Departmental Development Plan 2013-2016
School of Computer Science and Communication
Departmental Development Plan 2013-2016

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Computational Biology (CB)

The Department of Computational Biology (CB) hosts several research groups, all using computational techniques to analyse and model biological systems. Much research focuses on modelling functions of the brain, from sensory processing and motor control to memory and cognitive functions. Part of the department is located at the SciLifeLab facility and concentrates on developing methods for the analysis of biological sequence data (DNA, RNA, proteins). Finally, one group is primarily applying advanced physics methods to biological data.

Education
Members of CB are active in a number of courses, particularly advanced courses, such as machine learning, neural networks, biological modelling, and bioinformatics. We are co-hosting a Marie Curie master’s programme on systems biology in cooperation with Aalto University. Our presence in the computer science programme is limited, but our long-term goal is to create a separate undergraduate programme or track in biological modelling.

PhD studies
Most CB PhD students are enrolled in the computer science PhD programme, but some are part of the physics programme. Many students have been recruited via the Erasmus Mundus programme EuroSPIN in close collaboration with universities in Germany, Great Britain, and India. This has boosted international exchange for our PhD students and has given them many opportunities to take advantage of courses and faculty expertise from several places. We will continue to promote international and cross-disciplinary mobility for our PhD students.

Research
Modelling brain functions was recently recognized as a strategically important research field, especially through the launch of the Human Brain Project (HBP) EU flagship initiative. CB has been instrumental in this initiative, and the department is currently in a good position to attract funding from HBP. We will form a new research centre, KTH Brain-IT, to coordinate activities in this area around KTH and to better market these to HBP and other funding sources.

Faculty recruitment and the future
The faculty at CB consists of seven professors and one associate professor. We are in the process of recruiting two assistant professors, one in neuroinformatics and one in bioinformatics. Despite this, we are still dominated by senior faculty and plan to recruit more young researchers to fill tenure-track positions.

Infrastructure
Some of the research at CB is critically dependent on high-performance computing resources. We will primarily make use of PDC’s expertise and facilities in order to maintain the necessary infrastructure.

Industrial liaisons and society at large
CB will increase its contacts with Swedish industry related to neural network and machine learning applications. The department will recruit an affiliated professor with experience in industrial applications.
Computer Vision and Active Perception (CVAP) Laboratory and the Centre for Autonomous Systems (CAS)

The Computer Vision and Active Perception (CVAP) Laboratory performs research in computer vision, robotics, and machine learning in close collaboration with the Centre for Autonomous Systems (CAS), a KTH centre that has involved several schools—CSC, EES, and SCI—in both research and education since 1996.

Education, PhD studies, and doctoral programmes
Members of CVAP and CAS are active in both undergraduate and graduate education and responsible for two master’s programmes: machine learning and systems, and control and robotics (hosted by the EES school). The goal for the period 2013–2016 is to include more research-oriented topics in the courses so as to involve students as early as possible in the department’s research. We plan to design courses that integrate project work on real robotic hardware, thus allowing students to both programme and evaluate real physical systems in natural environments. All CVAP/CAS PhD students are enrolled in the computer science PhD programme, and the department will work actively to establish PhD-level courses in the areas of computer vision, machine learning, and robotics.

Research, industrial liaisons, and society at large
Research in computer vision will strengthen the movement towards technologies for human visual perception and memory support. Visual perception is central to human beings’ ability to interact with the surrounding world; vision is also central in forming memories of one’s daily life and interactions with other people. The degradation of a person’s abilities to perceive and memorize visual stimuli is therefore a general disadvantage. The possibilities of compensating for this degradation have historically been very small. But developments in the technology of camera design and computers, as well as increased understanding of methods for building artificial visual systems that interpret and organize visual information, are changing this situation for the better. There is a definite possibility that in the future artificial systems will be built that capture and process visual information at the same performance level as the human visual system, and that these will be able to organize the visual input into memories that can support declining perception and memory in individuals. These systems will, when fully developed, serve as “cognitive prostheses,” analogous to the way physical prostheses replace human body parts. Even today, however, systems can be built that aid in, for instance, reading and interpreting essential visual information in the environment.

CVAP will contribute to making these systems fully autonomous visual-information aids by (1) developing state-of-the-art automatic artificial visual processing, with special emphasis on visual data from systems that can be worn in an unobtrusive manner, and by (2) investigating methods of automatic visual-memory selection from these systems in order to enhance failing human visual memory.

Robotic systems that provide advanced service in industry, in search-and-rescue operations, in medical applications, and in assisting the elderly will become an integral part of future society. Initial systems have been deployed in the industrial and service sectors for the past several decades, but none of these are ready for consumer markets. Robots are expected to act in the environments built for humans; hence, they should possess some human capabilities both in terms of locomotion (e.g., the capacity to handle stairs), dexterity (e.g., the capacity to manipulate objects and tools made by and for humans), and
reasoning (e.g., the capacity to exchange information with humans in a natural manner).

In the context of mobile robotics, we will work in two main directions. First, we will seek methods for the adaptation to and exploitation of long-term knowledge and experience. The aim is to develop robot systems that can run for a long time (months) and show that tasks can be executed more efficiently by making use of continuously gathered knowledge. We will study the ways 3-D space changes over time and will extract quantitative and qualitative spatiotemporal models supporting navigation, task planning, and reasoning. The second thread of work will examine ways we can model and leverage the structure that is inherent in indoor environments. Most research to date has actively avoided making assumptions about this structure, as the focus has been the underlying algorithms and theory and their ability to deal with a completely unknown setting. We want to learn statistical models from, for example, floor-plan data sets, in order to form strong priors. We aim to establish a long-term strategic collaboration with Scania in the context of intelligent transportation systems.

We also plan to continue work on interaction with and the manipulation of objects. Compared to those of humans or primates, today’s robotic hands and medical prostheses are extremely restricted in sensing and dexterity. The latter commonly have only a single degree of freedom, allowing them to grasp and manipulate a limited set of objects. Replicating the effectiveness and flexibility of human hands requires a fundamental rethinking of ways to exploit the available mechanical dexterity. To achieve this, we aim to develop mathematical models and techniques for motion representation suitable for (1) the recognition and understanding of dexterous motion of human hands, (2) the generation of hand-control strategies in robots, and (3) the evaluation of the mechanical dexterity of complex structures. The general idea is to marry the topology-based representations with statistical graphical models supporting mappings between symbolic-level and low-level sensory control spaces. During the period 2013–2016 and in the context of this aim, we will work actively towards establishing collaboration with ABB.

Our work analysing human activity in video will continue in three directions. One such area is modelling human activity and human-object interactions for the purpose of robot learning through human demonstration. Another area is modelling and recognizing chains of human activities for the purpose of mining large amounts of video during forensic investigations, or for recognizing activity and making decisions in real-time surveillance. Third, we aim to address the very challenging task of modelling saddle nonverbal cues, such as facial tensions and small shoulder movements. Working methods would include, for instance, powerful new tools for cognitive psychology studies and more-accurate synthesis of human motion and appearance in games and movies.

**Faculty recruitment and the future**

To continue the excellent and strong research in the area of computer vision and to compensate for the retirement of one professor in the field, we foresee announcing one professor and one assistant professor position in this area during the next several years. Strategic recruitment is also related to the growing area of machine learning, in which we also anticipate announcing one full professor position.

**Infrastructure and technical support**

An advanced infrastructure and constant updates to our robotic hardware are necessary for our research. In relation to the upcoming Horizon 2020, as well as current developments in robotic research in Europe, access to advanced hardware will become paramount. Therefore, we foresee that a large portion of our funding, both internal and external, will be dedicated to purchasing new robot systems that are becoming available on the market. We believe this is important also in relation to education and
the establishment of new project courses. The opportunity to work with real physical systems is vital to attracting a new generation of students interested in addressing various problems related to such systems: general programming, system architectures, security and safety, and human-robot interaction, to name only a few. This way, research conducted at CVAP and CAS will also closely relate to the research pursued in other CSC departments.
CB and HPCViz now is a joint service, CRT, a joint development plan is to be worked out in the next update.

High-Performance Computing and Visualization (HPCViz)

High-Performance Computing and Visualization (HPCViz) is organized to address current and emerging challenges in the efficient use of large-scale computational resources, efficient and varied manipulations of massive data sets, and method and model development—taking advantage of the new possibilities offered by modern computational infrastructure and access to large data sets. This area presents a number of challenges that demand a cross-disciplinary approach and skills ranging from the efficient use of large-scale resources to computational modelling and the industrial and scientific applications of tools, products, and services.

Education

HPCViz aims to strengthen its educational programme at KTH; in particular, new courses are being developed on both the basic and the advanced level. The VIC studio will remain a key resource in education; today it is used in about fifteen courses and in a number of thesis projects.

PhD studies

The department offers several courses at the PhD level, and most students in these courses are enrolled in the computer science doctoral programme. The exception is students of the former NA group, who are part of the old numerical analysis programme. The goal is to enrol all new students in the computer science doctoral programme.

Research

HPCViz's research aims to develop new concepts for the improved use of high-performance computer systems, including modelling and simulation, as well as the analysis and synthesis of (typically) visual data. The approach encompasses a number of requirements: (1) the efficient use of high-performance systems requires advances both on the algorithmic level and in parallel programming techniques (languages, compilers, runtime systems, tools); (2) the sheer amount of data generated by large-scale simulations and instruments like accelerators, sequencing machines, and so on, often generated in a streaming fashion, imposes new requirements on the exploration methods and the numerical capacity of the architectures being used; (3) usually the data exhibits a complex structure, and it encodes high-dimensional and even time-varying information spaces; (4) access to large data sets from measurements opens up new possibilities for computational modelling and simulation, combining theory- and data-driven methods; (5) interactive data-exploration techniques are subject to real-time constraints with respect to data generation and analysis, information fusion, and visualization. One significant aspect of the approach is dedicated to the design and engineering of algorithms and software systems for simulation and data exploration that are capable of dealing with these requirements.
Research at HPCViz is highly interdisciplinary, and the department should continue to seek collaborative projects within the School of CSC and KTH at large, in particular through Small Visionary Projects, the Swedish e-Science Research Centre (SeRC), and the ICT platform. In the coming years, an additional goal is to engage more in other platforms, especially life science technology, energy, and transport—areas in which the department is already actively conducting research. Also in the future, the department will seek financing from the most competitive external funding sources (ERC, EC, KAW, VR, SSF, Vinnova), in combination with direct industrial funding. The department is engaged in ICT4Life and will seek to increase its role in the planned centre.

Faculty recruitment and the future
Professor Erwin Laure heads HPCViz, and its deputy is Professor Johan Hoffman; two associate professors in visualization have been recruited since the department’s establishment in July 2012. The department is actively recruiting a professor in visualization, as well as two assistant professors in high-performance computing and scientific computing. It is crucial that HPCViz reach a critical mass of talented researchers fairly quickly in order to benefit from the clear momentum that the combination of resources creates. Most faculty members have been recruited from outside Sweden, and the goal is to continue to promote an international environment.

Infrastructure
The department has close ties with the Centre for High Performance Computing (PDC), which delivers supercomputing capabilities nationally (through the Swedish National Infrastructure for Computing; SNIC) and internationally (through PRACE). HPCViz also runs the Visualization Studio (VIC; headed by Björn Thuresson), an important KTH resource for both research and education. One goal for the coming years is to exploit the combination of expertise and infrastructure (PDC, VIC) at the department in formulating new research projects.

Industrial liaisons and society at large
HPCViz has cultivated its collaboration with industry and public sector actors, an effort that will be further strengthened in the coming years. Partner organizations include Scania, Microsoft, Saab, Volvo Cars, Vattenfall, Raysearch Laboratories, and Stockholms Läns Landsting. The department currently has one adjunct professor (Christer Norström, SICS), and the goal is to attract additional industry affiliations in the coming years.

The department will build up its existing collaboration with Open Lab and the House of Science (Vetenskapens Hus) and continue to participate in events such as Forskarfredag in order to promote research and education at the department.
Centre for High-Performance Computing (PDC)

The Centre for High Performance Computing (PDC) is located in the School of CSC at KTH. PDC’s goal is to provide Swedish academia with world-class and cost-efficient infrastructure for scientific computing, data storage, and handling and archiving large scientific data volumes, along with advanced expert support and training. PDC is one of six members of the Swedish National Infrastructure for Computing (SNIC) and receives major funding from the Science Council (VR) via SNIC and from KTH. PDC’s role in SNIC is to provide the highest-end infrastructure available for computing and storage. PDC has also represented SNIC on an international scale both in Europe and in the United States and is leading the Swedish contributions to the PRACE and EUDAT projects. PDC is also a main resource provider to the SeRC and has close links to Swedish and Nordic high-performance computing activities.

Education

The main educational project at PDC is its summer school, which is highly recognized throughout Sweden. PDC is also developing a comprehensive training programme addressing various high-performance computing issues; parts of this programme are being reapplied in academic courses offered by the HPCViz department. PDC also contributes computing resources to many courses at both the undergraduate and the PhD level.

Research

PDC takes part only in research projects that are directly related to the PDC infrastructure. Other research projects are handled by the HPCViz department. Thus, PDC is participating on behalf of and often represents SNIC in major European e-infrastructure projects (PRACE, EUDAT, EGI). PDC also supports the projects of a wide variety of researchers from KTH and elsewhere by providing high-performance computing resources and expertise. In this capacity, PDC takes part in several national (e.g., SeRC, VR) and international (e.g., EC, Nordforsk) projects.

Faculty recruitment and the future

PDC is critically dependent on retaining highly qualified staff on both the system and the support side to provide its services. A particular focus is advanced expert support, and PDC has recently hired experts in several application areas who work closely with PDC’s users—most importantly in the context of SeRC—to improve their efficiency on PDC systems. Sustaining and improving this effort is a major aim for the coming years. Particularly, a critical mass of experts needs to be reached in order to fully exploit their potential.

Infrastructure

The main system at PDC—the Cray XE6 Lindgren, which is also Sweden’s contribution to the European supercomputer project PRACE—is now three years old and will need to be replaced in one year. PDC is engaged in ongoing discussion with SNIC, KTH, and other possible underwriters regarding funding for this new system, which should provide a capacity of over 1 petaflops. In this context, we are also reviewing the hosting conditions, given that the cost of power and cooling is a major concern for high-performance computing today, and providing the best possible conditions is of great concern.
For regional purposes and as a pre- and post-processing facility for the main system, PDC also requires a more throughput-oriented system. This system is expected to be purchased in a bundle with the main system with increased support from the region and KTH.

PDC collaborates closely with the Visualization Studio (VIC) to provide its users with advanced visualization capabilities.

**Industrial liaisons and society at large**

PDC started industrial collaborations some years ago through a joint project with Scania, and further industrial collaborations are being planned, given the great potential for expanding this activity. To strengthen these activities, PDC is now recruiting a business developer to lead the industrial liaisons programme.

PDC is also planning several events, potentially in collaboration with SeRC, that will highlight the importance of high-performance computing to the general public.

**Management and support**

Today PDC is managed by a director, Professor Erwin Laure, and a deputy director, Gert Svensson. The staff is organized into three groups: the system group, which handles the operation of the PDC system, is headed by the technical director; the support group, which assists at the first level and in more advanced specific application areas, has its own head; and the project and industrial activities are headed by the PDC director.

A long-term plan to set clear goals and to improve planning, internal communication, and the quality of PDC’s work has just been initiated. In the near future, a planning and development day will be organized and implemented in cooperation with a management consultant company.
Media Technology and Interaction Design (MID)

The department of Media Technology and Interaction Design (MID) is a cross-disciplinary group organized in five teams that represent its research focuses: culture and media production, interaction design, socio-technical practices, sustainability, and technology-enhanced learning. MID is responsible for the media technology MSCE programme and for the master’s programmes in HCI, in media technology, and in media management, and is also co-responsible for the human-computer interaction and design (HCID) track of the EIT ICT Labs Technological Innovation Master School. MID offers a doctoral programme in mediated communication.

Education

During the period 2013–2016, we will have the opportunity to develop and increase the quality of all our programmes. The number of master’s programmes can be reduced such that in 2015 we will have, at most, two master’s programmes grounded in our subjects and with profiles at the forefront of our research. This process of development involves all MID’s faculty.

In order to gain even higher engagement for education and to increase the research connection in all our courses, we will integrate our courses into the MID teams (2016). We will also work towards increasing the use of media to support learning in innovative ways (i.e., technology-enhanced learning; TEL).

PhD studies and doctoral programmes

All new PhD candidates are enrolled in the PhD programme in mediated communication. We continuously strive to improve the quality of this programme, as well as the community of PhD candidates. We will continue to hold the highly appreciated internal annual PhD conference.

We will organize regular supervisors’ meetings to discuss thesis quality in our subjects and supervision, as well as to develop common criteria for theses of a cross-disciplinary nature (2014). All PhD students should have the opportunity to meet senior advisers outside the core supervisor group (2013). We plan to support internships for our PhD students at companies and universities that we collaborate with (2014–2015).

We aim to achieve a stable pool of mandatory and key courses (2015). Courses are continuously being developed in order to face areas and problems of both a practical and a theoretical nature. We will maintain our collaboration with the ABE school and the University College of Arts, Crafts, and Design in implementing a doctoral programme in arts, technology, and design (2013).

Research

The research at MID will continue the successful work of strengthening our five areas, defined as teams. We will increase production of high-quality journal and conference publications in all the teams. We will also work for more numerous team-oriented and cross-team grant applications, aiming to increase external funding. We foresee that areas such as work practices, sustainability, and learning support technologies will continue to grow and will therefore require a great deal of knowledge in the areas of HCI and media technology. There is also a need to innovate research methods and to develop theories that support human activities and cognition. We will advance such research areas in order to develop new design principles and patterns.
Well-designed computer systems can provide advanced support for industrial settings, as well as opportunities for new innovative technology for everyday situations. MID will work for both, supporting more traditional computer-oriented work situations and innovating more leisure-oriented situations. We expect the area to be integral to any future service sector.

The TEL team at MID has the goal of leading the development of innovative TEL environments at KTH, in addition to conducting research projects in collaboration with schools and organizations. The team organization can be changed during the period 2013–2016, and new teams may evolve—for instance, interaction technologies (focusing on technologies to support the process of interaction design at various stages through, e.g., interaction modelling and user interface generation). Such concerns will be coupled with novel technologies for interaction, including novel input methods (e.g., gesture detection) and novel output modalities.

**Faculty recruitment and the future**

MID’s engagement in education has increased, and we have a need to recruit two associate professors in media technology (2013), one of whom also has competence in HCI (2013). In order to secure core faculty over time, we would also like to recruit an assistant professor in HCI (2015).

Since 2009 we have focused on building up a large group of PhD students, and this goal has been achieved. The number of PhDs should preferably remain stable, and focus can shift to recruiting post-docs (2014).

Between 2013 and 2016, we expect to promote about four professors in the group (2016). We will discuss the need to strengthen the group with one professorial position in technology-based HCI. This position could also bridge the departments MID, CVAP/CAS, and TMH (2016).

**Infrastructure**

The number of labs has increased within CSC, and we see the need for continuous maintenance, development, and a lab assistant in order to ensure the high quality of our labs over time (2014).
Department of Speech, Music, and Hearing (TMH)

The research and teaching at TMH aim at an understanding of how humans communicate through speech, sounds, music, and gestures and of how these elements can be combined to create humanlike communication with machines, including emotions and social interaction signals. The field is truly multidisciplinary, based on engineering methods from computer science and electrical engineering, combined with perception and cognition disciplines. Research at TMH received high ratings in RAE 2008 and 2012 for international excellence.

Education
TMH will continue to increase its teaching share at the school, including programme courses in the computer science and media technology programmes, as well as candidate and master’s theses.

New courses that fit into the programmes will be launched, including the following:

- Human Perception for Information Technology (starting in Fall 2013)
- Pattern Recognition for D (starting in Fall 2014)
- Sound Programming for D/Media (starting in Fall 2014)
- Programming Methods for Instrument/Voice Synthesis and Interaction (starting in Fall 2015)

Research
During the period 2013–2016, the speech group will continue to develop computational models of speech generation and understanding based on analyses of how humans interact verbally face to face. Humanlike multimodal spoken dialogue systems that interact via virtual agents or physical avatars constitute a core topic that will be developed for domestic robot interaction, in cooperation with Computer Vision and Active Perception (CVAP), and other man-machine applications based on social interaction. Two emerging research directions with great potential are gesture analysis for enhanced multimodal interaction and speech technology for disabled persons and an aging population within the KTH ICT4Life initiative. Infrastructure for speech technology, including multimodal databases on the national and the EU level, will be built up.

The Sound and Music Computing Group (SMC) will continue to develop its core areas, including music-information retrieval on a perceptual basis, music performance models that feature truly human behaviour, and the sonification of interaction in virtual environments and in elite sports. New initiatives will include the combination of haptics and sonification for the real-time manipulation of virtual objects, in cooperation with Media Technology and Interaction Design (MID), and natural user interfaces whereby humanoid robots can communicate emotional states and intentions through sounds and gestures (with CVAP). Voice research will be extended to advanced numerical models of the voice source based on physiological data and aerodynamics (with HPCViz and CB). The nascent work on sound interaction and music creation for disabled young persons aimed at recovery and at increasing users’ quality of life will be expanded within the KTH Life Science Technology platform.
Faculty recruitment

After a recent generation shift, the faculty members comprising the speech group’s new leadership are being promoted to positions as professors. The faculty will be strengthened to secure the department’s continued development by recruiting at least one assistant professor in speech technology and one in sound and music computing. At least one associate professor will be recruited to the SMC group when one professor retires, in order to promote the new sound and music computing profile.

The future: Faculty, PhD exams, publication rate, and funding

Specific points

• Two associate professors in speech technology will be promoted to professors.

• At least one assistant professor in speech technology with a specialization in dialogue systems will be recruited.

• At least one associate professor in sound and music computing will be recruited.

• A position as assistant professor in sound and music computing will be announced with specialization in SMC technology for disabled persons and the aging population.

• Seven PhD students and two Lic students will graduate, and ten new PhD students will be enrolled (including at least one industry PhD student).

• One large externally funded project on multimodal interaction will be launched as a result of CSC intergroup collaboration on Small Visionary Projects (SVP).

• TMH will take the main responsibility for developing the CSC Performance and Multimodal Interaction Lab (PMILab), including infrastructure for multimodal data collection and telepresence experiments.

• The speech group will co-host Interspeech 2017 (1,300 participants), collaborating with the Linguistics Department at Stockholm University.

• The Stockholm Music Acoustics Conference (SMAC 2013; about 350 participants) will be organized as a joint event with the Sound and Music Computing Conference (SMC 2013).

• The CSC computational biology group will move into the same facilities as the SMC group.

Management

Professor Joakim Gustafson will be the new head of the department for a four-year period starting on 1 October 2015. He will also take over leadership of the speech group for four years, beginning 1 March 2013. Associate Professor Jonas Beskow will assist as a group leader and take over the responsibilities in 2018.
Centre for Sustainable Communications (CESC)

The Centre for Sustainable Communications (CESC) is a Vinnova Centre of Excellence (VinnEx) that conducts research on ICT and sustainable development, particularly focusing on ICT and the environment, in order to contribute to social change. CESC is a cooperative undertaking of KTH, Coop, Ericsson, the Interactive Institute, the Stockholm County Council, the City of Stockholm, and TeliaSonera. CESC’s strategic research areas are cities, people, effects, and methods—always in relation to ICT and sustainable development. CESC is a collaboration mainly of the CSC and the ABE schools, located at CSC, and its operations are concentrated in MID at CSC and the Environmental Strategies Research fms at ABE. In addition to its VinnEx projects, CESC conducts research in separate projects with various partners. Total annual turnover is almost 20 MSEK in monetary transactions and about twice that when in-kind contributions are included. The VinnEx segment accounts for about 10 MSEK per year, other projects for several million per year, and Green Leap for the rest (these numbers are for the whole CESC, not only CSC’s part).

Green Leap, a free-standing part of CESC headed by Sara Ilstedt, is a network for design and sustainable development in collaboration with Konstfack, the University College of Arts, Crafts, and Design. The general goal of Green Leap is to act as a catalyst for change by involving design in sustainable development. The initiative is supported by the Swedish Energy Agency. Green Leap is set to establish collaboration agreements with a number of design consultancies. At KTH, mainly the CSC, ITM, and ABE schools collaborate in Green Leap.

Education

As a centre, CESC cannot take part in educational activities; however, CESC encourages education about ICT and sustainability and has played a role in increasing the number of basic and advanced courses at KTH. Part of CESC’s aims comprises continued educational support as a way of communicating the results of CESC research.

PhD studies and doctoral programmes

Most PhD students at CESC are enrolled in the CSC and ABE PhD programmes. Thus, they always have double identities (typically, CSC students are affiliated with CESC and MID). CESC is currently running a project on developing a strategic plan for internationalization, and we strongly encourage PhD students to attend international conferences, to publish in well-reputed academic journals, and to visit international research departments during their PhD studies. Working closely with our partners, CESC intends to facilitate connections between PhD students and other organizations and thereby help students find attractive employment after they complete their dissertations.

Research

CESC is an interdisciplinary research centre that continuously strives to attract researchers from many different disciplines. For CESC, publication in well-reputed scientific journals is a high priority, and collectively, the group should publish at least 12 papers in scientific journals and conferences proceedings of excellent reputation. CESC should also continue to actively create and support new research and collaboration initiatives. During the period 2013–2016, CESC should move from its current “Stage 3” as a VinnEx centre to Stage 4; by the end of the period the VinnEx status will expire. A strategy for the period following 2016 will therefore need to be developed during the coming years.
In 2014 CESC will organize the second international conference on ICT for sustainability (ICT4S). We aim to include 50–60 research papers and to register 250 participants altogether. The conference is an important event for establishing CESC as a leading group in the research area. One future challenge will be to develop the conference. There are currently preliminary plans to hold the third ICT4S conference in Amsterdam and the fourth perhaps in Asia. The idea of organizing a travelling conference is to strengthen the field internationally and to forge bonds within the ICT4S community.

Green Leap's coming years will be decisive for its long-term future. Green Leap aims to become very successful in a current call for funding from the Swedish Energy Agency “Energy, IT, Design.” In the programme text, Green Leap is pinpointed as a very strong group in this area. Partnering with CESC and the Interactive Institute, Green Leap will make a strong effort to bring in a large part of the total funding from that call. If this succeeds, Green Leap will expand and further strengthen the group's position as an academic leader in the field of design for sustainable development.

**Industrial liaisons and society at large**

CESC has played an important role in creating “KTH Smart Sustainable Cities,” a programme that has gained support from the energy platform, the ICT platform, and KTH Sustainability. This work has involved five schools and includes setting up a PhD student “think-tank” and a steering group. The idea is to connect different parts of KTH through work designing smart sustainable cities and in that way to become a very strong actor in Swedish research and innovation in this area. A first success in this regard was Vinnova’s approval of our proposal to write a Strategic Innovation Agenda on the topic. The grant is small (0.4 MSEK), but its strategic importance may be very great. During the coming years, we will work persistently both internally, connecting various parts of KTH, and externally, with our partners (ABB, the City of Stockholm, Ericsson, Fortum, Intel, IBM, ITU) to achieve our agenda.
Theoretical Computer Science (TCS)

The mission of Theoretical Computer Science (TCS) is to conduct high-quality research and education in computer science. TCS has a mostly theoretical focus, but unlike many similar groups around the world, it has significant interests and activities in other, more applied branches of computer science, as well. TCS sees itself as a key resource for core computer science competence at KTH and plans its development accordingly.

Education

In the past, TCS has taken significant responsibility for the development of computer science education at KTH, both broad introductory courses, and the computer science (D) programme in particular. TCS will continue to play a key role in teaching computer science and related topics at KTH through teaching and supervision, curriculum development, and the evolution of new pedagogical methods.

This concerns not just core TCS topics but also computer science broadly construed, as reflected by additions to the group over the past five years or so in areas such as network security, language technology, and databases. Future teaching needs constitute one important parameter in determining the profile of coming recruitments at the junior level.

Software engineering and associated technology has over the past few years emerged as a key education area to be strengthened. A long-term goal is the creation of a new masters program in Software Engineering. New recruitments will be needed at all levels, and new, sustainable instruments to ensure that the education is well in line with the industrial state of the art need to be developed. This work will make use of the CASTOR center in advanced software technology research currently in preparation.

It is important to improve the integration of teaching and research where this is applicable. TCS will work to develop budgetary models that, better than today, allow researchers to offer high-quality, specialized courses in their areas of expertise. Another more long-term challenge is to distribute teaching tasks at all levels of the curriculum more equally across the faculty.

Undergraduate teaching in topics related to practical software development needs to be well rooted in industrial practice. This is a prioritized target for improvement for TCS. We will explore different instruments for this, such as engagement of affiliate faculty, and, if possible, “industry sabbaticals” for lecturing staff.

PhD studies and doctoral programmes

Improving the range of courses offered to PhD students is an important priority: TCS will allocate resources towards this in the following areas:

• Actively engaging in the CS doctoral programme to improve its structure and quality
• Developing new PhD-level courses
• Making better use of short-term and medium-term visitors to provide short, ad hoc courses
• Establishing a new international summer school in TCS
Research
The goal for the coming period is to further develop the research profile of TCS in the following ways:

• The group will continue to develop its research in its core areas: Complexity theory and approximation algorithms, security and privacy, software technology, natural language processing, and computer science didactics. This includes seeking research funding through the available channels, and increasing the volume of doctoral students affiliated with the group.

• A particular priority is the area of software engineering and software technology. The CSC school is currently preparing the ground for a new center, the CASTOR center in advanced software technology research together with key faculty in the ICT school. Getting this center up and running and securing support from key industrial partners is an important strategic goal for the period.

• Completing the recruitment of the new professorship in Software Technology supported by the WASP program. With this recruitment significant new resources will be entering the software area at KTH and the TCS group.

• Strengthen renewal by new recruitments as detailed below. A particular focus for the period is the broad area of software engineering and software technology. Emphasis is on recruitment of top research talent at tenured or tenure track level.

Collaboration
TCS has a wide and well-established collaboration network internationally, nationally, and locally. It is important to maintain and develop these networks, including in relation to Horizon 2020. A priority for the coming period is to expand as appropriate TCS involvement in research collaborations on the school and KTH levels, including, where applicable, in the EIT and the KTH research platforms.

Faculty recruitment and the future
In the earlier version of this plan we identified the need for recruitment at senior level within software technology as a key concern. With the new professorship supported by the WASP program this looks like coming to fruition.

At junior level, TCS sees a significant need for faculty renewal, particularly in the software area. Reflecting this, TCS proposes during the 2016–2017 period to recruit three new faculty at assistant or associate professor level.

At more junior level TCS will emphasize recruitment of postdocs and new PhD students as permitted by the available external funding.

Particularly important is to improve the groups gender balance. As part of its recruitment work TCS will work actively to encourage applications from suitable female candidates.

Industrial liaisons and society at large
Several research tracks at TCS have the potential for significant impact on a societal and an industrial level. This is attested in part by the strong results at the RAE12 evaluation. TCS will work to maintain and develop these areas as well as new ones.

TCS will continue to develop its industrial network through existing collaborations, by strategic affiliated recruitments, and by collaborative research projects.