The purpose of this note is to study an explicit finite difference scheme for the Hugoniot-Hugoniot model:

\[ C_{11} \frac{\partial \sigma}{\partial x} - \frac{3}{\alpha} \left( \frac{\partial \sigma}{\partial t} + \frac{\partial \sigma}{\partial x} \right) + \frac{\partial \sigma}{\partial x} \left( \frac{\partial \sigma}{\partial t} + \frac{\partial \sigma}{\partial x} \right) = 0 \]

\[ w_0 = (1-\mu) \rho \frac{\partial x}{\partial t} - \mu \rho \frac{\partial x}{\partial t} \]

\[ h_0 = (1-\mu) \rho c_s^2 \frac{\partial x}{\partial t} - \mu \rho c_s^2 \frac{\partial x}{\partial t} \]

\[ \eta_0 = (1-\mu) \rho \frac{\partial x}{\partial t} - \mu \rho \frac{\partial x}{\partial t} \]

Define

\[ \sigma = \frac{3}{\alpha} \frac{\partial \sigma}{\partial x} \]

\[ \gamma = \frac{\partial \sigma}{\partial x} \]

\[ u = \frac{\partial \sigma}{\partial x} \]

\[ v = \frac{\partial \sigma}{\partial x} \]

\[ \omega = \frac{\partial \sigma}{\partial x} \]

\[ \eta = \frac{\partial \sigma}{\partial x} \]

Here

\[ E_0 < E < E_{\infty} \]

Our aim is to prove that

\[ E_0 < u < E_{\infty} \]
Managing Director

Research, education and new business creation

Simula Research Laboratory has now been in operation for two years. The focus in the first year was on hiring personnel and moving to Fornebu. In 2002, Simula settled in to its new home and focused on research and the creation of a long-term strategy.

The Minister of Education and Research, Kristin Clemet, officially opened Simula on April 4, 2002. She said in her opening speech that, "with the Simula Centre we have obtained an environment that sets a focus on quality and gives skilful researchers the time and resources necessary to carry out research of the highest international quality. We will invest extensively in Norwegian research, but we must also dare to concentrate our investment on specific chosen areas."

The Minister of Trade and Industry, Ansgar Gabrielsen also referred to Simula in the Parliament on May 14, 2002. He stated that, "in the information technology field there is often a short distance from basic research to commercial applications. We therefore have high expectations of the Simula Centre newly opened at Fornebu. Simula's goals are to conduct basic research that is internationally recognised and to contribute to innovation and the creation of new businesses."

These two quotations highlight two of Simula's three major responsibilities:
1. research of the highest international quality,
2. education of graduate university students in Informatics,
3. establishment of businesses based on the research it conducts.

Research

Simula Research Laboratory conducts research in the areas of software engineering, communication technology and scientific computing. In all these areas, we have the same goals: long-term research on basic problems with an eye to possible applications in industry and other parts of society. Compared with the universities, Simula puts greater emphasis on possible applications and, in addition, the research is directed towards specific areas for longer periods of time. Hence, individual researchers at Simula have less freedom in choosing research topics than their counterparts at the universities. In 2002 we have worked hard to focus our research effort into relatively few projects. This is necessary in order to acquire and hold a position as a respected international research laboratory.

One of Simula's largest projects involves experiments with computer software development. That activity is described in more detail on page 12. This field has had a long tradition of experiments carried out on students in non-realistic work situations. Simula has addressed these shortcomings directly and is establishing a new standard for how these experiments should be conducted - out in industry and with real practitioners as subjects. The director of the department where these experiments are being carried out, Professor Dag Sjøberg, received Simula's 2002 Research Award.

Education

Simula Research Laboratory co-operates with the four universities in Norway in providing education to Master's and Doctoral students. The staff at Simula achieves this by teaching courses and supervising students from the universities. The universities are responsible for this education and the Simula staff contributes in terms of part-time positions. In 2002, Simula staff members supervised five students who successfully defended and obtained their Doctorate degrees. We also participated in the delivery of 19 university courses. Presently, employees at Simula in cooperation supervise 18 doctoral students, in co-operation with professors at the universities. It is Simula's responsibility to continue this work and thereby strengthen higher-level education within the IT field.

Innovation and new business creation

Research and education are traditional roles for researchers, whereas creating new businesses is not. Given that our researchers have limited experience with this activity, we have expended considerable effort investigating how it should be organised and financed. The employment agreements with every employee at Simula Research Laboratory provide a solid foundation. They contain principles and procedures outlining how commercial rights will be shared between individuals and Simula. In 2002, we have started establishing effective structures for applying our research results to solving real life problems. Professor Morten Daaehlen leads this work with enthusiasm. Simula's work with new business creation is described in more detail on page 16.

We look forward to establishing the mechanisms necessary to finance our first new business venture before next year's Annual Report is written.

Simula Research Laboratory is a research centre conducting basic long-term research on selected areas within information and communication technology. Through its operation the centre is supposed to contribute to innovation in Norwegian industry.

Simula Research Laboratory Annual Report 2002
Simula Research Laboratory (Simula) has made significant progress in 2002, in full accordance with the foundation laid when it was created in January of 2001. During the year, Simula has accomplished several things, including establishing itself in new facilities at Fornebu, becoming fully operational and completing the organisational transformation to a limited company with a new Board.

Simula started as a project at the University of Oslo in 2001, in response to a resolution of the Norwegian Parliament. This resolution established a research organisation in the future IT and Knowledge Center on the site of the former Oslo Airport at Fornebu. Simula’s Board notes that Simula has progressed well and according to plan, while the larger IT and Knowledge Center has developed considerably more slowly than predicted.

Simula moved from the Oslo Innovation Center at the end of 2001 and was officially opened in April 2002 by the Minister of Education and Research, Kristin Clemet. The Minister made it clear in her speech that the official opening was an important occasion for the Norwegian research community and that the Norwegian Government would provide funding to Simula at the level originally expected. This meant a grant of NOK 45 million in 2002. A later additional grant resulted in a total budget of NOK 49 million in 2003, which was a significant increase over 2002.

Clemet also noted in her speech that Simula has focused on the five elements that will be critical for Norwegian research in the future: quality, internationalisation, strong technical leadership, knowledge transfer and researcher mobility. In addition, Simula has committed to maintain a close relationship with industry. The Ministers of Justice, Agriculture, Petroleum and Energy, Trade and Industry and International Development were also present at the official opening.

The Board has noticed an increasing level of activity at Simula during the year. There are now three fully staffed research departments which are functioning well. A further increase in activities is planned for 2003.

Simula's Board: Bernt Anda, Askvik Tveit, Joande Nygard, Cecilie Ohm, chairperson Berit Svendsen, Tore Ganssle, Odd Gropen, Kjell Brattbrynsen, Lars Holden, Olav Lyne. Linda Ingalsbyten and Ragnar Reine were not present during the photo session.
Strategy and startup
Simula's new Strategy for 2002-2002 has been presented to the Board on two occasions and is planned to be competed in the first half of 2003. The strategy builds on the premise that Simula will continue to have three research departments: Scientific Computing (SC), Software Engineering (SE) and Networks and Distributed Systems (ND). In addition, 2002 saw the creation of a department dedicated to developing new businesses based on research results and managing Simula's commercial interests. This new department is called Simula Innovation.

The operation of Simula is based on a ten year research contract (2001-2010) with the Research Council of Norway. Simula has signed a co-operation agreement with the four Norwegian universities, the research organisation SINTEF, the Norwegian Computing Centre and the Research Council. There are also framework agreements which regulate the relationship between Simula and these institutions.

Simula Research Laboratory was established as a limited company at a meeting in the Ministry of Education and Research on June 11, 2002. Six days later, the new Board assembled for the first time. The company is owned by the Norwegian state, which holds 80% of the shares, and SINTEF and the Norwegian Computing Centre which each own 10% of the shares. Two central issues in the Board's work in 2002 were the progress of the "Fornebu vision" and Simula's leasing agreement for office and lab space in the terminal building.

Excellent research
An international review of basic research in information and communication technology (ICT) concluded in 2002 that Norway invests too little in basic research in relation to the country's potential and in comparison to other countries in Western Europe and the United States. The review recognised, however, that Norway has several strong ICT research communities achieving international quality in several areas, the result of competent and hard-working researchers. Simula's Scientific Computing department received the best possible rating, "Excellent", while the other two departments were rated as "Good".

The next major milestone for Simula is an independent review, to be held under the auspices of the Research Council. This is expected at the

TEF, Norsk Regnesentral og Norges forskningsråd, og i tillegg er det utarbeidet rammerforvalter som reglerer forholdene mellom Simula-sentrene og hver enkel av disse institusjonene.


Fremragende forskning
En internasjonal evaluering i 2002 av grunnforskningen innen informasjons- og kommunikasjons- teknologi (ICT) fastslår blant annet at Norge investerer for lite i grunnforskning i forhold til landets potensial og i forhold til andre land i Vest- Europa og USA. Evalueringen konstaterer likevel at Norge har flere sterke ICT-miljøer med internasjonale kvalitet på flere områder, noe som skyldes dypt at investeringer og hardt arbeidende forskere. Simulas sentrets SC-avdeling fikk toppskore i strategisk "Fremragende" (Excellent) i evalueringen, mens de to andre avdelingene fikk karakterer "God".


4 Simula Research Laboratory Annual Report 2002
end of 2004. It is the Board’s clear ambition and declared goal that the Scientific Computing department maintains its top rating and that the other two departments improve from “Good” to at least “Very good”.

National and International co-operation
Simula attaches great importance to various forms of co-operation with its own institutions and other research communities, nationally and internationally. One of the most important initiatives in this area is the agreement each research department has with the Department for Informatics at the University of Oslo. These agreements cover the teaching and supervision of Master’s students.

Simula had not been established long enough to be considered as a host institution when the Research Council introduced its Centre of Excellence (CoE) program in 2002, but it is still playing a role in three of the Centres. The SC department is an official participant in the CoE institution Physics for Geological Processes at the university of Oslo, developing robust methods for solving thermal flow problems in geology, particularly in an area referred to as mantle convection.

SC also has a research collaboration in the area of robust methods for fluid dynamics with another CoE institution, Mathematics for Applications. As a part of this collaboration, staff in the SC department are participating in the development of new study programs in applied mathematics at the University of Oslo (at the Bachelor, Master’s and PhD levels). There are now plans to expand the collaboration. Finally, the SC department works with Chalmers University of Technology in Gothenburg, Sweden on the development of p-FEM software, and the universities of Erlangen and Dortmund in Germany on international workshops and conferences.

The ND department is involved, both nationally and internationally, in several large projects, including Quality of Service-Aware Component Architecture (QoA) with the University of Tromsø, SINTEF, Lancaster University, University of California, Irvine and Washington University. The project Vertical Integration of QoS in Heterogeneous Networks (VINe) is carried out in collaboration with Universitat de Valencia, University of Southern California, Rice University, Carleton University, Technische Universität Wien, the international technology corporation ABB and the Norwegian online game developer Funcom.

The SE department has industry as its laboratory. They work closely with companies, carrying out case studies which generate knowledge on improving the processes for developing software. In 2002, these companies included Software Innovation, Ericsson in Askers, Ericsson in Grimstad, WM-data, Nera, Mogul, EDB4Tel and TietoeAsera. Project improvement work was carried out in co-operation with the Norwegian University of Science and Technology (NTNU) and SINTEF.

Internationally, the SE Department has contributed to a larger survey on the area of software inspections together with Fraunhofer in Kaiserslautern, Germany. Other international partners included Carleton University, Canada; University of Glasgow, Great Britain; and Lund University, Sweden.

The goal of the SE department is to perform more realistic experiments than those normally carried out nationally and internationally. In meeting this goal, the department used approximately 200 programmers as research subjects from companies like Accenture, Cap Gemini Ernst & Young, TietoeAsera, Elmentor, Software Innovation, Genera and ObjectNet.

Simula Innovation collaborates with the private companies IT Fornebu AS and IT Fornebu Inkubator AS on new business creation, and with the University of Oslo on both new business creation and research. Statens Kartverk is an important partner in the field of map delivery.

Public awareness
Both Norwegian and foreign research communities have shown great interest in Simula this year and many different groups have visited and toured the centre. Simula has also received extensive and positive coverage in the media, focusing on Simula’s research, progress in the “Fornebu vision” and not least in connection with the official opening.

flodhøyer generert av nattarktastrøfe som astore-
dekollasjoner og undersjæreke ras.

SC har også et forskningsamtale omktinge
robuste metoder for verkstedsstøtter med SFF-institusjonen Mathematics for Applications. Som en del av dette samarbeidet deltar ansatte i SC i utvik-
ling av helt nye studieprogrammer i anvende matematikk (bachelor, master og PhD-nivå) ved Universi-
tetet i Oslo.

I tillegg til dette samarbeider SC blant annet med
Chalmers tekniska högskola i Göteborg om utvik-
ling av p-FEM software, samt universitetene i
Erlangen og Dortmund i Tyskland i forbindelse
med workshops og internasjonale konferanser.

Avdelingen for Networks and Distributed Sys-
tems samarbeider både nasjonalt og internasjonal
i flere store prosjekter, blant dem Quality of Service-
Aware Component Architecture (QoA) med Universi-
tetet i Tromsø, forskningsstiftelsen Sintef, Lan-
caster University, University of California, Irvine
og Washington University. Projekttet Vertical In-
tegration of QoS in Heterogeneous Networks (VINe)
foregår i samarbeid med Universitat de Valencia,
University of Southern California, Rice University,
Carleton University, Technische Universität Wien,
det internasjonale teknologiselskapet ABB og den
norske matselskapet Fjordkom.

Software Engineering-avdelingen har industrien
som sitt laboratorium. Derfor samarbeider avdelin-
gen tett med bedrifter der man kan gjennomføre case
studier med sikten å frembringe kunnskap om
hvordan prosesser for utvikling av programmer kre
forbedres. Blant finansiering av samarbeidet med
2002 er Software Innovation, Ericsson i
Askers, Ericsson i Grimstad, WM-data, Nera, Mogul,
EDB4Tel og TietoeAsera. Forbedringsarbeidet har
vært avført i samarbeid med NTNU og Sintef.

Internasjonalt har SE-avdelingen samarbeidet om
en større survey innen inspeksjoner sammen med
Fraunhofer i Kaiserslautern, Tyskland. Andre inter-
nasjonale samarbeidsparter har vært Universitetet
i Carleton, Kanada, Universitetet i Glasgow, Storbri-
ttania, og Universitetet i Lund, Sverige.

SE-avdelingen har hatt som mål å gjennomføre
mer realistiske eksperimenter enn det som vanlig
utøres i fagsfeltet internasjonal. Som et eksempel
har avdelingen benyttet ca. 200 programmerere fra
konsulentfirmaer som Accenture, Cap Gemini
Ernst & Young, TietoeAsera, Elmentor, Software
Innovation, Genera og ObjectNet.

Simula Innovation samarbeider blant annet med
de private selskapene IT Fornebu as og IT Fornebu
Inkubator as på området for systekonsept, og Universi-
tetet i Oslo innen både nyskaping og forsking.
Statens Kartverk er en viktig samarbeidspartner
i dette feltet.

Formidling
Både norske og utenlandske forskningsmiljøer har
vist stor interesse for Simulas-verktøy på løpet av

Simula Research Laboratory Annual Report 2002
Administration and work environment
At the end of 2002, there were 60 people in various positions connected to Simula. A large majority were researchers, of which 10 were recruited internationally and 13 were women.

Managing Director Professor Morten Dæhlen was given a one year leave of absence in April 2002 to assume responsibility for building up the new Simula Innovation department. At the same time, Professor Aslak Tveito was appointed Acting Managing Director.

Simula became a member of the employees' organisation Atelia and some employees formed a chapter of The Norwegian Society of Chartered Engineers, a labour union. Procedures were implemented for a workplace safety officer (verneombud) and Health, Environment and Safety work. It is the Board's assessment that Simula has a good work environment. There have been no registered cases of work-related illness or accidents in 2002.

Simula's operations do not contribute in any way to environmental pollution.

Finances
In 2002 Simula had operating revenues of NOK 45.8 million. Profit amounted to NOK 4.8 million, which was transferred to equity. The conditions are present to support continued operation and the Financial Statement is presented in light of these conditions.

The Board considers that the company has found a suitable operating structure. No situations have occurred after the end of the year which impacts the Financial Statement as presented.

The way forward
The Board would like to thank Simula's management, researchers and other staff for a substantial and valuable contribution in the past year. Simula is now established in appropriate offices and labs, and the financial foundation for operation appears to have been secured. Further, a strategy for the organisation has been developed, and competent people have been hired to carry out the activities which the strategy prioritises. The next step is to improve the quality of research activity further, leading up to the planned review by the Research Council at the end of 2004. At the same time, Simula's education and new business creation activities must receive the necessary priority.

Despite the challenging times in the IT and Telecom field at present, IT Fornebu stands by its vision of creating an internationally attractive IT and knowledge-based community at Fornebu. It is the Board's ambition that Simula Research Laboratory will be a significant contributor to the fulfillment of that vision.
Operating accounts Resultatregnskap

<table>
<thead>
<tr>
<th>Note</th>
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</thead>
<tbody>
<tr>
<td>OPERATING INCOME Driftsinntekter</td>
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<tr>
<td>OPERATING EXPENSES Driftskostnader</td>
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<td>Depreciation of fixed assets Avskrivning varige driftstider</td>
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<tr>
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<tr>
<td>TOTAL OPERATING EXPENSES Sum driftskostnader</td>
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</tr>
<tr>
<td>OPERATING PROFIT Driftsresultat</td>
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<tr>
<td>FINANCIAL ITEMS Finansposter</td>
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<td>Other interest income Annen rentenett</td>
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<tr>
<td>Other financial income Annen finansinntekt</td>
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<tr>
<td>Other interest expenses Annen rentekostnad</td>
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<td>Other financial expenses Annen finanskostnad</td>
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<td>TOTAL FINANCIAL ITEMS Sum finansposter</td>
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<td>PROFIT Årsresultat</td>
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<td>ALLOCATION OF PROFIT Disponering av årsresultat</td>
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<td>Transferred to equity Overført annen egenkapital</td>
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<td>Total allocated Sum disponert</td>
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Balance sheet Balanse

<table>
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<tr>
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<tbody>
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<td>ASSETS Eiendeler</td>
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<tr>
<td>CAPITAL ASSETS Anleggsmidler</td>
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</tr>
<tr>
<td>Fixed assets Varige driftstider</td>
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<tr>
<td>Furniture, equipment, etc. Driftsutstyr, inventar o.l.</td>
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</tr>
<tr>
<td>Total Fixed Assets Sum varige driftstider</td>
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<tr>
<td>TOTAL CAPITAL ASSETS Sum anleggsmidler</td>
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<tr>
<td>CURRENT ASSETS Omsetningsmidler</td>
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<tr>
<td>Receivables Fordringer</td>
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<tr>
<td>Customer receivables Kundefordringer</td>
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<tr>
<td>Other receivables Andre fordringer</td>
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</tr>
<tr>
<td>Total receivables Sum fordringer</td>
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</tr>
<tr>
<td>Bank deposits Bankreinsidder</td>
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<tr>
<td>TOTAL CURRENT ASSETS Sum omsetningsmidler</td>
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<td>TOTAL ASSETS Sum eiendeler</td>
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EQUITY AND LIABILITIES Egenkapital og gjeld

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<tr>
<td>EQUITY Egenkapital</td>
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<tr>
<td>Contributed equity Innlatt egenkapital</td>
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<tr>
<td>Share capital Selskapskapital</td>
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<tr>
<td>Earned equity Opptjenet egenkapital</td>
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<tr>
<td>Other equity Annen egenkapital</td>
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<tr>
<td>Total earned equity Sum oppjent egenkapital</td>
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<tr>
<td>TOTAL EQUITY Sum egenkapital</td>
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LIABILITIES Gjeld

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<tbody>
<tr>
<td>Short-term liabilities Kortvarig gjeld</td>
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</tr>
<tr>
<td>Accounts payable Leverandører</td>
<td></td>
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<tr>
<td>Taxes and other government fees due Skyldige offentlige avgifter</td>
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<tr>
<td>Other short-term liabilities Annen kortvarig gjeld</td>
<td></td>
</tr>
<tr>
<td>Total short-term liabilities Sum kortvarig gjeld</td>
<td></td>
</tr>
<tr>
<td>TOTAL EQUITY AND LIABILITIES Sum egenkapital og gjeld</td>
<td></td>
</tr>
</tbody>
</table>
Note 1 – Accounting principles

Regnskapsprinsipper

The accounts of Simula Research Laboratory are rendered in accordance with the Norwegian Accounting Act of 1998 and generally accepted accounting practices in Norway.

Principle for valuating and classifying assets and liabilities

Assets determined to be for long-term ownership or use are classified as fixed assets. Other assets are classified as current assets. Receivables to be paid back within one year are still classified as current assets. Corresponding criteria are applied when classifying short-term and long-term liabilities.

Capital assets are valued at acquisition cost, but depreciated to actual value when a reduction in value occurs which is not expected to be temporary. Capital assets with limited economic life are systematically depreciated.

Long-term liabilities are booked at their original face value. Long-term liabilities are not revalued to actual value as a result of fluctuations in interest rates.

Current assets are valued at the lowest of acquisition cost or actual value. Short-term liabilities are booked at their original face value. Short-term liabilities are not revalued to actual value as a result of fluctuations in interest rates.

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

Foreign currency

Cash items in foreign currency are converted using conversion rates in force at the financial year end.

Fixed assets

Fixed assets are depreciated over their expected economic life. Depreciation is, as a rule, spread in a linear fashion over the assumed economic life of the asset.

Receivables

Customer receivables and other receivables are booked at face value after deducting a provision for expected bad debts. This provision is based on an assessment of the individual receivables. In addition, there is a general provision for expected bad debts applied to all receivables as a whole.

Pensions

Pension items are based on a linear contribution profile and an expected final salary.

Taxes

The company has no tax costs since its activities are not considered to be taxable.

Note 2 – Financial market risk

Finansiell markedsrisiko

The company has little exposure to financial market risk.

Selskapet er i liten grad eksponert for finansiell markedsrisiko.

Note 3 – Capital assets

Anleggsmidler

<table>
<thead>
<tr>
<th>IT equipment and infrastructure</th>
<th>Furniture and equipment</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquired 2002</td>
<td>1,149,202</td>
<td>1,549,818</td>
</tr>
<tr>
<td>Acquisition cost 31/12</td>
<td>1,149,202</td>
<td>1,549,818</td>
</tr>
<tr>
<td>Accumulated depreciation Akk. avskrivninger</td>
<td>230,030</td>
<td>277,224</td>
</tr>
<tr>
<td>Booked value 31/12</td>
<td>919,172</td>
<td>1,272,594</td>
</tr>
<tr>
<td>Normal depreciation Ordinære avskrivninger</td>
<td>230,030</td>
<td>277,224</td>
</tr>
<tr>
<td>Depreciation in % Avskrivning i %</td>
<td>20 – 33%</td>
<td>20 – 33%</td>
</tr>
</tbody>
</table>

Årsregnskapet er satt opp i samsvar med regnskapsloven 1998. Det er utarbeidet etter norske regnskapsstandarder.

Hovedregel for vurdering og klassifisering av eiendeler og gjeld


Enkele poster er vurdert etter andre regler, og redegjøres for nedenfor.

Valuta

Pengeposter i utenlandsk valuta omregnes til balanseårets kurs.

Varige driftsmidler

Varige driftsmidler avskrives over forventet økonomisk levetid. Avskrivningene er som hovedregel fordelt lineært over antatt økonomisk levetid.

Fordringer

Kundefordringer og andre fordringer oppføres til pålydende etter fredag for avstemning til forrentet tap. Avstemning til tap gjøres på grunnlag av en individuell vurdering av de enkelte fordringene. I tillegg gjøres det for vissenskapsfordringer en aspesifisert avstemming for å dekke antatt tap.

Pengeonering

Ved regnskapsføring av pensjon er lineær oppjøningsprofil og forventet utløp som oppjøningsgrunnlagfast til grunn.

Skatter

Selskapet har ikke innarbeidet skattekostnader da virksomheten ikke er vurdert å være skattepliktig.
Note 4 – Pension costs  Pensjonskostnader

The company has a retirement pension plan covering a total of 40 people. The pension plan provides defined future benefits. These are dependent, for the most part, on number of contribution years, salary level at retirement age, and size of benefit received from the Norwegian National Insurance plan. The pension plan is financed through funds invested in the Norwegian Public Service Pension Fund.

Selskapet har pensjonsordning som omfatter i alt 40 personer. Ordningen gir rett til definerte fremtidige ytelser. Disse er avhengig av antall oppføringsår, lønnstall ved oppnådd pensjonsalder og størrelsen på yttelmene fra folketrygdens. Den kollektive pensjonsavtalen er finansiert ved fondsopbygning organisert i Statens pensjonsklasse.

Note 5 – Personnel costs, number of employees, etc.  Lønnskostnader, antall ansatte, godtgjørelser m.m.

<table>
<thead>
<tr>
<th>Personnel costs</th>
<th>Lønnskostnader</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries</td>
<td>Lønn</td>
</tr>
<tr>
<td>National Insurance contributions</td>
<td>Folketrygdavgift</td>
</tr>
<tr>
<td>Pension costs</td>
<td>Pensjonskostnader</td>
</tr>
<tr>
<td>Other benefits</td>
<td>Andre ytelser</td>
</tr>
<tr>
<td>Total</td>
<td>Sum</td>
</tr>
<tr>
<td>2002</td>
<td></td>
</tr>
<tr>
<td>18,370,898</td>
<td></td>
</tr>
<tr>
<td>2,675,368</td>
<td></td>
</tr>
<tr>
<td>1,004,428</td>
<td></td>
</tr>
<tr>
<td>562,470</td>
<td></td>
</tr>
<tr>
<td>22,613,164</td>
<td></td>
</tr>
</tbody>
</table>

Average number of employees: 43
Gjennomsnittlig antall ansatte: 43

Note 6 – Operating Income  Driftsinntekter

The company's operating income was distributed as follows:
Selskapets driftsinntekter fordeler seg som følger:

| Research funding  | 45,221,440 |
| Reimbursement for research fellows | 425,000 |
| Refusion for stipendiat | 186,967 |
| Rental income  | 55,681    |
| Other income   |           |
| Total           | 45,889,088 |

Note 7 – Share capital and ownership  Aksjekapital og eierstruktur

The company's share capital consists of 1,000 shares, each valued at NOK 1,500.

The shares are owned by:
The Government of Norway, Ministry of Education and Research 80%
Norwegian Computing Center 10%
Sinvent AS (a company in the SINTEF Group) 10%

The company was incorporated on June 11, 2002. The accounts include transactions for the entire year since the decision to incorporate was taken in 2001. The company is a direct continuation of the "Simula-senteret" project which operated at the University of Oslo prior to January 1, 2002.

Note 8 – Equity  Egenkapital

<table>
<thead>
<tr>
<th>Share capital</th>
<th>Other equity</th>
<th>Total equity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aksjekapital</td>
<td>Annen aksjekapital</td>
<td>Sum aksjekapital</td>
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<tr>
<td>1,500,000</td>
<td>-</td>
<td>1,500,000</td>
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<tr>
<td>Retained earnings</td>
<td>4,824,160</td>
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<tr>
<td>Equity at 31/12</td>
<td>4,824,160</td>
<td>6,324,160</td>
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Simula Research Laboratory Annual Report 2002
Numerical methods and software for solving partial differential equations

The research in the Scientific Computing department focuses on numerical methods and software for solving partial differential equations. Our aim is to develop efficient, reliable, and maintainable software addressing mathematical models based on partial differential equations.

- This topic is of major relevance for engineering, natural science, medicine, and finance, because:
  - Mathematical models are used, or are expected to be used, to a large extent in these areas.
  - The mathematical models are often based on partial differential equations.

- The partial differential equations for complex real-world phenomena can only be solved with advanced numerical methods available in sophisticated software.
The rapid development of hardware, numerical methods, and more reliable software leads to an increased importance of mathematical modelling in terms of partial differential equations. Our special focus is on the interplay between software and numerical methods. We have contributed to defining the topic as a scientific field and have already obtained an international position within the field.

Our activities are grouped into two main projects:

**The Multi-Physics Simulation Project**
The goal of the Multi-Physics (MP) project is to establish generic methods for developing and evaluating advanced software for compound, complicated physical phenomena. Generic means that the results are of practical importance in a wide spectrum of disciplines. The challenge in multi-physics simulation is that software production is competence-demanding and time-consuming, and it is difficult to estimate the quality (accuracy) of the software. We want to develop methodologies to meet this challenge.

The project is a natural extension of our previous work on generic scientific software for partial differential equations (Diffpack). We want to realise the potential in that work, namely the possibility to attack complicated partial differential equation models and generate software in a more efficient and safe way than is possible with today’s common tools.

There are three main research topics in this project:
- Numerical methods,
- Verification of numerical codes, and
- Software tools.

**The Cardiac Computation Project**
The Cardiac Computation (CC) project is a special case of the MP project, where we concentrate on a single model, of the electrical activity in the heart.

The long-term goal is to establish a full-scale, realistic simulator with practical processor requirements. This demands comprehensive development of numerical methods and software, in addition to extensive verification and validation of the model. The verification part will require a special focus on mathematical and numerical analysis of simplified models, mimicking essential features in the full model for the electrical activity in the heart.

Possible applications of the simulator will include simulation of pathological conditions. By altering the model parameters in a specified piece of the heart, the effect of e.g. infarction on the hearts' performance can be studied. Another possible application is to investigate the effects of drugs. If the local action of the drug is known, e.g. a specific channel blocker, this can easily be incorporated into the model. This makes it possible to observe the resulting macroscopic behaviour of the heart.

---

A framework for simpler parallel computing

The hardware development of today’s standard single-processor computers can hardly keep pace with the rapidly increasing demand of computational scientists. One solution to this problem is to use a computer with many processors and memory units for a large-scale computation, so-called parallel processing. The entire computation is divided among the processors, so that the computation time is reduced by a large factor. In essence, the power of many processors and memory units is united to provide a significant increase in the computing speed and memory size.

In addition to hardware, the issue of software is also important for parallel computing. This is because existing sequential programming code, which was written for a standard single-processor computer, will not work directly on a parallel computer. New ways of programming are needed in writing software code for parallel computers, making parallel programming a difficult task. One of the projects at the Department of Scientific Computing is therefore focused on establishing an implementation framework and software libraries for coding parallel simulators.

The objective is to ease the user effort at writing parallel code for numerical simulations. The basic ideas behind the research project are (i) to allow re-use of many existing sequential software components, and (ii) to prepare libraries of parallel processing-specific code.

Object-oriented programming is a key programming technique used in this project. Such a programming style has earlier achieved great success in developing the sequential scientific computing environment Diffpack. Using object-oriented programming, we have developed in this project two small parallel libraries that take care of parallel computing specific tasks. The other computing tasks in a parallel simulation are automatically "relayed" to the existing sequential Diffpack libraries. In addition, we have also used object-oriented programming to establish a framework that simplifies the user’s actual parallel programming work. The MPI standard is used in the backbone of the parallel software libraries, making them portable to all the major parallel computing systems. In addition, special care has been taken with the library implementation, so that application codes using these libraries can achieve good performance on different parallel computer systems.

Using the implementation framework and the parallel software libraries, we have successfully transformed many sequential Diffpack simulators into their parallel counterparts. The so far largest parallel simulation has been done on an SGI Origin 3800 system for simulating the electrical potential field within a human body. The 3D computational grid for the entire body involves 83,005,440 tetrahedra and 13,864,301 unknowns. Further improvement of this parallel simulator is under way to enable simulations of an even larger scale. Consequently, we are looking forward to taking the first step in doing cardiac simulations with sufficient resolutions needed for medical practices.
Underestimating uncertainty in IT estimates

The study of IT projects carried out by researchers at Simula Research Laboratory shows that system developers have a strong tendency to underestimate the uncertainty of their cost estimates.

For example, even when subjects state they are "almost certain" about their estimates, they hit the target only 50–60% of the time. Through experiments with professional software developers and Informatics students, the Software Engineering (SE) department at Simula has analysed the causes of this systematic underestimation of uncertainty. The experiments have led to new methods for analysis and assessment of uncertainty. These methods are now being tested out and results so far indicate that minor adjustments in the estimation process can deliver major improvements in the accuracy of uncertainty reporting. IT-projects often have high uncertainty, or risk, in terms of technology, customer requirements, problem-solving and resource availability. Accurately assessing uncertainty is essential for project managers and budget responsibilities to effectively manage projects. A commonly recommended method is to provide minimum and maximum values along with an assessment of how certain one is that the actual cost will fall between these values. For example, a project manager could state that he or she is 90% certain that the project will cost between 2 and 2.5 million. This means that the actual cost will fall outside this range only 10% of the time.

It appears that there are problems with this common method. Through
The research is focused around three themes:

**Software development effort estimation**
The research aims to improve existing and develop new models, processes and tools for estimation, planning and risk analysis of software projects.

**Object-oriented analysis and design**
The research aims to evaluate the impact of object-oriented analysis and design technologies on various software quality attributes such as understandability, changeability and correctness.

**Methods for realistic experiments**
To increase the realism of the research, the department aims to conduct controlled experiments involving professionals solving real tasks on real systems. The department is developing sophisticated experimental platforms to collect data with minimal overhead.

observing many IT projects, we have seen that programmers and project managers have major problems assessing degree of uncertainty and it is often underestimated. In addition to finding that “almost certain” really means “50–60 % certain” as mentioned above, we found that programmers made no significant changes to their minimum and maximum cost estimates regardless of whether they were asked to be 50 %, 75 %, 90 % or 99 % certain. Based on a series of experiments we found two important causes for this:

1) It is particularly difficult to learn to assess degree of uncertainty without systematic analysis of the accuracy of previous estimates. In other words, people cannot adjust their behaviour without receiving direct feedback on it. This type of analysis is seldom, if ever, carried out in the companies we studied.

2) When it is difficult to estimate uncertainty, then it is easy for realism to be pushed aside by other criteria. We found in one of our experiments that system developers and project leaders judged programmers who stated a lower degree of uncertainty as being more competent to estimate and program than those who stated a higher level of uncertainty. Surprisingly, this judgment was present even in situations were they were told that the programmers’ statements of uncertainty were strongly overoptimistic and that their estimates were no more accurate than the estimates made by others. In other words, overoptimistic uncertainty assessments were interpreted as indicators of high competence.

In order to improve the assessment of uncertainty of cost estimates, we have developed and evaluated two formal uncertainty models and a new way of expressing uncertainty. The formal models, which are based on data from earlier estimating experience, seem to provide realistic uncertainty assessments. In other words, when the models state that they are 70 % certain, the actual result is, on average, close to this. The disadvantage with the formal models appears to be that they cannot handle certain important uncertainty information that human experts can handle. Therefore, if the project has some “unique” uncertainty characteristics, then expert evaluation without formal models often provides the most accurate degree of uncertainty.

One interesting result from our experiments is that changing the question form seems to significantly increase the accuracy of expert evaluations of certainty. This is accomplished by changing the framing of the question. For example, from “Provide minimum and maximum cost estimates which you are 90% certain the actual cost will fall between” to “How certain are you that the actual cost will fall between 50 % and 200 % of the estimated cost?”

The last alternative also seems to make learning from estimation experience more effective. The new uncertainty models and question form are now being tested in Norwegian companies.
Researchers at Simula are creating a new generation of network which they believe will form an important part of the future Internet.

The Internet consists of two parts. In a building or an area there is a local area network (LAN). These are most often "Ethernets" and adhere to a technical standard called IEEE 802. The Internet is built up of many LANs connected together with hardware devices called routers. Routers are becoming more and more complicated and this is leading developers and researchers to examine the possibility of building larger LANs. It is easier to control and manage a LAN than a set of LANs linked together with routers. Concurrently, work is underway to make networks more reliable and able to process different types of information in different ways. For example, telephone and image traffic, which is more vulnerable to delays in transmission, should get a higher priority than data traffic.

Simula is actively involved in the standardisation of this new generation of network which is based on a ring structure. Rings have been used in LANs before, for example in a building or between a few buildings. However, Simula is extending this model to build large rings which can span cities (Metropolitan Area network, MAN) and even regions or small countries.

This image shows how network traffic can develop over time (x-axis); high priority traffic (e.g. telephone) is shown in blue, medium priority (e.g. video) in purple and low priority traffic (e.g. file transfer) is shown in green. All traffic is somewhat delayed since it can travel no faster than the speed of light. The distance measured here was 36 kilometres so this delay amounts to 180 microseconds. We see that telephone traffic always has a delay of approximately 180 microseconds regardless of how busy the network becomes. This is shown in the far right of the image. The delay in video traffic increases somewhat as overall traffic increases. Delays in file transfer traffic increases significantly as the network becomes busier.
Quality of Service for future distributed applications

Networks and distributed systems are the communication infrastructure of the information society. This infrastructure is the sum of all the computers and devices that are connected through the Internet. Its functionality and quality is, to an increasing extent, necessary for the functioning of modern societies.

The research area of the department is Quality of Service (QoS) management for future distributed applications and services. QoS for distributed applications and services refers to their extra-functional properties, including for example the provided response time, bandwidth, privacy, safety, accuracy, and media-quality (for continuous media). QoS management then refers to the planned allocation and scheduling of network and end-system resources and software algorithms to meet the QoS needs of applications.

Future distributed applications have an increasing demand for QoS. However, applications such as control systems, multimedia and file transfer services have very different QoS requirements. Some are tolerant to occasional loss of data and missed deadlines, while others are not. Hence QoS cannot be satisfied using a single service level, but instead requires differentiated service levels and mechanisms that depend on the application.

QoS is a concern that cuts across network, end-system (middleware) and application layers, and end-to-end across different end-system and networking technologies. The provision of QoS is complicated by the fact that future applications have to operate seamlessly in such an environment of different networks (wireless, wired, system-area, local-area, wide-area) and end-systems (embedded devices, PDAs, PCs, high-end computers).

Our research experience in networking technologies, middleware, and multimedia systems, helps in understanding QoS management integration issues and to propose and evaluate relevant QoS management technologies.

The goal of the department is to become an internationally recognised contributor of solutions for QoS management. The department aims to be internationally leading in two complementary focus areas:

- Vertical and horizontal interoperability of network quality of service mechanisms
- Component architecture support for dynamic management of real-time QoS

For the period 2002 – 2005 the department will concentrate its research activities in these two areas.

Component architecture support for dynamic management of real-time QoS

Component architectures make it easier for developers to build reliable distributed applications from reusable software components and are widely used today for development of distributed and web-based applications. However, current component architectures lack support for applications with real-time constraints and other QoS requirements.

The main goal of this activity is to investigate how to develop complex applications with real-time constraints and media quality requirements on a component architecture platform and learn through experimentation how dynamic management and adaptation of real-time QoS can be supported in general-purpose component architectures. We aim to develop a component architecture that preserves the essential benefits of existing architectures while adding support for platform-managed QoS.

Vertical and horizontal interoperability of network QoS mechanisms

The long-term goal of this activity is to contribute to the realisation of cross-cutting, end-to-end QoS support over heterogeneous networks. We aim to devise solutions for integration of the different approaches to QoS that exist. These approaches vary, both horizontally – between different underlying network technologies, and vertically – between the Internet standards and the underlying network technologies. This spans a wide range of issues. We concentrate on the following aspects of the problem area:

- Mechanisms for service guarantees and differentiated service levels in classes of network technologies.
- Interoperability of QoS concepts and mechanisms that exist both in the underlying network technologies and the Internet Protocol layer.
- Methods for optimisation of overall network performance within and between classes of network technologies.

This standardisation is led by the Institute of Electrical and Electronic Engineers (IEEE). The new ring-based standard is called “Resilient Packet Ring” (RPR) or IEEE 802.17 for short.

Researchers at Simula have built an RPR simulator to analyse potential behaviour. The simulator is built using the object-oriented principles developed by Ole-Johan Dahl and Kristen Nygaard forty years ago and is written in the Java programming language, a descendant of Dahl and Nygaard’s language, Simula.

The most important advantage of ring-based networks is that there are always two routes between two points on the ring. If an escavator cuts a cable and the ring is broken, traffic can go the other way around the ring, even though it may take longer to get to its destination.

There are many research challenges in RPR. For example, all the stations connected to the ring have the same rights when it comes to sending data. This is simple if the patterns of traffic on the ring are constant, but more complex when traffic patterns change and the new traffic must be sent “fairly” and as quickly as possible.

One of the most important challenges is the handling of different data in different ways. The Standards Group has proposed that information entering the ring will be grouped into three classes: high, medium and low priority. Transferring of files is not usually considered urgent whereas the words and pictures from a telephone conversation must be transmitted in milliseconds. Researchers at Simula have investigated what consequences this will have for the future Internet with the aim of developing a good standard.
EFFECT: A new model for creating commercial businesses from basic research

During the spring of 2002, Simula conducted a study of mechanisms and systems for creating commercial businesses from basic research. This study included selected geographical regions and universities in Europe and USA. The main result is a new model, called EFFECT. The model is developed in collaboration with industrial, financial and governmental partners.

The employment agreements with every employee at Simula contain principles, and to a certain extent procedures, outlining how commercial rights will be shared between individuals and Simula. This ownership model gives balanced incentives for both parties for the long-term creation of new businesses based on research results and ideas. Simula performs basic research, hence production of scientific publications is ranked as the most valuable product from the institution.

We have proposed that the Research Council of Norway provides Simula with a fund to be used as seed capital for creating new businesses. The main goal of the fund, called the EFFECT-fund, is to attract “competent capital” for early investment, hence providing a significant reduction in risk for private investors.

The funding mechanism will, in collaboration with the authorities, be formalised during the spring of 2003. A basic condition is that this funding must be matched with an equal amount of capital from private investors. We also propose that investors, who provide seed capital to match the investment from the EFFECT-fund, can buy out the EFFECT-fund after 3–5 years at cost price. This will only be done if the commercialisation is successful. The funds resulting from this “buy-back” go to Simula, where they become a new set of incentives to reinvest in further research and innovation. The initial ownership of the new businesses will be shared between individuals, Simula itself, the EFFECT Fund and venture capitalists.

To have a forum in which to present our results and ideas to professional investors, Simula Innovation will create and maintain a network of professional entrepreneurs, financial partners (investors) and people with market knowledge. We plan to organise this as both a web-based information channel and a series of focused meetings between researchers and forum members.

Simula Innovation will, through partners, provide courses in entrepreneurship for students and possibly other people involved in business creation.

Practical arrangements with respect to office space, accounting services, etc. will be provided by partners and incubators. However, Simula can, in some cases, provide office space for selected new businesses. Note that the funding mechanism, if established, will have an independent board containing people with experience in seed investments. Note also that new businesses can be established without the special seed investment fund described above.

We believe that it is important to locate innovation activities, including funding mechanisms, as close as possible to the research activities.

From Research to Business

Research-based innovation for industrial development and business creation is a complex issue, and many different mechanisms and supporting systems are applied to transfer knowledge and obtain commercial results. Companies all over the world conduct or buy research in order to stimulate innovation and eventually improve their business potential. In various ways such research and innovation is stimulated by governmental funding, ranging from tax reduction mechanisms to direct funding of research projects. Results and ideas from these types of activities are generally owned by the industry. When exploitable research results and ideas are owned by research institutions and researchers, other innovation routes have to be followed.

An obvious and important route for Simula is direct research collaboration with commercial businesses and researchers in industry. Based on such collaboration, innovations in industry are achieved through early transfer of results and general knowledge development. Another important achievement in such collaboration is that Simula gets early feedback on our research and first hand knowledge about challenging industrial problems. During the past decades an increasing number of new commercial businesses have been created directly from basic research. In particular, this has been the case within areas like information and communication technology (ICT), biotechnology and medicine. Simula has therefore decided to establish a separate unit responsible for business creation from research conducted at Simula and our partners. This unit is called Simula Innovation.

Simula Innovation focuses on two major tasks:

- Business development based on research results and ideas.
- Management of the commercial interests of Simula – ownership in “spin-off” companies, patents and licence agreements.
Business development includes the whole process of finding results and ideas with commercial potential and refining these to business plans that can be presented for partners, both industrial and financial. It also includes investigating and using other avenues for commercialisation, such as patents and license agreements.

Simula Innovation was set in operation during the fall of 2002. The basic principles of how Simula Innovation will operate were established during a study of business creation systems in selected regions and universities around the world. The main result from this study is the EFFECT-model (see separate article). Simula Innovation is now implementing this model.

In addition to the development and implementation of the EFFECT-model, a number of commercialisation processes has been developed during 2002. Our main goals for 2003 are to establish one or two new commercial companies and to obtain funding for early investments in these “spin-off” companies.

Simula Innovation has also during 2002 established close relations to investors and other partners. Of particular importance is the partnership with IT Fornebu and IT Fornebu Incubator, which also provide financial support to Simula Innovation. Moreover, Simula Innovation participates in innovation processes at the University of Oslo, which also plans to implement the EFFECT-model.

Finally, Simula is working with various government agencies on establishing seed capital for early investments.

The innovation and business creation activities are currently organised as a separate department within Simula. As we implement the EFFECT-model, we will address organisational issues and important questions on corporate governance. It is likely that Simula Innovation will be established as a subsidiary of Simula Research Laboratory AS.
Publication in Journals (with referee)


Papers in proceedings (with referee)


A. Karahasanovic and D. Sjøberg: Visualising Impacts of Change in Evolving Object-Oriented Systems: An Explorative Study. Proceedings of the International Workshop on Graph-Based Tools GraphTea’02, Barcelona, Spain, October 7–8 2002, pp 22–31


H. Westerheijn and E. Koren: “Leave the programmers alone” – A Case Study. 4th International Conference on Product Focused Software Process Improvement, Springer-Verlag Lecture Notes, Rovaniemi, Finland, December 9 – 11, 2002
Papers in proceedings (without referee)


X. Cai and H. P. Langtangen: Developing Parallel Object-Oriented Simulation Codes in Diffpack published in Proceedings of the Fifth World Congress on Computational Mechanics, Vienna University of Technology, ISBN 3-950154-0-6, 2002


PhD theses


Other scientific publications (incl. research reports and preprints)


D. Calhoun and H. P. Langtangen: Writing C++ Interfaces to FORTRAN Packages. Research report 2002–07 at the Simula Research Laboratory


B. F. Nielsen and A. Tveito: Preconditioning by inverting the Laplacian; an analysis of the eigenvalues. Research report 2002–03, Simula Research Laboratory


# Doctorates and Master’s Degrees in 2002

<table>
<thead>
<tr>
<th>Doctorates (Dr.scient)</th>
<th>Supervisors</th>
<th>Thesis</th>
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<tr>
<td>Anders Andersen</td>
<td>Frank Ellissen</td>
<td>A Reflective Middleware Platform including Quality of Service Management</td>
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<tr>
<td>Tarik Cicic</td>
<td>Stein Gjessing</td>
<td>Network Level Deployment and Recovery</td>
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<tr>
<td>Lars Paul Huse</td>
<td>S. Gjessing</td>
<td>A Comparative Study of Different Programming Paradigms in an SCI-based Multi-processor Environment</td>
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<tr>
<td>Joakim Sundnes</td>
<td>Glenn Torje Lines, Aslak Tveito, Per Grattum</td>
<td>Numerical Methods for Simulating the Electrical Activity of the Heart</td>
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<tr>
<td>Harald Berge</td>
<td>Hans Petter Langtangen</td>
<td>Programming of a Navier-Stokes Solver and Coupling with an Energy Equation Solver</td>
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<td>Monica Hanslien</td>
<td>G.T. Lines, A. Tveito</td>
<td>Analysis of Numerical Methods for the Monodomain Model in One and Two Space Dimensions</td>
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<tr>
<td>Karl Erik Levik</td>
<td>H.P. Langtangen</td>
<td>Q-Morph – Implementing a Quadrilateral Meshing Algorithm</td>
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<tr>
<td>Daoshan Li</td>
<td>Viktor Eide, F. Ellissen</td>
<td>Distributed Media Journaling – A Case for Event-based Communication with CORBA Notification Service</td>
</tr>
<tr>
<td>Anette Cecilie Lien</td>
<td>Erik Arisholm</td>
<td>Guidelines for Process Improvement with a Focus on Change Management in Web-Development Projects</td>
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<tr>
<td>Thor Linell</td>
<td>Magne Jørgensen, Dag Sjøberg</td>
<td>Software Cost Estimation – State-of-the-Art</td>
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<td>Kjetil Moløkken</td>
<td>M. Jørgensen</td>
<td>Expert Estimation of Web-Development Effort: Individual Biases and Group Processes</td>
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<td>Henrik Olsen</td>
<td>S. Gjessing</td>
<td>Image-based Rendering</td>
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<tr>
<td>Kristin Skoglund</td>
<td>D. Sjøberg, E. Arisholm</td>
<td>Measurement of Changeability in Object-oriented Software Systems</td>
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<tr>
<td>Gunnar Sletta</td>
<td>Xing Cai, H.P. Langtangen</td>
<td>Visualization of Scientific Datasets Obtained From Parallel Simulation</td>
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<td>Erik Syversen</td>
<td>Bente Anda</td>
<td>Comparing two Ways of Applying Use Case Models in Object-Oriented Design with UML</td>
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<tr>
<td>Kjetil Tyvand</td>
<td>V. Eide, F. Ellissen</td>
<td>An Evaluation of Event Notification Systems in Object-Oriented Design with UML</td>
</tr>
<tr>
<td>Johan Fredrik Øhman</td>
<td>Tor Skeie</td>
<td>High Availability Time Synchronization in Ethernet</td>
</tr>
</tbody>
</table>
In Memory of Two Outstanding Researchers

Norway lost two of its best and most recognised researchers and scholars within six weeks of each other in the summer of 2002. Professor Ole-Johan Dahl and Professor Kristen Nygaard laid the foundation for major international recognition in the early 1960s when they developed object-oriented programming and the programming language Simula. These two developments rank today among the most significant research results of the previous century.

Ole-Johan Dahl and Kristen Nygaard were awarded both the Turing prize, considered the “Nobel prize” in Informatics, and the prestigious John von Neumann medal before they died on June 29 and August 10.

The computer systems that form the foundation of the modern information society are among the most complex things humans have created. Through their ground-breaking research, Nygaard and Dahl made it possible to manage that complexity. Simula laid the groundwork for the development of later languages like Smalltalk, C++, Eiffel, Beta and especially Java, which has become the central language for application development on the Internet.

Kristen Nygaard was best known in Norway as the leader of the National Debate over Norway joining the European Union. He received his Master’s degree in Mathematics from the University of Oslo in 1956. He worked for the Norwegian Defence Research Establishment until 1960, then for many years with the Norwegian Computing Center before becoming a Professor at the University of Oslo.

Nygaard made an impression on all who met him, with his vitality, seemingly limitless knowledge, wit, self-irony and not least his open, generous and friendly personality. He was at home with other internationally-acclaimed researchers, but was just as interested in talking to young students. Kristen had an enormous group of contacts, both in Norway and internationally. Even in his last year he made presentations to groups in Europe, North and South America and Asia. He was a living legend who was met with deep respect around the world.

Ole-Johan Dahl was Norway’s first professor in Informatics. As a textbook author, lecturer and supervisor of a long line of students at the University of Oslo, Dahl was instrumental in building up Norwegian IT competence during the last half of the twentieth century. He introduced, among other things, object orientation and Simula into the teaching of Informatics in the 1970s. These methods were controversial in the beginning, but became a powerful example for Informatics education in many places around the world.

Dahl’s research in later years focussed on theoretical data processing, development of programming languages and proving the correctness of computer programs. Despite his immense contributions to education and research, Ole-Johan remained modest, preferring to talk about other things than his accomplishments.

It is with great sadness we must acknowledge that our good friend and colleague are no longer with us. We will miss Kristen and Ole-Johan greatly, but they live on as a source of professional and personal inspiration. The employees of the Simula Research Laboratory are honoured to carry forward a proud tradition by working at a research institution named after these two pioneers’ momentous achievement.

The owners of Simula

Simula Research Laboratory is a limited company with the following owners:

- Norwegian Government
- Norwegian Computing Center
- Sintef

The operation of the Simula centre is financed with grants from the Ministry of Education and Research, the Ministry of Trade and Industry, and the Ministry of transport and Communication. The grants are administered through the research Council of Norway, who will also run the evaluation of the centre, with support from international experts.

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