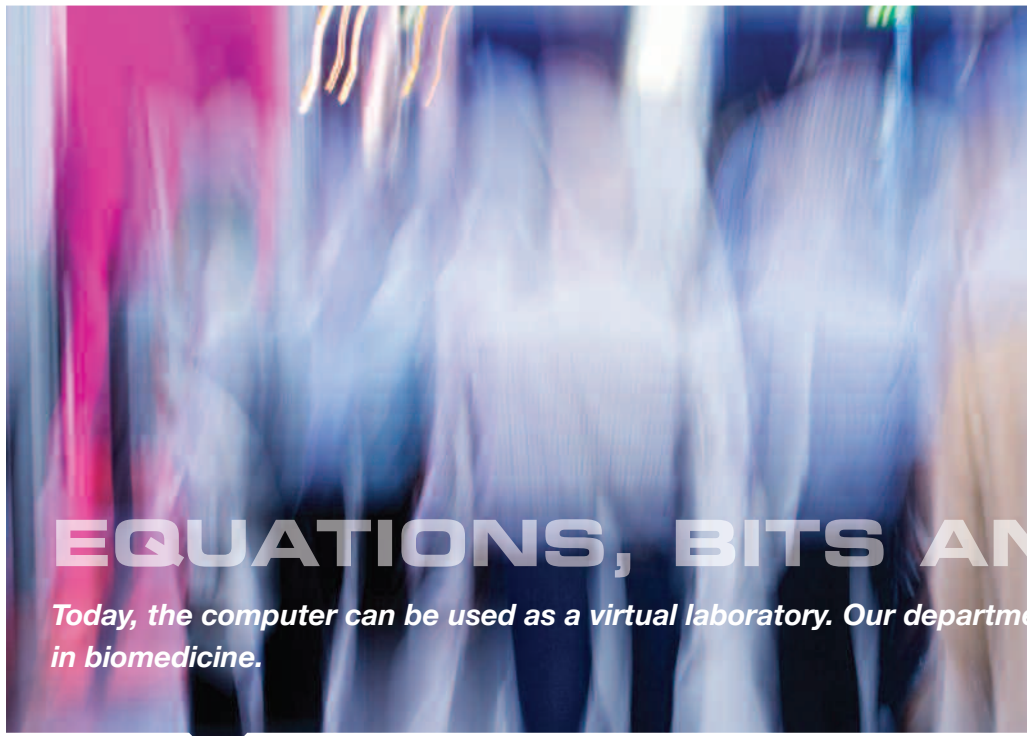
BIOMEDICAL COMPUTATIONS

The Biomedical Computation department is the core of a prestigious Norwegian Center of Excellence, named Center for Biomedical Computing. The center's long-term goal for its period of duration, 2007-2017, is to develop and apply novel simulation technologies to reach new understanding of complex physical processes affecting human health, by targeting selected medical problems where insight from mathematical modeling can contribute to changing clinical practice.

A key mission is to make new methods and software accessible to computational scientists and engineers through professional, open source software. This original software (primarily FEniCS) will help to advance many other scientific fields dealing with complex multi-physics problems, because the underlying mathematics and solution methods are the same across disciplines.

Our research approach relies on well-defined projects with multi-disciplinary teams, consisting of local staff interacting with internationally acknowledged experts in physical modeling, mathematics, numerical methods, scientific software development, bioengineering, medical research, and clinical treatment. The novelty of the research lies in our ability to attack the questions by a broad natural science approach and describe medical processes by mathematics, physics and biology.



Why do people with a malformed lower part of the brain occasionally develop cysts in the spinal cord, causing severe medical problems? We use computer simulations to test medical hypotheses from a physical point of view. Extensive computer modeling and simulation have helped to confirm the idea that abnormal anatomy leads to abnormal fluid flow in the spinal canal, which again may lead to pressure deviations in the spinal cord.

Through such an approach, we can develop theories to gain new understanding that previously would be impossible, unethical or impractical with real experiments or classical theory.

FENICS PROJECT

CAN SOFTWARE BE SIMPLE, GENERAL AND RELIABLE, YET EFFICIENT?

Traditionally, simplicity, generality, reliability and efficiency are contradictory goals for simulation software. However, due to the FEniCS Project, simulation codes that would normally take an expert months or even years to program can now be developed by novice users in a fraction of the time. This is possible by simplifying and automating the task of solving mathematical models based on partial differential equations (PDEs).

RELIABLE COMPUTER SIMULATIONS

Numerical simulations can be inaccurate or just plain wrong. Physical and visual inspections of solutions are not sufficient because even wrong solutions may look plausible. Instead, reliable error estimates should be used to assess the accuracy of numerical results. Unfortunately, such estimates are not in widespread use because of their mathematical and programming complexity. However, in the FEniCS Project we are well underway to automate the computation of error estimates for any given numerical simulation.

CAN PATIENT-SPECIFIC SIMULATIONS PREVENT STROKES?

The computational tools we develop in the FEniCS Project enable us to investigate complex three-dimensional physiological processes taking place in individual patients. Simulations can indicate the necessity of surgery, and predict certain effects of different surgical options. These computations can be used to save lives, validate theories and hypotheses, and gain new insight capable of changing medical practice and understanding.

The upper 10% of the kinetic energy in two different aneurysms. The aneurysm to the left focuses the energy at the top and ruptures, while the right one dissipates the energy throughout the whole aneurysm.

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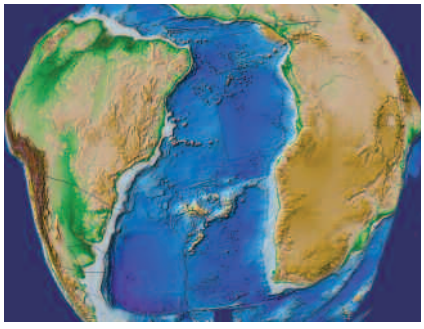
COMPUTATIONAL GEOSCIENCE

The Norwegian oil and gas industry spends millions of dollars on exploration in an environment in which oil is scarcer than ever before. The new frontier for exploration is finding reservoir rocks buried deeper or more inaccessible than ever before. Collecting data about the subsurface becomes more and more expensive and unreliable and so the industry is turning to computer simulations to map the subsurface and its possible resource content. The challenges involved in integrating scarce data into simulations, building new models or understanding how the earth looked in the distant past motivate our work.

SOLVING THE "PUZZLE EARTH"

When continental drift was discovered, scientists realised that the surface of the Earth was radically different tens to hundreds million years ago. Once the world was accurately mapped, fitting the outline of the continents together, like a puzzle, showed that the similarities weren't a coincidence; the idea of the super-continent Pangea was born. Such reconstructions are now done by computers and refined by our understanding of the rifting processes between the continents. However, developing a single model of this type is time consuming and involves making many assumptions. Thus, hypothesis testing is difficult. We aim at solving this refined "Puzzle Earth" by applying new software and methods that allow us to track the uncertainties and enable us to evaluate the likelihood of a particular fit of the puzzle.



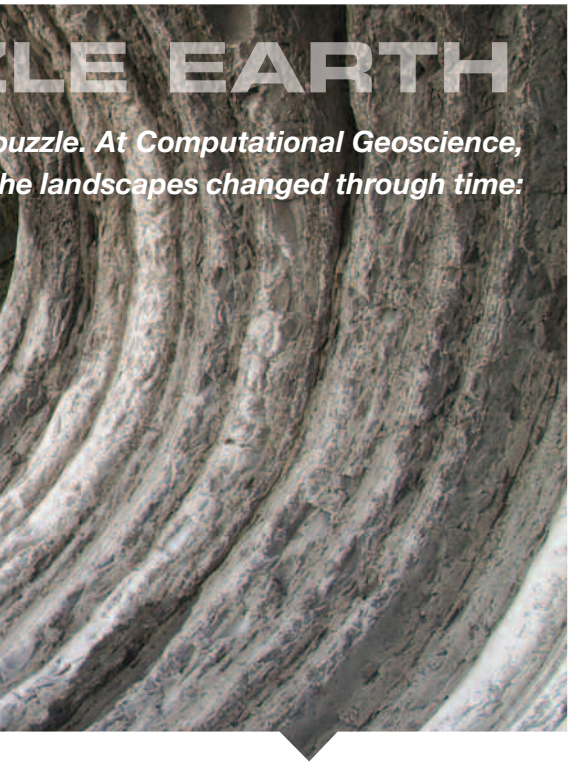
Tectonic reconstruction of the South Atlantic 80 million years ago (courtesy: Statoil and Kalkulo).

GOING BEYOND GAMING:
Graphics Processors in Geoscience

The graphics processing unit or GPU is the fastest developing technology in the modern computer. Recently, hybrid supercomputers with large numbers of GPUs have been developed. Such computers provide the potential for large amounts of computer power at far reduced power consumption rates but are difficult to program. Just as Google Translate automatically translates webpages from one human language to another, new technology is allowing scientific software to be automatically optimized for use on a GPU. This automated framework has the potential of considerably enhancing the productivity of computational geoscientists, letting us focus on the scientific questions.

CHALLENGES IN INDUSTRIAL COMPUTING

There are two principal challenges with geological observations: the time problem and the space problem. Geological observations are obtained in the present, but are used to infer the history of the Earth over millions of years. When developing models of the Earth's evolution on those time scales, we cannot validate the model with direct observations of its past state: the time problem. As for the space problem, we are unable to dissect the Earth except for small portions found at the surface or when drilling. While we can make indirect observations, for example by measuring the Earth's magnetic or gravity field, again models have to be developed to link that to the internal structure. To solve this problem, we are investigating ways of best using the available data to constrain model parameters, choose a particular model over another or quantify the uncertainty of our model based on our assumptions.



Folded geological layers at the Zumaias beach, Basque Country.

COMPUTATIONAL GEOSCIENCE AT SIMULA

The department consists of scientists with a mix of nationalities and academic backgrounds. Our team includes geophysicists, geologists, applied mathematicians, statisticians, computer scientists and physicists. This interdisciplinary environment breeds innovative geoscience of relevance to academia and Norwegian industry. Since 2005, Simula has had a close collaboration with Statoil, addressing computational challenges related to oil and gas exploration. Statoil funds a significant portion of the department's research and the development of supporting software by Simula's commercial subsidiary, Kalkulo.

COMPGEO PEOPLE*

Stuart Clark, Head of Department

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TO TRUST OR NOT TO TRUST

An electronic device is no longer a stand-alone instrument, but communicates and collaborates with other devices in ways that are not obvious.

When you press "search" on your device, a machine owned by your telecom operator authorizes your usage of the network. A second machine translates the text "www.searchprovider.com" into the physical address of the right server park. On its way from your cellphone to the server park, your request is handled and forwarded by a base station and tens of routers and switches through the Internet. Within the server park, there are thousands of processors that are connected through an interconnection network. Tens of switches and processors in the center are involved in processing your request, before the answer is sent back to you – possibly through another Internet path than the inbound one. For your simple search to work, literally hundreds of computers need to collaborate without faults.

UNDERSTANDING AND IMPROVING NETWORK ROBUSTNESS

We face the challenge of understanding and improving the robustness of complex interaction between machines. This challenge involves studying the unprotected and rugged environment of wireless communication, leading to new protocols. This understanding involves finding solutions to how millions of machines in a datacenter should be interconnected. With so many components in the center, there will never be an instance of time when all of them are fault free. Furthermore, new mechanisms are needed to keep national and global infrastructures functional through breakage incidents and unplanned events.

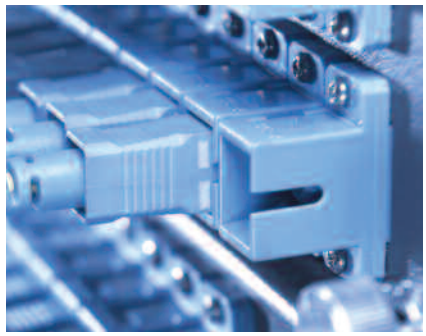
The complexity of data communication combined with the opaqueness of network structures and data center designs complicates the picture. Therefore, we need to approach the Internet by observations and measurements similarly to the way science has approached complex natural phenomena. Based on observed properties, we can define strategies and architecture that support the robustness and trustworthiness that we demand of our applications.

TECHNICAL CORNERSTONES IN SOCIETY

Networks are rapidly becoming the technical cornerstones of society's infrastructure. We have seen reports of network failures having stopped businesses, grounded airplanes, halted trains, hampered hospitals and treatment services, and isolated police forces. The evidence is widespread that networks are single infrastructures of failure for many services and functions that we depend on.

NETWORK SYSTEMS

When we move more of our services, software and computational platforms into the cloud, these things will be available to us only as long as the network connects us to them. When thousands of small green energy installations in the homes are able to produce power into the SmartGrid, our energy production will only work as well as the communication network that it uses to synchronize its production and distribution of electricity.



When electronic communication between patients and health personnel allows disabled and elderly people to live longer in their homes, this is safe only as long as the network is operational. For these reasons, we are working on the improvement of network trustworthiness.

The Network Systems department attacks the problem of trustworthiness along multiple axes. Through detailed analysis and mathematical modeling we understand properties of protocols for wireless access. Through simulation, we can understand the properties of network devices that have not yet been realized in hardware. Through measurements of existing networks, we assess their properties, and based on these properties, we devise new solutions that build upon the strengths and weaknesses that the measurements expose.

The Network Systems department collaborates with universities in Asia, Europe and America. Equally important, however, is the contact with the owners of the problems we work on. Our research results have been taken up by multinational companies, as well as by small national ones.

NETSYS PEOPLE*

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Stein Gjessing, Chief Research Scientist

Yan Zhang, Senior Research Scientist

Amund Kvalbein, Research Scientist

Ernst Gunnar Gran, Research Scientist

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Samuel Rodrigo Mocholi, Postdoctoral fellow

Sven-Arne Reinemo, Postdoctoral fellow

Ahmed Elmokashfi, Postdoctoral fellow

Sabita Maharjan, PhD Student

Hung Vo, PhD Student

Saif Shams, PhD Student

Kristian Evensen, Research Engineer

Jie Xiang, Research Engineer

* at end of 2011
** in adjunct position

MEDIA PERFORMANCE

Multimedia services comprise a large part of the available Internet services today, and the interaction with digital media pervades most people's everyday lives at home and at work. Video streaming, Voice-over-IP and online games are some prominent examples, which raise strict requirements to the entire system performance.

To provide best possible service quality, reduce bottlenecks and reduce costs, it is important to optimize the utilization of available resources and adaptively schedule access to all the different components.

The Media Performance department is active in several areas of distributed multimedia systems, but the branches of our research fit together to form one big picture. To maintain a firm grasp of the complete picture, we collaborate with national and international industrial and academic partners. We prefer to conduct experimental research, but do not tie ourselves to this or any other particular method.

Addressing the challenge of supplying interactive multimedia to Internet users, the Media Performance department seeks to reduce costs, increase the number of users, and optimize the perceived service quality. This goal ties together research areas that are as diverse as multicore programming and user perception. Our research keeps a global scope, since any level of a system may constitute a performance bottleneck.

VIDEO DELIVERY SYSTEMS

We cover a range of video delivery systems, from traditional video streaming, via video search, to 3D representation of content and delivery of free-view video. In a fairly mature part of the field, we address questions of efficient delivery and best user experience when using the adaptive segmented HTTP streaming that is currently favoured by industry. In a very young part of the field, we investigate means of combining video streams from sparse camera arrays that monitor large spaces to generate 3D scenes in real-time and deliver them to viewers.

One particular new result that we presented in 2011 was a new algorithm and prototype that was developed in cooperation with Netview Technology AS, which used GPS-based throughput measurements to crowdsource a database for bandwidth prediction on commuter routes; another result demonstrated that congestion control can interfere with server performance in adaptive TCP streaming systems such as MPEG DASH and Microsoft Smooth Streaming.

PERCEPTUAL VIDEO QUALITY ASSESSMENTS

To make the right decision in video coding, adaptation during transport and rendering on users' screens, it is necessary to understand how these decisions affect the people watching the result. Limited resources always inhibit the delivery of perfect quality. Adapting to available resources involves a choice

of, for example, compression method, target bandwidth, quantization factor, resolution or frame rates of videos. Whether decisions are good depends on external conditions, as well as content and user intent. We address the wide-open research field of good decision making.

Our work on perceptual quality evaluation led to new insights into video quality perception on mobile devices. We confirmed in more stringent experiments that infrequent switching of video quality is generally better for viewers' impression of quality than frequent switching that may exploit available bandwidth better. These experiments uncovered furthermore that quantization is the most beneficial scaling factor once scaling becomes necessary.

DISTRIBUTED DATA PROCESSING

Multimedia applications, especially in 3D, generate large data volumes that must be processed in a timely manner. With growing complexity and an increased user expectation, the computational demand for multimedia data processing grows. The latest hardware architectures use an increasing number of heterogeneous multi-core processors to cope with the demand for computing power. Developers find it much harder to develop applications for such architectures than for homogeneous sequential ones. We investigate how multimedia applications can be developed for and deployed on such architectures.

DATA COMMUNICATION

Existing data communication protocols are designed for best-effort networks. Today, transport protocols are optimized for high-bandwidth applications like plain file transfers and web browsing. Interactive distributed multimedia applications, however, have a different requirement: the delivery of small amounts of data within consistently short times. Our department investigates new protocols and mechanisms that address this challenge and that are realistically deployable on the Internet.

In 2011, we extended our successful cooperation with Funcom, as well as various other national and international partners to deepen our exploration of Internet latency and ways of improving it. Our cooperation with Uninett, Cisco, CAIDA, Funcom, and the Universities of Oslo, Kaiserslautern and Karlstadt, was rewarded by the research council with the granting of a new project, TimeIn, that succeeded against extremely tough competition.

MEDIA PEOPLE*

Carsten Griwodz, Head of Department

Pål Halvorsen, Senior Research Scientist

Frank Eliassen, Senior Research Scientist **

Alexander Eichhorn, Postdoctoral fellow

Andreas Petlund, Postdoctoral fellow

Paul Beskow, PhD Student

Thomas Kupka, PhD Student

Håvard Espeland, PhD Student

Pengpeng Ni, PhD Student

Deepak Dwarakanath, PhD Student

Ragnhild Eg, PhD Student

Beata Joanna Dopierala, PhD Student

Preben Olsen, PhD Student

Håkon K. Stensland, PhD student

* at end of 2011
** in adjunct position

REPORT OF THE BOARD OF DIRECTORS

Simula Research Laboratory AS is part of the Simula Group and performs fundamental long-term research on selected aspects of software and communication technologies, with the aim of contributing to creativity and innovation in business.

From left:
Erik Heggem, Ola Skavhaug, Gunnar Hartvigsen, Pinar Heggernes, Tormod Hermansen, Ingvild Myhre, Ottar Hovind (administration), Marianne M. Sundet (administration), Ingolf Søreide, Inger Stray Lien, and Mats Lundqvist.

In its 10th operating year, the Simula Research Laboratory AS and the Simula Group achieved a turnover of NOK 97.4 million and NOK 121.1 million, and net profits of NOK 4.3 million and NOK 5.8 million, respectively.

ADMINISTRATION AND ORGANISATION

Simula is organised as a limited company under the ownership of the Norwegian Ministry of Education and Research. The company combines academic traditions with recognised business management models.

Simula Research Laboratory AS (Simula) is the parent company of Kalkulo AS, Simula Innovation AS and Simula School of Research and Innovation AS. Kalkulo and Simula Innovation are wholly-owned subsidiaries, while Simula School of Research and Innovation is owned by Simula (56%), Statoil (21%), the municipality of Bærum (14%), Telenor (7%), the Norwegian Computing Center (1%), and Sintef (1%).

The parent company and its three subsidiaries have close cooperation, and are located at Fornebu, in the municipality of Bærum.

ACTIVITIES AND PRODUCTION

Simula conducts fundamental long-term research on communication in computer and mobile networks, scientific calculations, and methods for developing and testing extensive software systems. The research focuses on fundamental challenges that combine technological development with value for industry and society as a whole.

Simula's research is published in international scientific journals and by leading publishing companies. In 2011, Simula's research featured in 49 articles in international journals, 1 book, 5 chapters in books and 62 conference articles.

Over the course of 2011, Simula's scientific employees supervised 8 doctoral candidates and 20 Master's students to the successful completion of their degrees. The University of Oslo is an important partner and granted most of these degrees.

PERSONNEL AND HSE

At the end of 2011, the Simula Group had a total of 126 employees, with 101 in full-time positions and 25 in part-time positions. Of these, 104 were men and 22 were women, with 67 Norwegians and 59 foreign nationals. 52 people were employed as research fellows, with 20 post-doctoral fellows and 32 PhD students.

At the end of 2011, Simula Research Laboratory had a total of 43 employees, with 30 in full-time positions and 13 in part-time positions. Of these, 36 were men and 7 were women, with 32 Norwegians and 11 foreign nationals.

A working environment survey was conducted in September, with positive results, confirming that our employees experience Simula as being a good working environment. The individual departments and Simula as a whole plan to follow up concrete action points based on identified areas for improvement.

The board aims to continue its focus on long-term health, safety and environment work. Absence due to illness was under 2% in 2011, which is below average compared with similar companies. The Group will be working actively to keep sick leave at continued low levels. There were no reports of occupational related sickness or accidents during the year.

Simula's business activities do not pollute the external environment.

EQUAL OPPORTUNITY AND INTEGRATION

Simula's board has adopted an ambitious action plan with the goal of increasing the proportion of female employees in scientific positions to 25% by 2015. The proportion of female employees in scientific positions remained unchanged from 2010, at 19%. When we examine individual categories, it is positive that the proportion of full-time female researchers has increased from zero in 2010 to 13% in 2011. Simula will continue to work actively and systematically to improve the gender balance within the organisation and, to meet our target, we will be implementing concrete initiatives for retaining good female candidates already employed by Simula, as well as attracting new and talented female candidates. These initiatives involve recruitment, employment and the working environment. Simula is conscious that retaining talented female students can be an effective contribution to meeting our goal.

The Group is also working to promote the objectives of the Norwegian Anti-discrimination Act, to promote equality, ensure equal opportunities and rights and to prevent discrimination in the workplace. There are 25 different nationalities represented in the Simula Group. Simula offers courses in Norwegian, social events and support related to visa, tax, housing and other administrative issues.

BOARD OF DIRECTORS

Ingvild Myhre, Chair of the board
Gunnar Hartvigsen
Pinar Heggernes
Tormod Hermansen
Ingolf Søreide
Inger Stray Lien
Mats Lundqvist
Ola Skavhaug*
Erik Heggem*

* Employee representative

ETHICS

Simula follows ethical guidelines as described in "The Simula Code of Ethics", which also comprises research ethics, based on the fact that Simula is an institution dedicated to truth and the pursuit of truth. The institution's reputation is based on others being able to trust that research results are correct and have been produced in a verifiable and ethically responsible manner. For questions regarding research ethics, Simula's researchers shall adhere to the guidelines set by the National Committee for Research Ethics in Science and Technology (NENT). In addition, all employees must follow Simula's internal guidelines for scientific publishing, which are based on the Vancouver Convention.

RISK

The Board considers the financial risk to be limited, credit risk to be limited and the cash-flow risk to be limited. In conclusion the general risk of the business is considered limited.

POSITIVE ECONOMIC GROWTH

Simula Group saw an increase in both personnel and capacity in 2011. In its 10th operating year, the Group had a turnover of NOK 121.1 million, an increase of 11% from the previous year. Operating profits were NOK 7.9 million, with a net profit of NOK 5.8 million.

Simula's total operating revenue in 2011 was NOK 97.4 million. External project funding was a total of NOK 36.7 million. The net profit was NOK 4.3 million, which was transferred to equity. Equity in Simula is NOK 11.7 million, giving an equity ratio of 30% of the total equity.

Simula School of Research and Innovation's total operating revenue in 2011 was NOK 37.6 million, with a profit of NOK 1.3 million.

Simula Innovation AS had in 2011 an operating revenue of NOK 5.9 million, with a net profit of NOK -0.9 million after taxes and write-downs.

In 2011, Kalkulo's total sales revenues amounted to NOK 13.3 million, with a net profit of NOK 1.7 million after taxes and write-downs.

FUTURE DEVELOPMENT

The basic funding has not been adjusted for inflation. It is therefore very positive for the future of Simula's finances that, at the close of 2011, the Ministry of Education and Research confirmed that the Ministry's share of Simula's grant (NOK 29 million) will be adjusted for inflation as of 2013.

Simula is increasing its collaboration with industry.

The board believes that our annual accounts provide a correct picture of Simula Research Laboratory AS and the Group. The Group is in a healthy economic and financial position. In accordance with section 3, paragraph 3a of the Norwegian Accounting Act, conditions for continuing operations are confirmed present, and the annual accounts are prepared accordingly.

THE BOARD'S WORK

In 2011, Simula's board had four meetings, with a total of 32 cases for consideration. The employee-elected board member Amund Kvalbein retired from the board in 2011. The board would like to thank him for his commitment and inputs to the board. Erik Heggem joined the board as new employee-elected board member in 2011. The board was expanded with two representatives in 2011, and Ingolf Søreide (Statoil) and Pinar Heggernes (University of Bergen) became board members in June. Cooperation between the board and management is good. The board would like to thank all employees for their contribution throughout the year.

ACCOUNTS

PROFIT & LOSS STATEMENT

2011

2010	2011		Note	2011	2010
	GROUP			PARENT COMPANY	
108 614 673	121 083 635	OPERATING REVENUES	6	97 377 913	88 652 000
		OPERATING EXPENSES			
72 031 247	75 499 248	Salary and social costs	5	57 077 092	54 548 793
1 823 535	1 140 386	Depreciation	3	1 049 365	1 670 411
27 693 366	36 585 359	Other operating expenses	5,14	35 451 308	29 342 124
101 548 148	113 224 993	TOTAL OPERATING EXPENSES		93 577 765	85 561 328
7 066 525	7 858 642	OPERATING PROFIT		3 800 148	3 090 672
		FINANCIAL ITEMS			
569 589	630 332	Other interest income		508 250	478 415
25 740	71 028	Other financial income		58 955	19 901
39 948	14 882	Other interest expense		9 455	31 160
1 511 823	1 432 413	Other financial expense		59 720	22 307
-956 442	745 935	NET FINANCIAL ITEMS		498 030	444 849
6 110 083	7 112 707	PROFIT BEFORE TAXES		4 298 178	3 535 521
463 894	723 297	TAXES FOR THE YEAR		0	0
5 646 189	6 389 410	NET PROFIT		4 298 178	3 535 521
550 934	589 135	Minority interests		0	0
5 095 255	5 800 275	Result after minority interest		4 298 178	3 535 521
		TRANSFERS			
		Transferred to other equity		4 298 178	3 535 521
				4 298 178	3 535 521

ACCOUNTS

BALANCE SHEET

2011

The financial statements have been prepared pursuant to the regulations in the Norwegian Accounting Act of 1998. The statements have been drawn up in accordance with Norwegian accounting standards.

2010	2011		Note	2011	2010
	GROUP			PARENT COMPANY	
		FIXED ASSETS			
		Tangible fixed assets			
1 617 367	1 720 780	Furniture, fixtures, equipment	3	1 646 362	1 485 178
1 617 367	1 720 780	Total tangible fixed assets		1 646 362	1 485 178
		Financial fixed assets			
1 566 460	298 232	Investments in shares	12	0	0
250 000	0	Other receivables		0	0
0	0	Investments in subsidiaries	10	5 319 700	5 319 700
1 816 460	298 232	Total financial fixed assets			
3 433 827	2 019 012	TOTAL FIXED ASSETS		6 966 062	6 804 878
		CURRENT ASSETS			
		Receivables			
7 001 337	13 155 845	Accounts receivable		4 203 837	2 463 682
7 192 572	12 250 364	Other receivables		9 991 242	6 899 158
14 193 909	25 406 209	Total receivables		14 195 079	9 362 840
26 363 509	28 002 125	Cash and banks	9	18 369 526	18 445 187
40 557 418	53 408 334	TOTAL CURRENT ASSETS		32 564 605	27 808 027
43 991 245	55 427 346	TOTAL ASSETS		39 530 667	34 612 905
		EQUITY			
		Paid-in equity			
1 200 000	1 200 000	Share capital	7,8	1 200 000	1 200 000
1 200 000	1 200 000	Total paid-in capital		1 200 000	1 200 000
		Earned equity			
11 413 223	17 213 498	Other equity	8	10 497 785	6 199 607
1 841 734	2 430 869	Minority interests	8	0	0
13 254 957	19 644 367	Total earned equity		10 497 785	6 199 607
14 454 957	20 844 367	TOTAL EQUITY		11 697 785	7 399 607
		LIABILITIES			
		Accruals for liabilities			
286 767	286 719	Deferred tax	13	0	0
286 767	286 719	Total accruals for liabilities		0	0
		Short term liabilities			
5 364 330	7 252 624	Accounts payable		11 692 239	8 907 191
177 127	723 345	Tax payable	13	0	0
4 330 814	6 621 582	Other duties payable		2 336 860	2 405 763
19 377 250	19 698 709	Other short term liabilities		13 803 783	15 900 344
29 249 521	34 296 260	Total short term liabilities		27 832 882	27 213 298
29 536 288	34 582 979	TOTAL LIABILITIES		27 832 882	27 213 298
43 991 245	55 427 346	TOTAL LIABILITIES AND EQUITY		39 530 667	34 612 905

NOTES TO THE ACCOUNTS

NOTE 1 – ACCOUNTING PRINCIPLES

The financial statements have been prepared pursuant to the regulations in the Norwegian Accounting Act of 1998. The statements have been drawn up in accordance with Norwegian accounting standards.

The main rule for the valuation and classification of assets and liabilities

Assets intended for permanent ownership or use are classified as fixed assets. Other assets are classified as current assets. Receivables to be paid back within one year are always classified as current assets. The same criteria are applied to the classification of short- and long-term liabilities.

Fixed assets are valued at acquisition cost and written down to their fair value, if the fall in value is believed to be permanent. Fixed assets are depreciated over the useful life of the asset. Long-term liabilities are recognised at nominal value on the date the liability was incurred. Long-term liabilities are not revalued to fair value with respect to interest rate fluctuations.

Current assets are valued at cost, or fair value, whichever is the lower. Current liabilities are recognised at their nominal values on the date they were incurred. Current liabilities are not restated to fair values with respect to interest rate fluctuations.

Certain items are valued according to other rules, as explained below.

Foreign currency transactions

Assets and liabilities in foreign currency are translated into Norwegian kroner at the mid-rates quoted by Norway's National Bank on the balance sheet reporting day.

Tangible fixed assets

Tangible fixed assets are generally depreciated over the expected useful life of the asset. Depreciation is generally done on a straight-line basis over the expected useful life of the asset.

Receivables

Accounts receivable and other receivables are recorded at nominal amounts less provisions for anticipated losses from bad debts. Provisions for losses are based on individual assessments of the collectability of each receivable. In addition, if necessary, a general provision is made for anticipated bad debts on other receivables.

Pensions

A straight line earning profile is used to account for pensions and assumptions are made regarding expected salary upon retirement.

Taxes

The company has no tax expenses in the parent company accounts since its activities are not considered taxable.

Note 2 – Financial market risk

The company has little exposure to financial market risk.

NOTE 3 – FIXED ASSETS

Simula Research Laboratory AS

	Computer Equipment	Furniture/Fittings, equipment	Total
Acquisition cost Jan. 1	5.191.349	7.049.419	12.240.768
Acquired in 2011	519.514	691.036	1.210.550
Disposed of in 2011	- 620.742	-	- 620.742
Acquisition cost Dec. 31	5.090.121	7.740.455	12.830.576
Acc. depreciation	4.350.782	6.833.432	11.184.214
Net book value Dec. 31	739.339	907.023	1.646.362
Depreciation for the year	737.233	312.132	1.049.365
Depreciation %	20 – 50%	20 – 33%	

Simula Research Laboratory AS – Group

	Computer Equipment	Furniture/Fittings equipment	Total
Acquisition cost Jan. 1	6.887.153	7.049.419	13.936.572
Acquired in 2011	552.764	691.036	1.243.800
Disposed of in 2011	- 641.888	-	- 641.888
Acquisition cost Dec. 31	6.798.029	7.740.455	14.538.484
Acc. depreciation	5.984.273	6.833.432	12.817.705
Net book value Dec. 31	813.756	907.023	1.720.780
Depreciation for the year	828.253	312.132	1.140.385
Depreciation %	20 – 50%	20 – 33%	

NOTE 4 – PENSION COSTS

The Group has a pension plan that covers a total of 33 individuals in the parent company and 95 individuals in the Group. The pension plan provides defined future benefits. Pension benefits depend on the individual employee's number of years of service, salary level upon retirement age, and social security benefits. The collective pension agreement is funded by building up pension funds under the management of the Norwegian Public Service Pension Fund.

The company has taken out an pension insurance for the managing director expensed at NOK 329 818.

NOTE 5 – COST OF LABOUR, NUMBER OF EMPLOYEES, REMUNERATION, ETC.

	Simula Research Laboratory AS		Simula Research Laboratory AS Group	
Salary and social costs	**2010**	**2011**	**2010**	**2011**
Salaries	26.909.111	26.129.141	56.610.701	59.071.603
Social security	4.346.665	4.115.926	8.607.651	8.774.493
Pension costs	2.269.967	1.871.239	3.679.919	3.222.163
Other benefits	3.088.998	4.191.332	3.284.437	4.491.441
SkatteFUNN	-	-	-151.460	-60.452
Contribution to cover cost of labour at SSRI	17.934.052	15.671.656	-	-
Contribution to cover cost of labour at SI	-	5.097.798	-	-
Total	**54.548.793**	**57.077.092**	**72.031.247**	**75.499.248**
Average man-years of labour	40,3	37	92,3	112

Benefits to top management	Simula Research Laboratory AS	Simula Research Lab AS Konsern
Managing director	1.533.523	-
Other remuneration to managing director	302.120	-
Pension costs to managing director	406.955	-
Board of directors	187.000	187.000
Audit fees to Auditor	54.800	124.800
Other fees to Auditor	39.800	63.300

NOTE 6 – OPERATING REVENUE

	Simula Reserach Laboratory AS	Simula Research Lab AS Konsern
Research Funding	50.000.000	56.000.000
Subsidies from the Research Council of Norway and the EU	36.684.100	42.188.327
Services to subsidiaries	5.764.184	-
Other income	4.929.629	22.895.308

NOTES

TO THE ACCOUNTS

2011

NOTE 7 – SHARE CAPITAL AND OWNERSHIP STRUCTURE

The company's share capital consists of 800 shares with a nominal value of NOK 1 500 per share. The shares are owned by:
The Norwegian state /repr. by the Ministry of Research and Education.

NOTE 9 – BANK DEPOSITS

The company had withheld funds of NOK 2.157.703 in connection with rent of office space and NOK 1.225.122 in withholding taxes. The Group's withheld funds for withholding tax is NOK 2.869.471.

NOTE 8 – EQUITY

Simula Research Laboratory AS	Share Capital	Other Equity	Total Equity
Equity at Jan. 1	1.200.000	6.199.607	7.399.607
Profit for the year	-	4.298.178	4.298.178
Equity at Dec. 31	1.200.000	10.497.785	11.697.785

Simula Research Laboratory AS – Group	Share Capital	Other Equity	Minority-interests	Total Equity
Equity at Jan. 1	1.200.000	11.413.223	1.841.734	14.454.957
Profit for the year	-	5.800.275	589.135	6.389.410
Equity at Dec. 31	1.200.000	17.213.498	2.430.869	20.844.367

NOTE 10 – SUBSIDIARIES

	Office Location	Ownership Dec. 31	Net book value	Company at Dec. 31	Company result for 2011
Simula Innovation AS	Fornebu	100 %	4.356.300	4.600.762	-928.254
Kalkulo AS	Fornebu	100 %	406.000	4.372.311	1.688.408
Simula School of Research and Innov.	Fornebu	55,74%	557.400	5.493.209	1.331.077

NOTE 11 – TRANSACTIONS WITHIN THE GROUP

	2010	2011
Receivable on Simula Innovation AS	1.558.684	1.045.920
Payable to Simula Innovation AS	504.499	2.009.848
Receivable on Kalkulo AS	308.628	24.535
Payable to Kalkulo AS	199.841	42.015
Receivable on Simula School of R. and I. AS	181.288	863.841
Payable to Simula School of R. and I. AS	4.738.292	3.237.348
Contribution to Simula Innovation AS	1.500.000	7.597.798
Contribution to Simula School of R. and I. AS	17.934.052	15.671.656
Purchase of services from fra Simula Innovation AS	283.014	971.403
Purchase of services from Kalkulo AS	864.779	254.785
Purchase of services from Simula School of R. and I. AS	-	365.617
Sale of services to Simula Innovation AS	1.789.482	1.862.663
Sale of services to Kalkulo AS	1.481.950	1.716.693
Sale of services to Simula School of R. and I. AS	3.374.365	4.200.983

NOTE 12 – SHARES

	No.	Nominal value per share	Purchase price
Lividi AS	19.530	1,00	21.738
Resiliens AS	100.000	1,00	102.886
Testify AS	5.000	1,00	5.310
Expertware AS	30.000	1,00	31.914
Symphonical AS	545.528	0,10	1.095.151
Insilicomed Inc, USA	131.945	USD 1,80	1.220.755
Write down of shares			-2.179.522
Total			**298.232**

NOTE 13 – TAX

The activities of Simula Research Laboratory AS and its subsidiary, Simula School of Research and Innovation AS are not considered taxable. The subsidiaries Simula Innovation AS and Kalkulo AS are both liable to taxation.

Taxation for the year consists of:

Tax payable	723.345
Change in deferred tax	-48
Net tax expense	723.297

Tax payable for the year is calculated as follows:

Profit before tax	1.483.451
Permanent differences	73.219
Change in temporary differences	1.535.017
Tax loss carry forwards	-508.312
Taxable income	2.583.375
Tax payable	723.345

Deferred tax liability/asset

	Jan 1.	Dec. 31
Fixed assets	-3.515	-
Receivables	-508.312	-
Other differences	1.536.000	1.024.000
Basis for deferred tax	1.024.173	1.024.000
Deferred tax liability/asset	**286.767**	**286.719**

NOTE 14 – LEASES

The company has signed leases for four photocopiers which all expire in 2013. The company also has leases for three coffee machines, which also expire in 2013. Leasing expenses amounted to NOK 299.936 in 2011.

AUDIT REPORT

SIMULA RESEARCH LABORATORY

2011

LUNDES Revisjonskontor DA

Til generalforsamlingen i
SIMULA RESEARCH LABORATORY AS

REVISORS BERETNING FOR 2011

Uttalelse om årsregnskapet
Vi har revidert årsregnskapet for SIMULA RESEARCH LABORATORY AS som består av selskapsregnskap, som viser et overskudd på kr. 4.298.178,-, og konsernregnskap, som viser et overskudd på kr. 5.800.275,-. Selskapsregnskapet og konsernregnskapet består av balanse per 31. desember 2011, resultatregnskap og kontantstrømoppstilling for regnskapsåret avsluttet per denne datoen, og en beskrivelse av vesentlige anvendte regnskapsprinsipper og andre noteopplysninger.

Styret og daglig leders ansvar for årsregnskapet
Styret og daglig leder er ansvarlig for å utarbeide årsregnskapet og for at det gir et rettvisende bilde i samsvar med regnskapslovens regler og god regnskapsskikk i Norge, og for slik intern kontroll som styret og daglig leder finner nødvendig for å muliggjøre utarbeidelsen av et årsregnskap som ikke inneholder vesentlig feilinformasjon, verken som følge av misligheter eller feil.

Revisors oppgaver og plikter
Vår oppgave er å gi uttrykk for en mening om dette årsregnskapet på bakgrunn av vår revisjon. Vi har gjennomført revisjonen i samsvar med lov, forskift og god revisjonsskikk i Norge, herunder International Standards on Auditing. Revisjonsstandardene krever at vi etterlever etiske krav og planlegger og gjennomfører revisjonen for å oppnå betryggende sikkerhet for at årsregnskapet ikke inneholder vesentlig feilinformasjon.

En revisjon innebærer utførelse av handlinger for å innhente revisjonsbevis for beløpene og opplysningene i årsregnskapet. De valgte handlingene avhenger av revisors skjønn, herunder vurderingen av risikoene for at årsregnskapet inneholder vesentlig feilinformasjon, enten det skyldes misligheter eller feil. Ved en slik risikovurdering tar revisor hensyn til den interne kontrollen som er relevant for selskapets utarbeidelse av et årsregnskap som gir et rettvisende bilde. Formålet er å utforme revisjonshandlinger som er hensiktsmessige etter omstendighetene, men ikke for å gi uttrykk for en mening om effektiviteten av selskapets interne kontroll. En revisjon omfatter også en vurdering av om de anvendte regnskapsprinsippene er hensiktsmessige og om regnskapsestimatene utarbeidet av ledelsen er rimelige, samt en vurdering av den samlede presentasjonen av årsregnskapet.

Etter vår oppfatning er innhentet revisjonsbevis tilstrekkelig og hensiktsmessig som grunnlag for vår konklusjon.

Konklusjon
Etter vår mening er årsregnskapet avgitt i samsvar med lov og forskifter og gir et rettvisende bilde av selskapet og SIMULA RESEARCH LABORATORY AS' finansielle stillingen per 31. desember 2011 og av resultatet og kontantstrømmen for regnskapsåret som ble avsluttet per denne datoen i samsvar med regnskapslovens regler og god regnskapsskikk i Norge.

statsautorisert revisor
ODD LUNDE
medlem av D.n.R.

statsautorisert revisor
ERIK A. BELL
medlem av D.n.R.

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Bankgiro 6030.05.53128

AUDIT REPORT

SIMULA RESEARCH LABORATORY

2011

LUNDES Revisjonskontor DA

Uttalelse om øvrige forhold

Konklusjon om årsberetningen

Basert på vår revisjon av årsregnskapet som beskrevet ovenfor, mener vi at opplysningene i årsberetningen om årsregnskapet, forutsetningen om fortsatt og forslaget til anvendelse av overskuddet er konsistente med årsregnskapet og er i samsvar med lov og forskrifter.

Konklusjon om registrering og dokumentasjon

Basert på vår revisjon av årsregnskapet som beskrevet ovenfor, og kontrollhandlinger vi har funnet nødvendig i henhold til internasjonal standard for attestasjonsoppdrag (ISAE) 3000 «Attestasjonsoppdrag som ikke er revisjon eller forenklet revisorkontroll av historisk finansiell informasjon», mener vi at ledelsen har oppfylt sin plikt til å sørge for ordentlig og oversiktlig registrering og dokumentasjon av selskapets regnskapsopplysninger i samsvar med lov og god bokføringsskikk i Norge.

Oslo, den 21. mars 2012

Erik A. Bell
Statsautorisert revisor

ACHIEVEMENTS IN NUMBERS 2011

SCIENTIFIC EVALUATIONS

Simula has consistently focused on quality and high goals, and this work has been recognized in the evaluation reports conducted by international evaluation committees appointed by the Research Council of Norway.

"These evaluations and numerous other measures have found Simula to be a success and Simula has established itself as a national and, in many cases, an international leader with a substantial impact beyond the borders." [1]

	2001 National evaluation of the initial research groups	2004 Scientific evaluation of Simula	2009 Scientific evaluation of Simula	2012 National ICT evaluation
Communication Systems	Good	Good, with some very good elements	Very good, with some excellent projects	Very good
Scientific Computing	Excellent	Excellent	Excellent	Excellent
Software Engineering	Good	Very good	Excellent	Excellent

PUBLICATIONS AND DEGREES

"The publication activity for Simula is generally high and positioned in journals of high impact. The connections to industry are strong and provide examples for other universities and research institutes on how to establish such connections without impacting the depth of the research." [2]

	2011	Total 2001–2011
Articles in international journals	52	408
Conference proceedings	64	596
Books	1	12
Edited books	0	22
Chapters in books	5	73
PhD degrees	8	54
Masters' degrees	20	227

[1] From "Research in Information and Communication Technology at Norwegian Universities, University Colleges and Selected Research Institutes. An Evaluation, February 2012", page 102. The Research Council of Norway.

[2] Ibid.

STRATEGIC PROJECTS INITIALIZED IN 2011

The Certus Centre
Funding source: RCN, Center for Research-based Innovation
Project leader: Lionel Briand
Research partners: University of Oslo and Fraunhofer-Institut für Experimentelles Software Engineering.
Other partners: Esito AS, Schlumberger, Tandberg, Det Norske Veritas AS, Tomra Systems ASA, Norwegian Customs and Excise Department.
Project duration: 8 years
Funding from source: NOK 78 million

Center for Cardiological Innovation
Funding source: RCN, Center for Research-based Innovation
Project leader: Thor Edvardsen (OUS) and Molly Maleckar (Simula)
Partners: Oslo Universitetssykehus (OUS) is host, and Simula and GE Vingmed equal partners
Other partners: CardioSolv LLC, Biosense Webster Ltd and Kalkulo
Project duration: 8 years
Funding from source: NOK 20 million

5DPaleoEarth
Funding source: Statoil
Project leader: Stuart Clark
Funding from source: NOK 40 million, of which NOK 15 million for development work in Kalkulo
Project duration: 5 years

Resilient Networks 2
Funding source: Ministry of Transport and Communication
Project leader: Amund Kvalbein
Partners: KRD/E-valg, UNINETT
Project duration: 5 years
Funding from source: NOK 38 million

NorNet – Norwegian Infrastructure for Network Experimentation
Funding source: RCN, National Financing Initiative for Research Infrastructure
Project leader: Olav Lysne
Partners: NTNU and UNINETT
Project duration: 5 years
Funding from source: NOK 14 million

Efficient and Robust Architecture for the Big Data Cloud
Funding source: RCN, VERDIKT
Project leader: Tor Skeie
Partners: Lyse AS, Oracle Norge AS, University of Stavanger, UiO
Project duration: 4 years
Funding from source: NOK 12 million

Traffic behaviour of interactive time-dependent thin streams on the modern Internet
Funding source: RCN, VERDIKT
Project leader: Andreas Petlund
Partners: Karlstad University, FUNCOM, University of Kaiserslautern, UNINETT AS, CISCO Systems Norway AS, UiO
Project duration: 4 years
Funding from source: NOK 11 million

User-friendly programming of GPU-enhanced clusters via automated code translation and optimization
Funding source: RCN, FRINATEK
Project leader: Xing Cai
Partners: Sintef IKT Oslo, UCSD, San Diego Supercomputing Center
Project duration: 4 years
Funding from source: NOK 9.4 million

OPENCOSS (Open Platform for EvolutioNary Certification Of Safety-critical Systems)
Funding source: European Commission, 7th Framework Programme.
Project leader: Mehrdad Sabetzadeh
Partners: Alstom, France; RINA, Italy; Atego, France; DNV, Netherlands; Eindhoven University of Technology, Netherlands; University of York, UK; and Fiat, Italy.
Project duration: 3 years
Funding from source: NOK 8 million

In Silico Heart Failure – Tools for Accelerating Biomedical Research
Funding source: RCN, eVITA
Project leader: Joakim Sundnes
Project duration: 4 years
Funding from source: NOK 7.7 million

Patient-Specific Mathematical Modeling with Applications to Clinical Medical: Stroke and Syringomyelia
Funding source: RCN, funding for qualified candidates turned down for European Research Council starting grants
Project leader: Kent-Andre Mardal
Project duration: 5 years
Funding from source: NOK 6.9 million

ModelFusion: Model Management for Distributed Software Development
Funding source: RCN, FRITEK
Project leader: Shiva Nejati
Project duration: 4 years
Funding from source: NOK 6.6 million

Protection of Power electronically Interfaced LV Distributed Generation Networks
Funding source: RCN, RENERGI
Project leader: Yan Zhang
Partners: Aalborg University, SRL
Project duration: 3 years
Funding from source: NOK 2.8 million

HIGHLIGHTS 2011

JANUARY
The organizational structure of Simula is changed in order to better reflect the research activities and the financial framework. From three units with the activities organized in the several research groups, the current structure puts direct focus on seven research departments.

MARCH
Statoil and Simula expand the collaboration further and enter into an agreement with the 5DPaleoEarth project.

APRIL
State secretary Halvard Ingebrigtsen of the Ministry of Trade and Industry visits Simula.

Simula meets with the Labour party fraction of the Standing Committee on Education, Research and Church Affairs at the Parliament.

Collaboration with China: Simula enters into a Memorandum of Understanding with Beihang University.

MAY
The NorNet project receives funding from the Research Council of Norway.

Kristoffer Selim defends his PhD thesis Adaptive Finite Element Methods for Fluid-Structure Interaction and Incompressible Flow.

Hadi Hemmati defends his PhD thesis Similarity-Based Test Case Selection: Toward Scalable and Practical Model-Based Testing.

Ahmed Elmokashfi defends his PhD thesis On BGP Inter-domain Routing: an Investigation of Scalability with Respect to Churn.

The OPENCOSS proposal (Open Platform for EvolutioNary Certification Of Safety-critical Systems), with participation from the Certus centre, has been approved for funding by the European Commission under the 7th Framework Programme.

Kristian Valen-Sendstad defends his PhD thesis Computational Cerebral Hemodynamics.

JUNE
Joachim Berdal Haga defends his PhD thesis Numerical methods for basin-scale poroelastic modelling.

JULY
The Research Council of Norway publishes the results of the midterm evaluation of eight Centres of Excellence after three and half years of activity. The Centre for Biomedical Computing (CBC), hosted by Simula, is assessed as Exceptionally good and is secured funding for the next five years.

SEPTEMBER
In connection with Director-General Robert Madelin's visit to Norway, representatives from the EU commission and the Norwegian Government visit Simula. Madelin is responsible for the Digital Agenda for Europe, which is one of the flagship initiatives of the Europe 2020 Strategy, set out to define the key-enabling role that the use of Information and Communication Technologies (ICT) will have to play in the realization of Europe's ambitions for 2020.

The involved parties and representatives from the Research Council of Norway signed the agreement, and Simula's new Centre for Research-based Innovation (SFI) – the Certus Centre – was officially opened.

The Ministry of Transport and Communications and the Resilient Networks group at Simula invited stakeholders to a workshop held at Simula, with the purpose to discuss key challenges for a more robust Norwegian network infrastructure. Representatives from Telenor, Netcom, ICE, the Norwegian Post and Telecommunications, and the Norwegian Health Network were present.

The Norwegian Government presents the national budget for 2012, and Simula appreciates that the basic allowance is increased with 1 million NOK in an otherwise constrained budget for Norwegian research. The Ministry of Education and Research maintains its allowance from 2011, and the same does the Ministry of Transport and Communications. Compared to 2011, the Ministry of Trade and Industry has increased its part of the allowance to 11 million NOK. Simula sees this outcome as a strong signal in support of our growing collaboration with industry.

DECEMBER

In competition with 101 applications, two of Simula's proposals for the Verdikt program were awarded funding through the Research Council of Norway. Many of the proposals were rated excellent, but only six projects out of the 101 were selected for funding.

Opening of the Certus Centre

From left: Eirik Normann (RCN), Valery Buzungu (Cisco), Merethe Gotaas (Kongsberg Maritime), Thomas Nessel (FMC Kongsberg Subsea), og Lionel Briand (Simula). Photo: Karl Branaas

Simula marks the occasion of ten years in operation with the conference "Challenges in Computing". Eight internationally recognized experts presented challenges and opportunities that lie ahead in our fields of research. Norwegian Minister of Research and Education Tora Aasland conducted the opening.

The Springer Computational Science and Engineering prize 2011 was awarded to Laura Alisic, Carsten Burstedde and Georg Stadler for their exceptional research on plate tectonics simulation. The prize was presented by Norwegian Minister of Research and Education Tora Aasland at Simula's conference Challenges in Computing.

The Ministry of Research and Education announces that a part of Simula's basic allowance will be adjusted for inflation with effect from 2013.

Jie Xiang defends his PhD thesis Resource Management and Optimization for Cognitive Radio Networks.

Eli Gjørven defends her PhD thesis Enabling Self-Adaptation by Applying a Technology Agnostic Middleware with Support for Integration.

OCTOBER

The Center for Cardiological Innovation was formally established as a new Centre for Research-based Innovation (SFI) on 31 October 2011, after the signing of the agreement between the Research Council of Norway (RCN) and the host Oslo University Hospital. Simula is research partner in the center.

NOVEMBER

Kristin Børte defends her PhD thesis Software Effort Estimation as Collaborative Planning Activity.

Anniversary conference

Minister Tora Aasland and prize winner Carsten Burstedde

KEY FACTS 2011

SCIENTIFIC ADVISORY BOARD

The Scientific Advisory Board (SAB) is appointed by Simula's Board to provide focused professional advice on Simula's operation. Simula Research Laboratory has appointed to the SAB internationally recognized researchers, which cover all the scientific fields represented at Simula.

- Klara Nahrstedt, University of Illionis at Urbana-Champaign
- Roch Guerin, University of Pennsylvania
- Andrew McCulloch, University of California San Diego
- David Keyes, KAUST
- Deborah Wood, DNV
- Victor Basili, University of Maryland
- Ina Schieferdecker, Fraunhofer
- Abigail Barrow, Massachusetts Technology Transfer Center

MANAGEMENT

Professor Aslak Tveito, Managing Director

Ottar Hovind, Deputy Managing Director

Professor Are Magnus Bruaset, Director of Simula School of Research and Innovation

Dr. Audun Fosselie Hansen, Director of Simula Innovation

Marianne M. Sundet, Director of Administration

RESEARCH DEPARTMENTS

The Certus Centre
Head: Professor Lionel Briand

Best
Head: Professor Magne Jørgensen

BioComp
Head: Professor Hans Petter Langtangen

Camo
Head: Dr. Molly Maleckar

CompGeo
Head: Dr. Stuart Clark

Media
Head: Professor Carsten Griwodz

NetSys
Head: Professor Olav Lysne

BOARD OF DIRECTORS

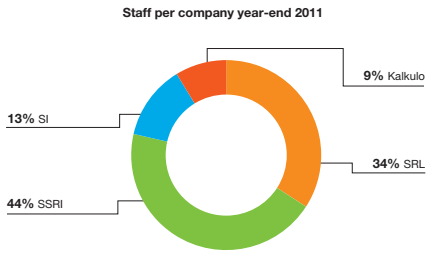
- Ingvild Myhre, Chair of the Board
- Inger Stray Lien
- Tormod Hermansen
- Gunnar Hartvigsen
- Pinar Heggernes
- Ingolf Søreide
- Mats Lundqvist
- Erik Heggem
- Ola Skavhaug

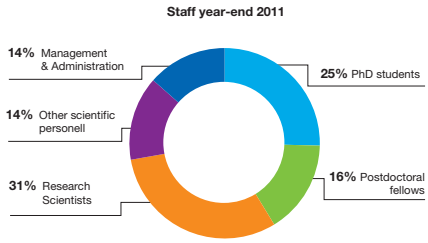
SUBSIDIARY COMPANIES

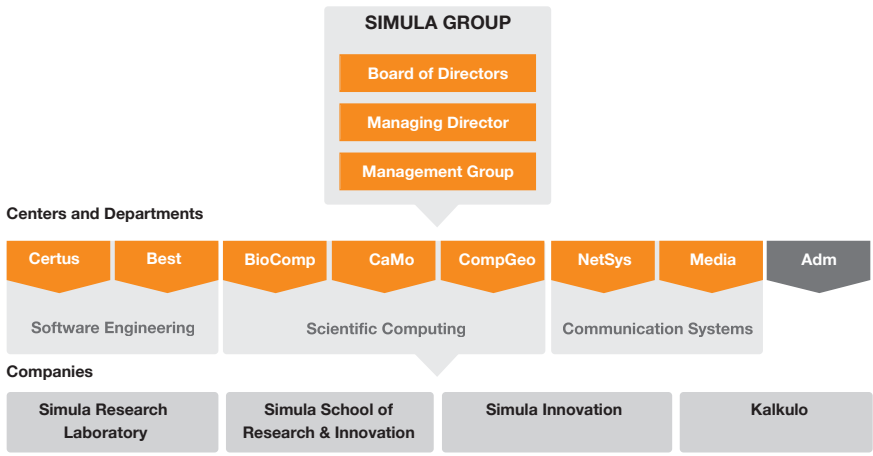
Simula School of Research and Innovation AS
Director: Professor Are Magnus Bruaset

Simula Innovation AS
Director: Dr. Audun Fosselie Hansen

Kalkulo AS
Director: Dr. Christian Tarrou







EQUAL OPPORTUNITIES AND INTEGRATION

Female proportion	2010	2011
Research scientists, post doctoral fellows and PhD students	19%	19%
Full-time research scientists in permanent positions	0%	13%
Postdoctoral fellows	21%	21%
PhD students	27%	23%

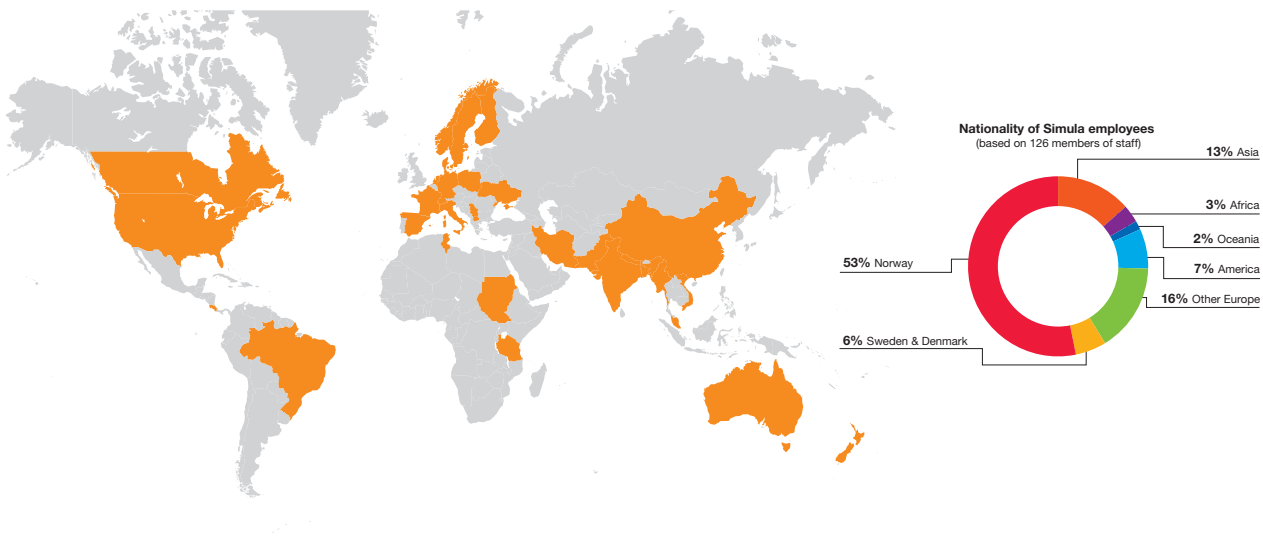
Scientific staff and gender proportion
As directed by the Gender Action Plan 2010–2015, Simula is aiming to have at least 25 per cent female employees in scientific positions by 2015. Simula will continue to work actively and systematically to improve the gender balance within the organisation and, to meet our target, we will be implementing concrete initiatives for retaining good female candidates already employed by Simula, as well as attracting new and talented female candidates.

Of all employees hired in scientific positions in 2011, 27 per cent were female, and it is especially positive that the number of female full-time research scientists in permanent positions has increased from zero in 2010 to 13 per cent in 2011. Zooming down to the PhD and postdoctoral level, the proportion of female employees has decreased from 27 to 23 per cent. The main reason for this is that several female PhD studens have completed their scholarships and left Simula in 2011. Of the new PhD students employed in 2011, 17 per cent were female.

Simula will continue focusing on gender and diversity awareness in the recruitment and hiring processes and implement measures of the Gender Action Plan in order to reach the goal by 2015.

International employees
Simula is an international workplace, and 47 per cent of the total work force is from countries outside Norway. As of year-end 2011, 25 different nationalities were represented among the employees.

The percentage of non-Norwegian employees at Simula has thus increased from 43 per cent to 47 per cent over 2011. On the PhD level, 72 per cent of the employees have another citizenship than Norwegian by the end of 2011. Compared to the previous year, this represents an increase of 9 per cent.



DOCTORATES and MASTER'S DEGREES

This list presents PhD or MSc degrees awarded by the University of Oslo. The degrees are obtained by candidates that are supervised thorughout their projects by Simula researchers.

Master's students	Supervisors	Theses
Joakim Bjørnstad	Tor Skeie, Sven Arne Reinemo	3D visualisation of network topology, routing, path distribution and network data in simulated InfiniBand clusters
Chris Carlmar	Pål Halvorsen, Carsten Griwodz	Improving latency for interactive, thin-stream applications by multiplexing streams over TCP
Kjetil Endal	Alexander Eichorn, Carsten Griwodz	A pipeline for high-quality free-viewpoint video
Øyvind Evju	Kent-Andre Mardal	Sensitivity analysis of simultated blood flow in cerebral aneurysms
Dag Haavi Finstad	Pål Halvorsen, Håkon Kvale Stensland, Håvard Espeland	Multi-Rate VP8 Video Encoding
Ivar W. Framnes	Glenn Lines	A comparison of norms for characterizing numerical solutions arising in simulations of the electrical cardiac activity
Steffen Sandtrøen Gullichsen	Alexander Eichorn, Carsten Griwodz	Delay in camera-to-display systems
Magnus Holm	Magne Jørgensen, Hans Christian Benestad	Construction and evaluation of a tool for quantifying uncertainty of software cost estimates
Torbjørn Skyberg Knutsen	Lionel Claude Briand, Mehrdad Sabetzadeh	Construction of Information Repostiories for Managing Standards Compliance Evidence
Øyvind Kolbu	Frank T. Johansen, Pål Halvorsen	QoS related admission control for Web services
Espen Angell Kristiansen	Håkon Kvale Stensland, Pål Halvorsen, Carsten Griwodz	Dynamic adaption and distribution of binaries to heterogeneous architectures
Ståle Bordal Kristoffersen	Pål Halvorsen, Carsten Griwodz	Utilization of instrumentation data to improve distributed multimedia processing
Brendan Johan Lee	Carsten Griwodz, Alexander Eichorn	Location Estimation Methods for Open, Privacy Preserving Mobile Positioning
Ronny Mandal	Lionel Claude Briand, Andrea Arcuri	Towards Safe Mutation Testing in a Sandbox Environment
Ivar Ursin Nikolaisen	Xing Cai	Bose-Einstein condensation in trapped bosons: A quantum Monte Carlo analysis using OpenCL and GPU programming

Master's students	Supervisors	Theses
Preben Nenseth Olsen	Håvard Espeland, Pål Halvorsen	Parallel Multimedia Algorithms in P2G
Gabriela Rutkowska	Kent-Andre Mardal	Computational Fluid Dynamics in Patient-Specific Models with Normal and Chiari I Geometries
Viktor Slavkovikj	Alexander Eichhorn	Live color Calibration of a Video Camera Array
Magnus Thorstein Sletholt	Dietmar Phfal, Jo Hannay, Hans Petter Langtangen	Agile Scientists? Investigating Agile Practices in Scientific Software Development
Vladimir Zorin	Sven Arne Reinemo, Tor Skeie	Packet tracing in simulation environments

Doctorates	Supervisors	Theses
Kristin Børte	Monika Nerland [1], Sten Ludvigsen [2], Magne Jørgensen	Software Effort Estimation as Collaborative Planning Activity
Ahmed Elmokashfi	Amund Kvalbein, Tarik Cicic, Olav Lysne	On BGP Inter-domain Routing: an Investigation of Scalability with Respect to Churn
Eli Gjørven	Frank Eliassen, Jan Øyvind Aagedal [3], Romain Rouvoy [4]	Enabling Self-Adaptation by Applying a Technology Agnostic Middleware with Support for Integration
Joachim Berdal Haga	Harald Osnes, Hans Petter Langtangen	Numerical methods for basin-scale poroelastic modelling
Hadi Hemmati	Lionel Briand, Andrea Arcuri	Similarity-Based Test Case Selection: Toward Scalable and Practical Model-Based Testing
Kristoffer Selim	Anders Logg, Harish Narayanan, Trond Kvamsdal [5], Nils Svanstedt [6]	Adaptive Finite Element Methods for Fluid-Structure Interaction and Incompressible Flow
Kristian Valen-Sendstad	Hans Petter Langtangen, Kent-Andre Mardal, Anders B. Logg, Mikael Mortensen, Bjørn Anders Petterson Reif [7]	Computational Cerebral Hemodynamics
Jie Xiang	Yan Zhang, Olav Lysne, Tor Skeie	Resource Management and Optimization for Cognitive Radio Networks

[1] Department of Educational Research, Faculty of Educational Sciences, University of Oslo [2] InterMedia, University of Oslo
[3] Department of Mathematical Sciences, NTNU [4] Sintef [5] Department of Informatics, University of Oslo
[6] Mathematical Sciences, Chalmers University of Technology [7] Department of Mathematics, University of Oslo

THE RESEARCHER OF THE YEAR AWARD

Every year since 2002, Managing Director Aslak Tveito has awarded the Simula researcher of the year. In 2011, Tveito awarded the researcher of the decade.

2002

PROFESSOR DAG SJØBERG

2003

PROFESSOR HANS PETTER LANGTANGEN

2004

PROFESSOR MAGNE JØRGENSEN

2005

PROFESSOR OLAV LYSNE

2006

PROFESSOR LIONEL BRIAND

2007

DR. BJØRN FREDRIK NIELSEN

2008

PROFESSOR
ARE MAGNUS BRUASET

2009

DR. KIRSTEN TEN TUSSCHER

2010

PROFESSOR CARSTEN GRIWODZ

2011

THE RESEARCHER
OF THE DECADE

PROFESSOR LIONEL BRIAND

LIST OF PUBLICATIONS 2011

Simula only reports publications where a significant part of the research has been funded by Simula. This means that at least one of the authors of the reported publications must have his/ her main affiliation with Simula, and has contributed to the publication as specified in Simula's publication guidelines. Publications from people in part-time positions at Simula are generally not counted unless the research is specifically performed as part of their employment at Simula. Such exceptions from the main rule are very few and must in all cases be approved by the head of department.

BOOKS

[1] H. P. Langtangen. *A Primer on Scientific Programming with Python*. Springer, second edition, 2011.

PHD THESES

[2] E. Gjørven. *Enabling Self-Adaptation By Applying a Technology Agnostic Middleware with Support for Integration*. PhD thesis, University of Oslo, 2011.

[3] K. Børte. *Software Effort Estimation As Collaborative Planning Activity*. PhD thesis, University of Oslo, 2011.

[4] J. Xiang. *Resource Management and Optimization for Cognitive Radio Networks*. PhD thesis, Simula Research Laboratory, 2011.

[5] A. Elmokashfi. *On BGP Inter-Domain Routing: an Investigation of Scalability with Respect to Churn*. PhD thesis, University of Oslo, 2011.

[6] K. Selim. *Adaptive Finite Element Methods for Fluid–Structure Interaction and Incompressible Flow*. PhD thesis, University of Oslo, 2011.

[7] J. B. Haga. *Numerical Methods for Basin-Scale Poroelastic Modelling*. PhD thesis, University of Oslo, 2011.

[8] K. Valen-Sendstad. *Computational Cerebral Hemodynamics*. PhD thesis, University of Oslo, 2011.

[9] H. Hemmati. *Similarity-Based Test Case Selection: Toward Scalable and Practical Model-Based Testing*. PhD thesis, University of Oslo, 2011.

ARTICLES IN INTERNATIONAL JOURNALS

[10] M. Jørgensen and S. Grimstad. The impact of irrelevant and misleading information on software development effort estimates: a randomized controlled field experiment. *IEEE Transactions on Software Engineering*, 37(5):695–707, 2011.

[11] S. Mouchawrab, L. Briand, Y. Labiche, and M. D. Penta. Assessing, comparing, and combining state machine-based testing and structural testing: a series of experiments. *IEEE Transactions on Software Engineering*, 37(2), 2011.

[12] T. Halkjelsvik, M. Jørgensen, and K. H. Teigen. To read two pages, I need 5 minutes, but give me 5 minutes and I will read four: How to change productivity estimates by inverting the question. *Applied Cognitive Psychology*, 25(2):314–323, 2011.

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[14] K. McDowell, H. Arevalo, M. Maleckar, and N. Trayanova. Susceptibility to reentry in the infarcted heart depends on the active fibroblast density. *Biophysical Journal*, 110(6):1307–15, 2011.

[15] A. Tveito, G. T. Lines, R. Artebrant, O. Skavhaug, and M. Maleckar. Existence of excitation waves for a collection of cardiomyocytes electrically coupled to fibroblasts. *Mathematical Biosciences*, (230(2)):79–86, 2011.

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[18] G. Bergersen and J.-E. Gustafsson. Programming skill, knowledge and working memory among professional software developers from an investment theory perspective. *Journal of Individual Differences*, 32(4):201–209, 2011.

[19] R. Yu, Y. Zhang, L. Song, and W. Yao. Joint optimization of power, packet forwarding and reliability in

MIMO wireless sensor networks. *ACM/Springer Mobile Networks and Applications (MONET)*, 16(6):760–770, 2011.

[20] R. Yu, Y. Zhang, G. Chen, C. Huang, and R. Gao. Energy-efficient and reliability-driven cooperative communications in cognitive body area networks. *ACM/Springer Mobile Networks and Applications (MONET)*, 16(6):733–744, 2011.

[21] Ø. Hjelle and S. A. Petersen. A hamilton-jacobi framework for modeling folds in structural geology. *Mathematical Geosciences*, 43(7):741–761, 2011.

[22] O. Al-Khayat, A. M. Bruaset, and H. P. Langtangen. Particle collisions in a lumped particle model. *Communications in Computational Physics*, 10(4):823–843, 2011.

[23] A. Arcuri. Evolutionary repair of faulty software. *Applied Soft Computing*, 11(4):3494–3514, 2011.

[24] M. Jørgensen. Contrasting ideal and realistic conditions as a means to improve judgment-based software development effort estimation. *Information and Software Technology*, 53(12):1382–1390, 2011.

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[26] J. Jiang, K. Johnson, K. Valen-Sendstad, K.-A. Mardal, O. Wieben, and C. Strother. Flow characteristics in a canine aneurysm model: a comparison of 4-D accelerated phase-contrast MR measurements and computational fluid dynamics simulations. *Medical Physics*, 38(11):6300–6313, 2011.

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[139] R. Behjati, T. Yue, S. Nejati, L. Briand, and B. Selic. An aadl-based SysML profile for architecture level systems engineering: Approach, metamodels, and experiments. Technical Report 2011-03, Simula Research Laboratory, 2011.

[140] S. Ali, M. Z. Iqbal, A. Arcuri, and L. Briand. Solving OCL constraints for test data generation in industrial systems with search techniques. Technical Report 2010-16, Simula Research Laboratory, 2011.

[141] F. O. Sem-Jacobsen and O. Lysne. Topology agnostic dynamic quick reconfiguration for large-scale interconnection networks. Research note, Simula Research Laboratory, 2011.

[142] T. Yue, S. Ali, and L. Briand. Automated transition from use cases to UML state machines to support state-based testing. Technical Report 2011-05, Simula Research Laboratory, 2011.

TALKS AND OUTREACH

[143] S. Wall. Modeling the infarct injured heart, insights into mechanical dysfunction. SIAM CSE Reno, Nevada, USA, 2011.

[144] X. Cai. A function-centric generic framework for parallelization. Talk at CLS Workshop at UiO on April 13, 2011.

[145] X. Cai. Study of the computational efficiency for different usages of pythoning. Talk at CLS Workshop at UiO on April 13, 2011.

[146] K. Valen-Sendstad, K.-A. Mardal, M. Mortensen, B. A. P. Reif, and H. P. Langtangen. Computational cerebral hemodynamics. The Norwegian Defence Research Establishment, 2011.

[147] A. Massing. Efficient implementation of Nitsche's method on overlapping meshes for interface problems in 3D. FEF 2011, Munich, Germany, 2011.

[148] A. Massing. Efficient implementation of Nitsche's method on overlapping meshes for coupled problems in 3D. Coupled Problems 2011, Kos, Greece, 2011.

[149] K. Valen-Sendstad, K.-A. Mardal, M. Mortensen, B. A. P. Reif, and H. P. Langtangen. Simulation methodology for cerebral blood flow. Biomedical Simulation Lab, Institute of Biomaterials and Biomedical Engineering at the University of Toronto, 2011.

[150] A. Massing. Efficient implementation of Nitsche's method on overlapping meshes in 3D. CSE 2011, Reno Nevada, USA, 2011.

[151] X. Cai and W. Zhang. Efficient computations of initial-value problems involving fractional derivatives. Talk at the seminar on wave propagation in complex media, November 23, 2011.

[152] S.-A. Reinemo, W. L. Guay, B. Bogdanski, O. Lysne, and T. Skeie. vFtree - a fat-tree routing algorithm using virtual lanes to alleviate congestion. Invited talk at the HPC Advisory Council Switzerland Workshop 2011, Lugano, Switzerland., 2011.

[153] K. Valen-Sendstad, K.-A. Mardal, M. Mortensen, B. A. P. Reif, and H. P. Langtangen. Direct numerical simulation of transitional flow in patient–specific intracranial aneurysms. ASME 2011 Summer Bioengineering Conference, 2011.

[154] A. Logg. The FEniCS project. Talk at Det Norske Veritas 2011-05-11, 2011.

[155] A. Logg. The FEniCS project. Talk at NOTUR 2011, University of Oslo, 2011.

[156] A. Logg. The FEniCS project. Workshop on Multiscale Problems and Methods, Simula Research Laboratory, 2011.

[157] A. Logg. The FEniCS project. Talk at EuroSciPy 2011 / Python in Physics, Ecole Normale Supérieure, Paris, 2011-08-09, 2011.

[158] M. E. Rognes. More or less shocking: Using energy estimates to answer scientific questions. Talk at Biocomp Seminar, Simula Research Laboratory, October 2011, 2011.

[159] M. E. Rognes. Automated goal-oriented error control a posteriori error estimation and adaptivity in finite element exterior calculus. Talk at USNCCM '11, Minneapolis, 2011.

[160] M. E. Rognes. Bringing error control to the non-expert - automation of a posteriori error estimation. Talk at CBC Workshop on Multiscale Problems and Methods, 2011.

[161] H. P. Langtangen. Abnormal flows in the brain and the spine: How to better understand diseases by computations. Talk at the Computational Life Science seminar, University of Oslo, 2011.

[162] A. Schroll. Self calibrating, adaptive models in the geo- and life sciences. Inverse Problems Workshop, 2011.

[163] K.-H. Støverud and V. Haughton. Ongoing research: Characterize CSF flow and identify the cause of syringomyelia with CFD. The workshop "Working Toward a Day Without Pain Gala", Buffalo, 2011.

[164] K.-H. Støverud. Cerebrospinal fluid (csf) oscillating flow and pressure. CBC Workshop on CSF Flow Associated with Chiari and Syringomyelia, 2011.

[165] K.-H. Støverud. Cerebrospinal fluid (csf) flow in Chiari I and syringomyelia. CBC Seminar / Third semester presentation, 2011.

[166] M. E. Rognes. FEniCS after 1.0: Current trends at cbc@simula. Talk at FEniCS'11 / Red Raider Minisymposium 2011, Texas Tech University, Lubbock, 2011.

[167] B. Kehlet. Code generation for ODEs. Talk at Biocomp Seminar, Simula Research Laboratory, 2011.

[168] S.-A. Reinemo, E. G. Gran, T. Skeie, and O. Lysne. InfiniBand congestion control. Contributed talk at the 2011 OpenFabrics International Workshop, Monterey, USA, 2011.

[169] T. Gillberg. A semi-ordered fast iterative method (sofi) for monotone front propagation in simulations of geological folding. The 19th International Congress on Modelling and Simulation (MODSIM2011), 2011.

[170] K.-H. Støverud. The effect of varying cross-sectional areas on cerebrospinal fluid flow and pressure in the cervical spine. MekIT'11 Sixth national conference on Computational Mechanics, 2011.

[171] K.-H. Støverud. The use and potential of FEniCS in medical applications. FEniCS'11 / Red Raider Minisymposium 2011, Texas Tech University, Lubbock, 2011.

[172] K.-H. Støverud. CSF flow and pressure in the cervical spine. CBC Workshop on Biomedical Modeling, 2011.

[173] V. Prot and B. Skallerud. Finite element analysis of the mitral valve with active muscle fibres. SIAM CSE Reno, Nevada, USA, 2011.

[174] M. S. Alnæs. The unified form language - a domain specific language for finite element methods. European Numerical Mathematics and Advanced Applications (ENUMATH), 2011.

[175] H. Narayanan. The role of k+ channels in human articular chondrocyte electrophysiology: a computational perspective. CaMo Seminar, Oslo, Norway, 2011.

[176] M. M. Maleckar. Modeling the effects of rotigaptide in atrial tissue: a cautionary tale. 9th International Conference of Numerical Analysis and Applied Mathematics, 2011.

[177] M. E. Rognes. Automated goal-oriented error control. Talk at CBC workshop on Biomechanics, 2011.

[178] M. E. Rognes. The FEniCS project. Talk at Imperial College, 2011.

[179] M. E. Rognes. Goal-oriented error control automated! Talk at SIAM CSE Reno, Nevada, USA, 2011.

[180] H. P. Langtangen. Kaos i hjernen - ny innsikt gjennom simuleringer. University of Oslo 1-day seminar: Realister invaderer helsevesenet, 2011.

[181] H. P. Langtangen. Kaos i hjernen - ny innsikt gjennom simuleringer. Talk at Fysikkforeningen, 2011.

[182] A. Logg. Solving poisson's equation with DOLFIN 0.2.11 (2002): a study of the portability of scientific codes across the time domain. Talk at Biocomp Seminar, Simula Research Laboratory, 2011-09-28, 2011.

[183] A. Logg. Adaptive finite element methods for fluid-structure interaction and incompressible flow. Talk at FEniCS'11 / Red Raider Minisymposium 2011, Texas Tech University, Lubbock, 2011.

[184] A. Logg. Adaptive finite element methods for fluid-structure interaction and incompressible flow. Talk at Simula/NTNU Workshop, Simula Research Laboratory, 2011.

[185] M. E. Rognes. Error control and adaptivity for the non-expert. Talk at CBC Workshop on Biomedical Modeling, 2011.

[186] M. E. Rognes. Fenics: the next generation PDE software. Talk at CBC Workshop on Biomedical Modeling, 2011.

[187] B. Kehlet. Code generation for time dependent problems. Talk at FEniCS'11 / Red Raider Minisymposium 2011, Texas Tech University, Lubbock, 2011.

[188] K. Valen-Sendstad, K.-A. Mardal, M. Mortensen, H. P. Langtangen, B. A. P. Reif, and D. A. Steinman. 'turbulence' in cerebral aneurysms. CBC Workshop on Biomechanics, 17-18 November, 2011.

[189] X. Cai. Parallel simulation of particle transport using OpenMP. Guest lecture at UCSD on January 31, 2011.

[190] J. E. Hannay. Stort & smidig eller stort & tungt. Talk given at Software 2011, Oslo., 2011.

[191] J. Koivumäki. Computational modeling of intracellular calcium dynamics in human atrial myocytes: Impact on action potential morphology. Seminar at the Technical University of Dresden, Germany, 2011.

[192] A. Massing. Nitsche's method for fictitious domain and overlapping meshes (in 3d). FEniCS'11 / Red Raider Minisymposium 2011, Texas Tech University, Lubbock, 2011.

[193] A. Massing. Nitsche's method for fictitious domain and overlapping meshes (in 3d). UMIT Research Seminar, Umeå, Sweden, 2011.

[194] X. Cai. Programming with OpenMP and mixed mpi-OpenMP. Invited lecture at pre-conference workshop of NOTUR 2011, 2011.

[195] X. Cai. Programming with OpenMP and mixed mpi-OpenMP. Invited lecture during USIT's Research Computing Services training week, 2011.

[196] A. Schroll. On automated computational modeling in the geo- and life sciences. Numerical methods for hyperbolic equations Recent trends and future directions (SAMHYP), ETH Zürich, Switzerland, 2011.

[197] M. Jørgensen. Human judgment in planning and estimation of software projects. ICKE 2011 (India), 2011.

[198] M. Jørgensen. Estimering av it-prosjekter: Hva vet vi? hvordan bli bedre? Sparebank 1-seminar, 2011.

[199] M. Jørgensen. Software development effort estimation: Why it fails and how to improve it. Seminar held for various companies in Ukraine, Mexico and Nepal, 2011.

[200] M. Jørgensen. Du er mer lik meg enn jeg er lik deg : Asymmetri i relativ estimering. XP-meeting, 2011.

[201] M. Jørgensen. Vinnerens forbannelse, informasjonsasymmetri, utvalgsrisiko, moralsk risiko og it-kontrakter. Confex Seminar, 2011.

[202] M. Jørgensen. How we know what isn't so : Common myths in daily life and software development. why do we believe in myths? Chalmers-seminar, 2011.

[203] M. Jørgensen. Identification and management of IT-projects with high risk of cost overrun. ABB seminar, 2011.

[204] M. Jørgensen. Identification and management of IT-projects with high risk of cost overrun. Bearing Point-seminar, 2011.

[205] S. Wall. Multi-scale modeling of the heart - computational approaches and applications to biomedicine. Scientific Computing and Imaging Institute, University of Utah,, 2011.

[206] O. Lysne. High node count - scalability challenges for interconnection networks. Second International Workshop on HyperTransport Research and Applications, 2011.

[207] L. Moonen. Evaluating and guiding the use of coding standards to reduce software faults. Keynote address, Embedded Source Code Quality Control, Antwerp, Belgium, 2011.

[208] M. Jørgensen. From fashion and opinion-based to evidence-based software and knowledge engineering. ICKE 2011 (India), 2011.

[209] L. Moonen. Building a better map: Wayfinding in software systems. Keynote address, IEEE 19th International Conference on Program Comprehension (ICPC), 2011.

[210] M. Jørgensen. Lønner det seg å investere i IT-prosjekter? Hva vet vi om ROI-prediksjoner? IDG seminar, 2011.

[211] P. Beskow, H. Espeland, H. K. Stensland, P. N. Olsen, S. B. Kristoffersen, E. A. Kristiansen, C. Griwodz, and P. Halvorsen. Distributed real-time processing of multimedia data with the P2G framework. EuroSys 2011, 2011.

[212] J. Koivumäki. Excitation-contraction coupling in human atrial myocytes: Remodeling in atrial fibrillation. 35th Meeting of the European Working Group on Cardiac Cellular Electrophysiology, 2011.

[213] P. Kekenes-Huskey, J. E. Hake, Y. Cheng, F. Sachse, J. Bridge, A. J. McCammon, and A. P. Michailova. Contributions of structural t-tubule heterogeneities and membrane Ca^{2+} flux localization to local Ca^{2+} signaling in rabbit ventricular myocytes. 4th Cardiac Physiome Workshop, Merton College, Oxford, 2011.

[214] J. E. Hake, W. E. Louch, K. Haugen, I. Sjaastad, S. O. M., A. McCulloch, A. P. Michailova, and G. T. Lines. A stochastic model of the ryanodine receptor featuring coupled gating and competitive binding of luminal and cytosolic Ca^{2+} and mg2+. Annual meeting in Biophysical Society, 2011.

[215] P. Kekenes-Huskey, J. E. Hake, Y. Cheng, F. Sachse, J. Bridge, A. McCammon, and A. P. Michailova. Contributions of multiple t-tubules and membrane Ca^{2+} flux localization to sub-cellular Ca^{2+} signaling in rabbit ventricular myocytes. 2. Gordon Research Conferences: Calcium Signalling, 2011.

[216] J. Koivumäki. Rate-dependent regulation of sarcoplasmic reticulum Ca^{2+} atpase in human atrial myocytes. The Scandinavian Physiological Society Annual Meeting, 2011.

[217] M. Jørgensen. IT-fiaskoer: Djevelen er i detaljene. Article in Computerworld, 2011.

[218] M. Jørgensen. Lønner det seg å følge IT-moten? Article in Computerworld, 2011.

[219] M. Jørgensen. Å svare på hvor fornøyd du er gjør deg mindre fornøyd. Article in Computerworld, 2011.

[220] M. Jørgensen. Huleboere bodde ikke i huler men i telt. Article in Computerworld, 2011.

[221] M. Jørgensen. Floss, flott eller flopp. Article in Computerworld, 2011.

[222] M. Jørgensen. Du er mer lik meg enn jeg er lik deg. Article in Computerworld, 2011.

[223] M. Jørgensen. Testere bør være destruktive. Article in Computerworld, 2011.

[224] S. Wall, J. Sundnes, N. Trayanova, R. C. P. Kerkhoffs, and V. Prot. Modeling coupled electromechanics in the cardiovascular system. SIAM CSE Reno, Nevada, USA, 2011.


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