

The Intervention Centre Annual report 2011

Oslo University Hospital and
Faculty of Clinical Medicine, University of Oslo

ANNUAL REPORT 2011

The Intervention Centre

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ANNUAL REPORT 2011

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The Challenge of technology-dependent medicine



As diagnostics and treatment are getting increasingly technology-dependent, the hospitals are forced to implement new routines in development and introduction of new methods. The new methods also require procedure standardisation and a clear distinction between routine treatment and research and development. Hybrid procedures requiring both surgery and advanced imaging challenge the existing hospital organization.

As many new minimally invasive procedures often require expensive equipment, but shorter stay in hospital and hopefully less postoperative discomfort, controlled studies are needed to document efficacy of the new procedures. Today, when new clinical procedures are introduced, documentation of clinical outcomes, patient experience and cost utility analysis is required to determine if the new method is beneficial or which organizational steps have to be taken to optimize safety and cost-efficiency.

As new techniques often require new skills, the opportunity to train and develop the technique on models, animals and in pilot patients is beneficial. This should be done outside the standard operating rooms, to give the involved staff the necessary calm and time. This also allows for better distinc-

tion between developing costs and running costs in hospital.

When a new procedure implies transfer of “ownership” of the disease from one clinical speciality to another, turf battles may occur. For many patients there is a discussion whether they should be referred to the cath lab or to surgery. This is exemplified by the stent graft procedures for aortic aneurysm and the TAVI procedures for aortic valve disease. At the Oslo University Hospital the Intervention Centre provides hybrid suites on “neutral ground”, where surgeons, radiologists and cardiologists can work together.

Advanced imaging and robotic technologies are fragile and when treatment is dependent upon technology it also becomes vulnerable to technological failure or breakdown.

To reduce running costs and ensure available backup systems for hybrid suites, such suites should be clustered in one place and be run by a dedicated staff familiar with the advanced technological environment. The Intervention Centre provides such facilities and therefore ensures that patients may be offered the latest and most advanced treatment in a safe environment.

Erik Fosse
Head of Department

Main goals and objectives



THE CENTRE HAS THE FOLLOWING TASKS:

1. Develop new procedures
2. Develop new treatment strategies
3. Compare new and existing strategies
4. Optimizing and development of advanced imaging techniques
5. Study the social, economic, and organisational consequences of new procedures on health care
6. Administration of radiation protection for all departments in the hospital

RESEARCH AREAS

- MR guided intervention and surgery
- X-ray, CT, ultrasound, video-guided interventions and surgery
- Robotics and simulators
- Sensor technology, data management and communication technology
- Physics in MR, CT, X-ray, US, PET and nuclear medicine

FACILITIES

The Centre is part of the general operation room area at Oslo University Hospital, Rikshospitalet. In addition to human procedures, The Intervention Centre has approval for animal trials in the operation theatres and hybrid suites. The staff is experienced in performing animal trials. In three suites advanced imaging equipment is integrated in an operation room environment.

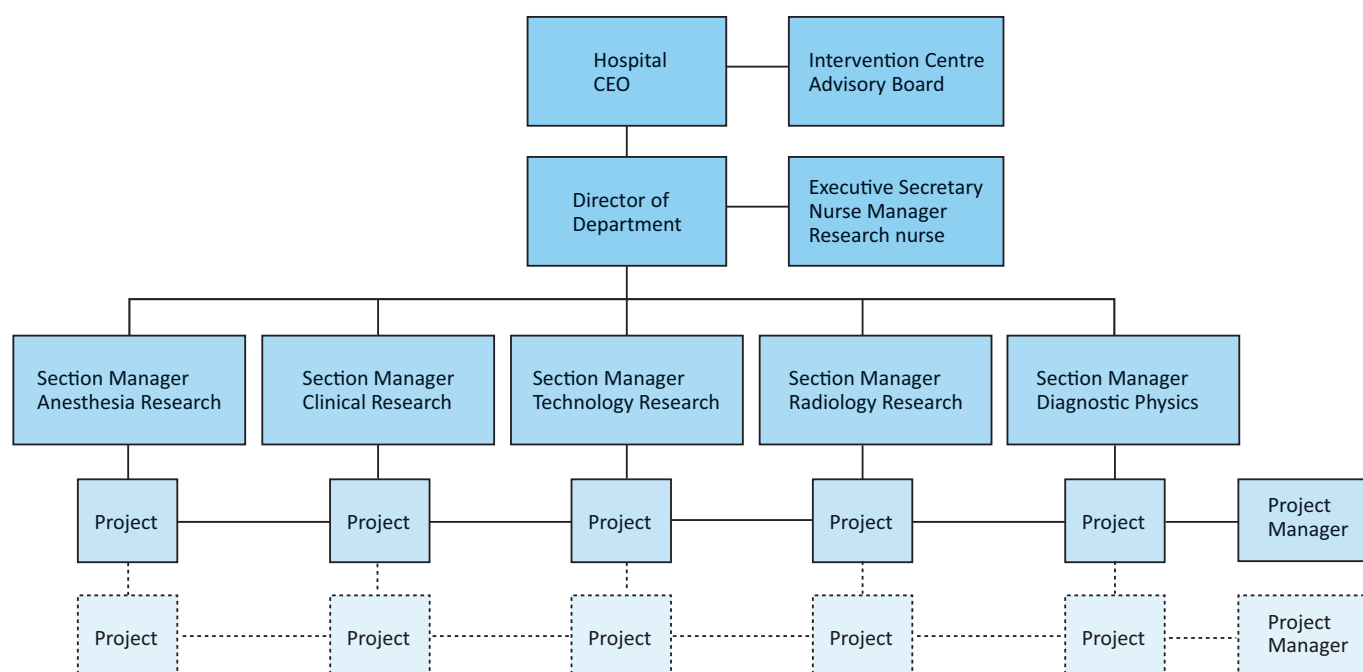
In 2007, all advanced imaging equipment was renewed. In the combined surgical and radiological suite, the conventional angiographic equipment was substituted by a Siemens Zeego system, based on robotic technology and new advances in imaging and functionality. The Intervention Centre has a research contract with Siemens and is a test site for their Zeego system. The MRI suite was completely rebuilt into a dual room suite where a Philips 3 Tesla MRI was installed in connection to a state-of-the-art Operation theater. The MRI was funded as a joint effort by the Norwegian Research Council, the University of Oslo and Rikshospitalet. In the videoscapy room all systems are equipped with Olympus HD equipment.

STAFF

The multi-disciplinary staff includes 45 persons (doctors, nurses, radiographers, medical physicists and technologists). Four professors and two associate professors, employed at the Faculty of Medicine and the Faculty of Mathematics and natural sciences of University of Oslo (UiO) and the Department of Electronics and Telecommunication of the Norwegian University of Technology (NTNU), are included among the staff.

The hybrid OR facilities at The Intervention Centre





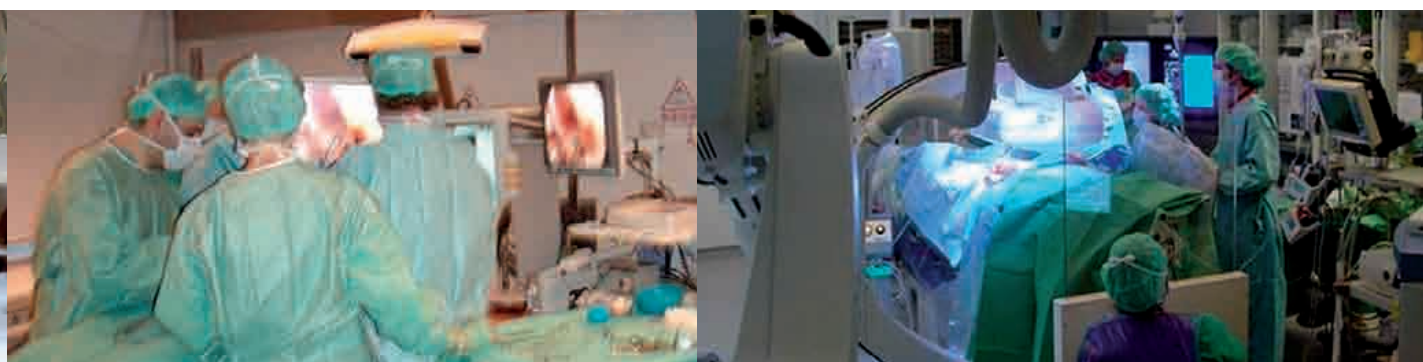
ORGANIZATION

The Intervention Centre is organized in The Clinic for diagnostics and intervention in OUH. A National Advisory board with representatives from all universities and university hospitals in Norway and the main departments of Oslo University Hospital is giving advice to the head of department.

In order to facilitate effective management of multi-disciplinary projects, the personnel and equipment at the Centre are allocated to five sections. All projects in the Centre are allocated to one of these sections, and the project manager is reporting to one section

manager. The operation rooms are managed by the unit nursing officer, reporting directly to the head of department. In 2005, OUH established a group of medical physicists specialized in diagnostic radiology, nuclear medicine and intervention. The establishment was supported by both the Southern and the Eastern Norway regional health authorities.

From 1st January 2010, the section for diagnostic physics was allocated to the Intervention Centre, providing most of the hospitals in the South-eastern health region of Norway with physic services for daily running of the radiology and nuclear medicine departments and for physics research infrastructure.



Diagnostic Physics Regional Services

21 physicists, employed on regular basis, offer a regional physicist service in the South Eastern part of Norway and are responsible for the radiation protection in Oslo University Hospital (OUS). This is the largest department of diagnostic physics in Norway.

In addition to quality assurance and radiation protection, the section is co-responsible for the daily follow-up and management of both the Regional Core Facility in Translational MRI NeuroImaging and the Regional Core Facility in PET-CT and involved in research in topics as MR-physics, CT-physics, intervention radiology, nuclear medicine including PET-CT, image processing and radiation protection. In addition, comparison studies of different modalities, optimisation of radiation protection in paediatrics, interventional radiology and internal dosimetry are also fields of research. Atle Bjørnerud is professor at the Department of Physics, University of Oslo and his group in the Section of Diagnostic Physics currently employs two post docs, 5 PhD students, 2 students from the Medical research school, and one data programmer.

REGIONAL PHYSICIST SERVICE

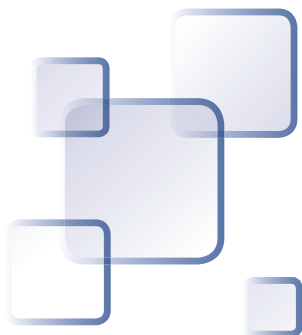
In 2005 OUS established a group of physicists specialized in diagnostic radiology, nuclear medicine and intervention, serving most of the hospitals in the southeastern part of Norway. In 2011 the section had commitments at all the hospitals in OUS and also at 13

hospitals and radiological institutes at 35 locations outside OUS. Collaborating hospitals and institutes in 2011 were AHUS, Lovisenberg, Sunnås, Feiringklinikken, Glittreklinikken, Martina Hansens Hospital, Diakon-hjemmet, Sykehuset Østfold, Vestre Viken avd. Ringerike, Sykehuset Telemark, Sykehuset Innlandet, ALERIS and Helsehuset Kongsberg. This is a non-profit service; the salary for physicists and traveling costs related to the work done in a hospital are paid for by the receiving hospital. To the extent that it is feasible each hospital has one contact physicist working together with radiologist and technicians in the radiology department. Multidisciplinary teamwork is one important factor of success. The services offered are:

- System acceptance tests
 - Image quality and radiation dose
- Quality assurance tests performed annually
- Multidisciplinary radiation dose versus image quality optimization projects within
 - CT
 - Trauma
 - Neuroradiology
 - Intervention
 - Pediatrics
- Lectures for surgical personnel using X-ray equipment
- Lectures at the radiological and nuclear medicine departments
- Dose measurements and dose estimates
- Consultancy in purchases of new radiology modalities

The economical benefits of a regional physicist service include reduced personnel needs due to recirculation of lectures, reports and knowledge between the physicists in the group. Also less measuring equipment is needed in the region due to a centralised pool of equipment. Other regional benefits are the achieve-





ment of high competence in CT, X-ray, MR, and nuclear medicine due to the exchange of experience and knowledge from different laboratories and hospitals. Technological problems are solved by experience from previous similar problems in other sites, and development of QA methods and procedures are consolidated in the group of physicists.

COURSES

The 3rd National PhD Conference in Medical Imaging was jointly organized by the Section of diagnostic physics, The Intervention centre and the Norwegian Research School in Medical Imaging in Oslo, 21-22 November 2011. The headline was “Good science – better healthcare?” and hot topics within advanced medical imaging was in focus under the conference. A panel debate with deans from the faculties of Medicine and Mathematical and Natural Sciences from the Universities in Bergen, Oslo and Trondheim discussed the topic “Good science – better healthcare – How do the universities address this issue?” In total, 114 PhD students and established scientist participated at the conference.

The section is responsible for two master courses in physics at the University of Oslo: “FYS 4760 Physics in diagnostic X-ray” and “FYS-KJM 4740/9740 MR-theory and medical diagnostics” and one CT post educating course for radiographers at the University college of Oslo.

The section also was co-responsible for a Nordic Course in CT colonography in Oslo in 2011.

QUALITY ASSURANCE

Methodology for acceptance tests and quality assurance on diagnostic modalities as MR, PET-CT, nuclear medicine, CT, fluoroscopy and X-ray were revised and further developed.

In 2011 QA on 315 modalities, from all vendors at the Norwegian market, were performed.



Research Groups

ANESTHESIA RESEARCH | *Section manager: Per Steinar Halvorsen, MD, PhD*

MEDICAL SENSORS

Leader: Professor Erik Fosse MD, PhD

Research subject:

Advanced cardiovascular monitoring

Technological advances and a better understanding of human physiology have allowed the development of medical sensors, which can be used for optimize diagnosing and treatment of disease states.

The Intervention Centre is coordinating a joint project called “Micro-Heart” for detection of heart motion changes. The goal is to develop a system for early detection of perioperative regional ischemia and monitoring of global cardiac function by miniaturized motion sensors, such as epicardial 3-axis accelerometers and ultrasound sensors. The techniques have been used successfully in both experimental animal and clinical studies. The “Micro-Heart” project is in close collaboration with Vestfold University College in Tønsberg. The Intervention Centre is responsible for the clinical research activity, whereas Vestfold University College is responsible for miniaturizing of the sensors and for incorporating the sensors into temporary pacemaker leads. The idea of using 3-axis accelerometer in perioperative ischemia detection is patented: Patent number: NO 20016385.



The accelerometer and miniature ultrasound sensors are also used in experimental models for assessing cardiomyopathy in sepsis and therapeutic hypothermia.

Together with the Department of Clinical Engineering, Professor Sverre Grimnes, this group was also involved in the development of a sensor for measuring the sweat production in different parts of the body by a bio impedance technique. This sensor provides continuous clinical information on the intensity of sympathetic nervous activity.

Projects	Project leader	Financing
Miniaturized epicardial ultrasound probes for perioperative myocardial monitoring	Professor Thor Edvardsen	HSØ
Myocardial function in graded ischemia assessed by myocardial sensors	Mentor, Professor Erik Fosse	NFR
Cardiomyopathy in sepsis	Professor Thor Edvardsen	
Ultrasonic diagnostics in acute and chronic heart failure	Professor Thor Edvardsen	HSØ
Circulatory and cardiac effects of transaortic valve implantation (TAVI)	Professor Erik Fosse	HSØ
Accuracy of accelerometer measurements in cardiac monitoring	Professor Erik Fosse	HSØ
Wireless sensor communication in advanced medical settings	Professor Erik Fosse	IVS
Development of a sensor for sweat measurement	Professor Sverre Grimnes	NFR
Cardiomyopathy in therapeutic hypothermia	Professor Jan Fredrik Bugge	Dep. of Cardiology OUS

PhD candidates:

Andreas Espinoza, MD, Stefan Hyler, MD, Siv Hestenes, MD, Ole-Johannes Grymyr, MD, Jo Eidet, MD, Harald Bergan, MD, Christan Trondstad, MSc, Karl Øyri, Cand San

Post Doc:

Espen Remme, MSc, PhD

BIOSENSOR RESEARCH GROUP

Leader: Professor Tor Inge Tønnessen MD, PhD

The Biosensor research have three main branches; 1) the biologic basis for ischemia and the choice of parameters for detection thereof, 2) the development of a specific pCO₂ sensor and 3) developing methods for early detection of rejection in transplant patients. The biologic basis has been studied through animal experiments.

The Biosensor research have three main branches:

- 1) The biologic basis for ischemia and the choice of parameters for detection thereof
- 2) The development of a specific pCO₂ sensor
- 3) Developing methods for early detection of rejection in transplant patients

Ongoing PhD programs in 2011:

1. Lars Wælgard, MD:
New clinical methods for detection of ischemia
Mentor: Tor Inge Tønnessen, the Intervention Centre/Dept of Anaesthesiology, Oslo University Hospital
2. Søren Pischke, MD:
Biosensors for detecting cardiac ischemia
Mentor: Tor Inge Tønnessen, the Intervention Centre/Dept of Anaesthesiology, Oslo University Hospital and Tom Eirik Mollnes, IMMI, Oslo University Hospital
3. Håkon Haugaa, MD:
Microdialysis monitoring in transplanted patients
Mentor: Tor Inge Tønnessen, the Intervention Centre/Dept of Anaesthesiology, Oslo University Hospital and Tom Eirik Mollnes, IMMI, Oslo University Hospital



COMPLEMENT RESEARCH GROUP

Leader: Professor Tom Eirik Mollnes, MD, PhD

Research subject:

The role of complement in human disease

Complement is part of the innate immune system protecting the host against invading micro-organisms. Regulatory control mechanisms normally prevent the system from extensive and systemic activation, thereby protecting the host from self damage.

Under various disease conditions complement is improperly activated, either locally leading to tissue damage or systemically with risk of serious homeostatic disturbances.

A primary research goal for the Complement Research Group is to elucidate the role of complement as a primary inducer of the inflammatory reaction and thereby form a basis for a future therapeutic approach in complement-mediated disease processes.

For this purpose we have developed novel assays for detection and quantification of complement activation products based on monoclonal antibodies to activation dependent epitopes on a number of complement components; the most important one being the assay for TCC (the terminal SC5b-9 complement complex). These assays are used to detect complement activation experimentally and clinically and to evaluate the effect of various complement inhibitors in experimental models. In a novel in vitro human whole blood model where all potential inflammatory mediators are able to interact mutually, we are currently studying the effect of complement inhibition on a number of arms of the inflammatory network. In particular we are focusing on the cross-talk between complement and the Toll-like receptors with emphasize on CD14. The main current clinical and experimental animal projects aims to elucidate the role of complement and CD14 in sepsis, systemic inflammatory response, ischemia-reperfusion injury and transplant rejection.

Web site:

www.med.uio.no/klinmed/forskning/grupper/komplementgruppen/

TECHNOLOGY RESEARCH | *Section manager: Ole Jakob Elle, PhD*

WIRELESS SENSOR NETWORKS

Group leader: Professor Ilango Balasingham, PhD

The sensors, signals, and systems research group aims to facilitate deployment intelligent sensors and systems for different procedures in surgery, minimal invasive therapy and ambient point of care monitoring. The main focus area of research is in efficient design and development of novel sensors, power efficient real time signal processing algorithms, sensor data fusion, and wireless communication solutions for in vivo and ex vivo purposes. Some of our activities have been on



studying the use of ultra wide band medical radars to estimate blood pressure, blood flow and tissue/organ motions. Furthermore, novel signal processing algorithms to facilitate power efficient processing of digital data in sensors, which are popularly called as sensor nodes in wireless communications networks. The digital sensor data fusion and multi parameter analysis are also active areas of research. We are working to design reliable, power efficient and robust wireless body area sensor networks for in vivo (*implantable*) and ex vivo use.

We have a close collaboration with the Department of Electronics and Telecommunications at the Norwegian University of Science and Technology (NTNU) in Trondheim and several national and international research institutions and companies participate in different projects.

In addition to several ongoing projects, the group participates in the projects "Oslo Medtech Cluster" and COST action "Cognitive Radio and Networking for Cooperative Coexistence of Heterogeneous Wireless". Project "Oslo Medtech Cluster" is funded by Innovation Norway, SIVA and Research Council of Norway through the ARENA program. The COST project IC 0902 "Cognitive Radio and Networking for Cooperative Coexistence of Heterogeneous Wireless" is funded by the COST, Research Council of Norway and Ministry of Foreign Affairs for 4 years.

The research group, which is split between Oslo and Trondheim, has presently 7 PhD fellows and 6 Post doctoral fellows employed through the projects. Dr. Sang-Seon Byun joined the group as an ERCIM Postdoc fellow in 2007, where he will continue working in the WISENET project for another year and will be located at NTNU in Trondheim. Dr. Ali Khaleghi, who joined us as a PostDoc fellow in the WISENET project returned back to Iran in December 2009 but came back as a visiting Professor in June 2010 for 3 months. Dr. Qinghua Wang joined the group as an ERCIM Postdoc fellow in 2010 and will be located at NTNU in Trondheim for one year. Dr. Jianguo Ding and Dr. Alex Cartagena Gordillo, worked as ERCIM Postdoc fellows, returned to their home countries China and Peru, respectively.

PhD programs:

1. MSc. Stig Støa:
Ultra wide band impulse radio
Mentors: Ilangko Balasingham and Erik Fosse, the Intervention Centre, Oslo University Hospital and Dag Wisland and Tor Sverre Lande, University of Oslo
2. MSc Hessam Moussavinik:
Super robust short range wireless sensor network
Mentor: Ilangko Balasingham, the Intervention Centre, Oslo University Hospital. Geir Øien and Tor Ramstad, Norwegian University of Science and Technology, and Niels Aakvaag, Multihop Com AS
3. MSc Minh-Long Pham:
Distributed signal processing for power efficiency
Mentor: Tor Ramstad, Norwegian University of Science and Technology and Ilangko Balasingham, the Intervention Centre, Oslo University Hospital
4. MSc Fatemeh Kazemeyni:
Modelling tools and optimization of wireless sensor network
Mentor: Ilangko Balasingham, the Intervention Centre, Oslo University Hospital. Olaf Owe and Einar Broch Johansen, University of Oslo
5. MSc Lars Erik Solberg:
UWB medical radar for estimating blood pressure
Mentor: Ilangko Balasingham and Erik Fosse, the Intervention Centre, Oslo University Hospital and Svein-Erik Hamran, Norwegian Defence Research Establishment
6. Nguyen Trung Hieu:
Information theoretical bounds for wireless sensor networks
Mentor: Tor Ramstad. Norwegian University of Science and Technology and Ilangko Balasingham, the Intervention Centre, Oslo University Hospital
7. Babak Moussakhani:
Signal processing for robust invivo-exvivo communication
Mentor: Ilangko Balasingham, the Intervention Centre, Oslo University Hospital and Tor Ramstad, Norwegian University of Science and Technology

Postdoctoral fellows:

1. Dr. Sang-Seon Byun:
Development of Cognitive wireless sensor networks
Mentor: Ilangko Balasingham, the Intervention Centre, Oslo University Hospital and Norwegian University of Science and Technology
2. Dr. Pål Anders Floor:
Signal processing for robust wireless communications
Mentor: Ilangko Balasingham, the Intervention Centre, Oslo University Hospital and Tor Ramstad, Norwegian University of Science and Technology
3. Dr. Raul Chavez-Santiago:
Cognitive UWB sensor networks
Mentor: Ilangko Balasingham, the Intervention Centre, Oslo University Hospital and Norwegian University of Science and Technology
4. Dr. Jianguo Ding:
Deployment and management of wireless sensor networks
Mentor: Ilangko Balasingham, the Intervention Centre, Oslo University Hospital and Norwegian University of Science and Technology
5. Dr. Alex Cartagena Gordillo:
On antennas and modulation for UWB sensor networks
Mentor: Ilangko Balasingham, the Intervention Centre, Oslo University Hospital and Norwegian University of Science and Technology
6. Qinghua Wang:
Sensor network localization
Mentor: Ilangko Balasingham, the Intervention Centre, Oslo University Hospital and Norwegian University of Science and Technology

Visiting professor:

Assistant Professor Ali Khaleghi:
Invivo and exvivo UWB applications
The K. N. Toosi University of Technology, Tehran, Iran.

TECHNOLOGY RESEARCH

**MEDICAL ROBOTICS
APPLICATION AND CONTROL***Group leader: Ole Jakob Elle, PhD*

Surgical robotics has been a research topic of The Intervention Centre since 1998. The Zeus Micro Joint telemanipulator has been used for animal studies performing coronary bypass-surgery and human trials for thoracoscopic IMA-takedown and sympathectomy. Through this work, spin-off research projects such as head-tracking as a control modality for a robotic scope-holder and haptic feedback to give the

operator the feeling of touch when remotely controlling the robot has been initiated. Industrial and academic contact with Patric Finlay (*Prosurgics Lmt.*, *Medimation Lmt.*) has been fruitful within the area of neurobotic systems, and a cross-disciplinary research collaboration between engineers and neurosurgeons were established through this contact. The project was aimed at precise positioning of a tool within target points in the brain using image guidance and without the use of a stereotactic frame, by use of the neurosurgical PathFinder robot. This project is on hold due to software upgrade of the PathFinder robot as a result of our preliminary use of the system.



In 2005 the PhD fellow Edvard Nærum was hired with the research topic of haptic and tactile feedback in remote surgery. Edvard Nærum was in 2008 at a research stay at Seattle University, USA hosted by Professor Blake Hannaford. Two papers were published in 2009 based on work performed with Balke Hannaford, and two more publications based on the collaboration with Hannaford are in preparation. Hannaford is an important academic contact within the robotic research field. Edvard Nærum is now working with his last study, and is planning to complete his PhD within 2011.

Katholieke Universitat Leuven was partner in the Marie Curie project ARIS*ER, which was coordinated by The Intervention Centre. As a spin-off from ARIS*ER, the EU-Strep proposal SCath (*Smart Catheterization*) was granted in 2009 initiated by Katholieke Universitat Leuven. The Intervention Centre is partner in this project, where the aim is to develop a navigation platform and a robotic control system for safer and more precise positioning of catheter introduced devices. The SCath project runs 2011 – 2014.

Ole Jakob Elle holds a position at The Department of Informatics, University of Oslo as an Adjunct Associate Professor. In 2009 a four year PhD-scholarship was decided to be dedicated to research work within robotic surgery at The Intervention Centre. The Candidate started his work in autumn 2010.

Department of Ear Nose and Throat is doing Cochlea Implants in the Angio Lab at The Intervention Centre. Ralf Greisiger is taking his PhD at Department of Informatics in the development of an expert system for optimising the placement of Cochlea Implants.

In 2010 EU granted a new project on automation in surgery. The project name is I-Sur (*Intelligent Surgical Robotics*) and aims at develop intra-operative sensing, intelligent control and reasoning systems in order to explore the degree of automation possible. The project that is coordinated by Professor Paolo Fiorini at University of Verona starts in Mars 2011 and runs until October 2014. The Intervention Centre responsibility is within intra-operative sensing and the development of advanced control algorithms. The project will fund one PhD and one Postdoc that was employed in 2011.

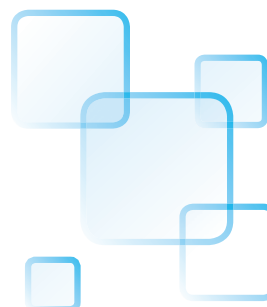
PhD programs:

The Robotic research group had four PhD projects running in 2011:

1. M.Sc. Edvard Nærum:
Haptic and tactile feedback in remote surgery
Mentor: Ole Jakob Elle and Erik Fosse,
The Intervention Centre, Oslo University Hospital
2. M.Sc. Tangui Morvan:
Collision detection and visualisation system to help and guide the surgeon while doing tele-manipulated surgery
Mentor: Eigil Samset and Ole Jakob Elle,
The Intervention Centre, Oslo University Hospital
3. M.Sc. Kim Mathiassen:
Semi-autonomous robotic systems for use in medical diagnostics and treatment
Mentors: Ole Jakob Elle at The Intervention Centre, Oslo University Hospital and Kyrre Harald Glette and Mats Erling Høvin at Department of Informatics, University of Oslo
4. M.Sc. Dilla Handini (I-SUR):
US imaging as an intra-operative sensing for Intelligent Surgical Robotic System
Mentors: Ole Jakob Elle at The Intervention Centre, Oslo University Hospital

Postdoctoral fellow:

1. Nguyen Ho Quoc Phuong (I-SUR):
Reasoning and situation awareness engine for automatic robotic control using real-time sensing including visual servoing



TECHNOLOGY RESEARCH

IMAGE PROCESSING
VISUALIZATION AND NAVIGATION

Group leader: Ole Jakob Elle, PhD

Most minimally invasive procedures restrict the access and direct vision to the regions which require surgery. Such procedures require intra-operative image modalities such as ultrasound or endoscopic images to be able to monitor the surgery. In many cases this information is not sufficient to perform the procedure accurately and safely. Merging information acquired pre-operatively, mainly from for instance MRI, CT or PET, with intra-operative data can increase the basis for decisions and thereby improve the safety and accuracy of the procedure. The image processing, visualization and navigation group develops cutting edge technological solutions which support minimally invasive procedures. As the title of the group indicates, the research focus is divided into three areas. Image processing methods are key elements in any software system which supports minimally invasive procedures. In particular, we are focused on developing real-time image-segmentation and -registration methods where

segmentation methods finds important anatomical structures such as tumors and vessel structures in images, while registration methods enables fusion of images. Visualization and navigation is required to present the medical images to the surgeon intra-operatively. We are developing visualization systems which use advanced techniques such as augmented reality and volume rendering for this purpose.

The project *“Mathematical and computational methods for co-registering multi-modal medical images” (MATMED)* is funded under the eScience program at the Norwegian Research Council for the period 2007–2011. It is a joint project between the Intervention Centre, Centre for Mathematics and Applications (CMA) at UiO and Center for Integrated Petroleum Research at the University of Bergen and funds three PhD positions. Petter Risholm defended his PhD within the MATMED-program 31st of May 2011 with the title *“Intra-operative deformable registration”*.

In 2009 the Marie Curie project IIIOS (*Integrated Intra-operative Imaging Operating System*) was funded by EU. The Intervention Centre is a partner in this project.



IIIOS is a Marie-Curie Research Training Network for the education of young researchers, and in connection with that each partner has the responsibility of arranging different training courses for the young researchers within the project throughout the duration the project. Part one of the IIIOS-Training course for 2010 were arranged by the The Intervention Centre, Oslo University Hospital on the 26th to 27th of August 2010, and had the title *“Interventional MRI in image guided procedures”*. The project is financing two PhD fellows at The Intervention Centre. The project runs until October 2013.

In February 2010 the EU funded project SCath (*Smart Catheterization*) started. The project is coordinated by Katholieke Universitat Leuven. The Intervention Centre is partner in this project, where the aim is to develop a navigation platform and a robotic control system for safer and more precise positioning of catheter introduced devices. The SCath project runs 2011 – 2014. The main role of The Intervention Centre is to develop improve the accuracy of the tracking information used in the navigation of the catheter and the development of better registration algorithms for effective motion compensation and correction of deformation in model based navigation.

PhD programs:

The group had four ongoing PhD programs in 2011:

1. Tangui Morvan (ARIS*ER- Early stage researcher):
Development of general purpose algorithms for collision detection using GPU (Graphics Processing Unit).
Mentor: Eigil Samset and Martin Reimers, Department of Informatics, University of Oslo
2. Sergiy Milko (ARIS*ER Early stage researchers):
Automatic registration of Ultrasound and CT/MRI images.
Mentors: Prof. Eigil Samset and Timor Kadir, Siemens Magnet Technologies
3. Petter Risholm (MATMED PhD student):
Intra-operative deformable registration.
Mentor: Prof. Eigil Samset, The Intervention Centre, Oslo University Hospital

4. Eivind Lyche Melvær (MATMED PhD student):
Reconstruction of 3D images from free-hand 2D ultrasound.
Mentors: Prof. Knut Mørken, CMA/UiO and Prof. Eigil Samset, The Intervention Centre, Oslo University Hospital
5. Egil Bae (MATMED PhD student):
Image Segmentation and Reconstruction using level sets and graph cuts.
Mentors: Prof. XueCheng Tai, CIPR/UiB and Prof. Eigil Samset, The Intervention Centre, Oslo University Hospital
6. Abubakr EL-Dirdiri (IIIOS):
Development of methods for the Integration of catheter tip tracking into the 3T MR.
Mentor: Frederic Courivaud and Ole Jakob Elle at The Intervention Centre
7. Rahul Kumar (IIIOS):
Develop new effective segmentation algorithms for the facilitation of endoscopic and cardio vascular navigation
Mentor: Ole Jakob Elle and Bjørn Edwin at The Intervention Centre. Fritz Albrigtsen and Martin Reimers at Department of Informatics University of Oslo. Thomas Langø at Sintef Health
8. Ralf Greisiger:
Objective Measurements and Cochlear Implants Imaging
Mentor: Greg Eigner Jablonski at Department of Ear Nose and Throat at Oslo University Hospital, Ole Jakob Elle and Per Kristian Hol at The Intervention Centre and Jon K. Shallop Associate Professor of Audiology and Senior Consultant at Mayo Clinic Medical School, Rochester, Minnesota.

Postdoctoral fellow:

Hugues Fontenelle PhD (SCath):
Algorithms for the compensation of inaccuracies in magnetic tracking when used in an OR setting.

Software Developer:

Rafael Palomar (SCath):
Implementation of navigation platform and the development of methods for compensation of motion and deformation in catheter navigation.

IMAGING RESEARCH AND IMAGE GUIDED INTERVENTION | *Section manager: Per Kristian Hol, MD, PhD*

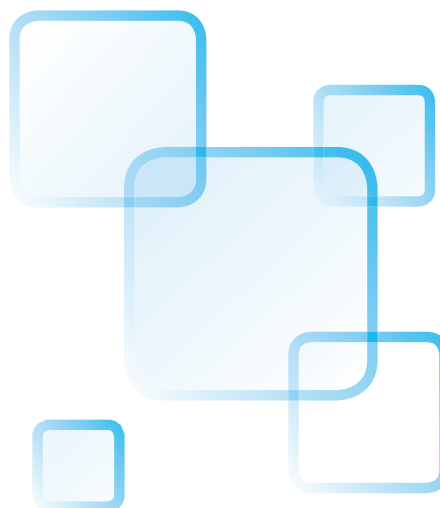
IMAGING RESEARCH AND IMAGE GUIDED INTERVENTION

Group leader: Per Kristian Hol, MD, PhD

A number of research projects using the 3T MR scanner or the combined angiographic suite are performed in corporation with different academic partners, including Departments of Neuropsychiatry and Psychosomatic Medicine, Oncology, Ear Nose and Throat, Neurosurgery, Neurology, Anesthesiology and Radiology. The research topics cover brain, spine, liver, prostate, brachial plexus and inner ear.

A total of 12 PhD programs used the angiographic suite or the MR scanner for their research in 2011:

1. Cand. Med. Trygve Kjelstrup:
Axillary plexus block, nervestimulater, ultrasound and MRI
Mentors: Øivind Klaastad and Harald Breivik, Department of Anaesthesiology, and Per Kristian Hol, The Intervention Centre, Oslo University Hospital
2. Cand. Med. Torbjørn Elvsåshagen:
Neuroplasticity in patients with bipolar disorders
Mentors: Ulrik Frederik Malt and Stein Andersson, Department of Neuropsychiatry and Psychosomatic Medicine, Oslo University Hospital. Espen Dietrichs, Department of Neurology, Oslo University Hospital. Ole Andreassen, Institute of Psychiatry, University of Oslo
3. M.Sc. Ralf Greisiger:
Cochlear Implants and DynaCT imaging
Mentors: Greg E. Jablonski and Terje Osnes, Dept of Ear Nose and Throat, Oslo University Hospital. Ole Jacob Elle and Per Kristian Hol, The Intervention Centre, Oslo University Hospital and Jon K. Shallop, Mayo Clinic Medical School
4. Cand. Med. Jarle Sundeth:
Faktorer som har betydning for resultatet av kirurgisk behandling av nakkeprolaps
Mentors: Frode Kolstad, Department of Neurosurgery and Øystein Nygård, Trondheim University Hospital
5. Cand. Med. Kristin Evensen:
The vulnerable carotid artery plaque
Mentor: David Russell, Department of Neurology, Oslo University Hospital
6. Cand. Med. Karolina Ryeng Skagen:
The vulnerable carotid artery plaque
Mentor: David Russell, Department of Neurology, Oslo University Hospital
7. Cand. Med. Geir Ringstad:
Assessment of Intracranial Pulsatility and Cardiac-beat Intracranial Volume Change using MRI
Mentors: Per Kristian Eide, Department of Neurosurgery, Kyrre E. Eble, The Intervention Centre, and Noam Alterin, University of Miami, Florida, USA
8. Astrid Almaas, Elin Blakstad, Sissel Moltou and Kenneth Strømmen:
Nutrition, growth and development of premature children
Mentor: Christian A. Drevon, Department of Nutrition, Institute of Basic Medical Sciences, University of Oslo
9. Cand. Psych. Gudmundur Skarphedinsson:
I vivo MR spectroscopy as a neuroimaging diagnostic study in children and adolescents with obsessive-compulsive disorders
Mentor: Tord Ivarsson, Regionsenter for barn og unges psykiske helse (PBUP Øst og Sør)



MR GUIDED HIGH INTENSITY FOCUSED ULTRASOUND TREATMENT

Group leader: Per Kristian Hol, MD, PhD

The 3T MR scanner at the Intervention Centre has integrated High Intensity Focused Ultrasound (HIFU) equipment as part of a research agreement with Philips Medical Systems. HIFU-therapy is completely non-invasive as the ultrasound energy is delivered outside the body, but focused in defined areas in an organ. MR-given real-time temperature feedback optimizes

the procedure. In 2011 projects on ablation of uterine fibroids and liver were on-going. Program to start ablation treatment of prostate are under preparation.

PhD programs:

Cand. Med. Eric Dorenberg:

Aspects of interventional procedures for treatment of uterine fibroids

Mentors: Jarl A. Jacobsen, Department of Radiology, Oslo University Hospital and Per Kristian Hol, The Intervention Centre, Oslo University Hospital



IMAGING RESEARCH AND IMAGE GUIDED INTERVENTION

NEURO COGNITIVE IMAGING

Group leader: Associate professor Tor Endestad



The fMRI group at the Center for Study of Human Cognition at UiO work with basic research related to cognitive functions. 2010 has been a year with many technical challenges and recollection of data.

The group is engaged in the study of memory and cognitive control. In one of the programs studies of early visual memory are combined with attention to better understand the building block of the human memory system. In addition memory errors (*false memories*) and the relationship between executive functions and impulse control are studied. Both patients with focal brain injuries and psychological disturbances are included in the research. In another line of projects studies of brain damaged patient address frontal lobe damage, hormone influence on cognitive functions.

Several projects with cooperation between the Centre and RH (*FRONT, Cerebellum*) were started in 2008 and continued in 2010. For all these projects data collection has been or are close to be finalized.



In addition to basic research, the group participate in the development of functional MRI as part of pre-surgical planning and improvement of neuropsychological diagnostics.

A new treatment project has been established in cooperation with RedCord. A physiotherapy based method for neck pain relief will be studied as a pre and post treatment study.

A cooperation with the University of Lund on linguistic processing has been started in 2011 and will continue in 2012.



Ongoing projects that continue in 2012:

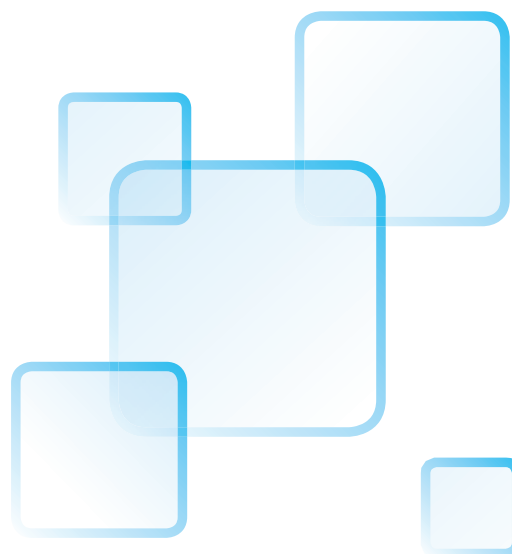
PhD Projects:

1. ***Can the brain make sense of nothing, fill in of the Blind spot***

PhD student: Dag Alnes
Principal res: Tor Endestad,
Svein Magnussen

2. ***Plasticity in the human visual system***

PhD student: Markus Handal Sneve
Principal res: Tor Endestad, Svein Magnussen



3. ***FRONT Frontal Lobe Injury and cognition***

PhD Students: Marianne Løvås, Ingrid Funderud
Principal Res: Tor Endestad, Anne Kristin Solbakk,
Magnus Lindgren

4. ***Cerebellar damage and cognitive control***

PhD Student: Torgeir Moberget
Principal Res: Tor Endestad, Stein Anderson

Post Doc projects:

1. ***Decision making***

Post Doc: Guido Guido Biele
PhD: Renata Suter

2. ***Placebo treatment of pain***

Post Doc: Siri Leknes
PhD: Dan Mikael Ellingsen

Master students:

1. ***Unconscious processing of emotions***

Master student: Laura Bakke
Principal Res: Tor Endestad, Bruno Laeng

2. ***Hippocampus and temporal lobe activation***

Master Student: Laura Bakke
Principle Res: Tor Endestad

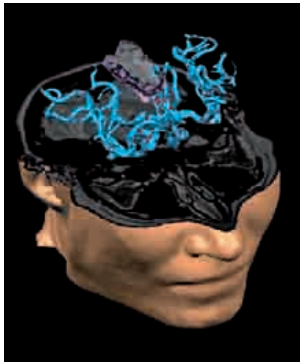
3. ***Action verbs***

Master Student: Tommy Silnes
Principle Res: Tor Endestad

MEDICAL PHYSICS RESEARCH | *Section manager: Anne Catrine Trægde Martinsen, PhD*

ADVANCED MR NEURO IMAGING

Group leader: Professor Atle Bjørnerud, PhD, UiO



The main research focus of the Advanced Neuroimaging Group (ANG) is related to functional MRI applied to different neuro-pathological conditions. There is currently a particular focus on MR based imaging for diagnosis, prognosis- and treatment response assessment in patients with primary brain tumors (*gliomas*). A multi-centre study for evaluation of diagnostic

efficacy of MR based perfusion imaging for diagnosis of gliomas is incorporated in the Norwegian Research Council (NRC)-financed project: Evaluation of functional Magnetic Resonance in the Diagnosis of Brain Tumors for Assessment of Clinical Efficacy (EMBRACE). As part of the EMBRACE project a new prospective study is ongoing, which will assess the clinical utility of advanced MR based imaging methods for evaluation of treatment response in high grade gliomas patients.

The ANG is a multi-disciplinary effort and is collaborating closely with many other groups both internally within the OUS and externally with world-class research groups in Europe and the US. The group also has a close link to industry through collaboration/co-development with software companies (*NordicNeuroLab, Bergen, Norway and CorTechs Labs, SanDiego, USA*). The group has filed several patent applications related to novel image processing techniques which have been sub-licensed to our industrial partners. The ANG group members are further involved in a large number of imaging studies ongoing in the Oslo-region. In particular, the group provides MR expertise in several morphometric MR studies where high resolution MRI is used to assess neuro-structural changes related to neurodegenerative disease, Alzheimer's disease and normal aging.

PhD students:

Paulina Due-Tønnessen

Mentors: Atle Bjørnerud, Kyrre Eeg-Emblem

Evaluation of functional magnetic resonance in the diagnosis of brain tumors for assessment of clinical efficacy

Tuva Hope

Mentors: Atle Bjørnerud, Inge Rasmussen, Asta Håberg

MR based analysis of functional and hemodynamic parameters in brain tumors

Endre Grøvik

Mentors: Kjell-Inge Gjesdal, Atle Bjørnerud,

Kathinka Kurz, Trygve Storaas

Magnetic Resonance Imaging: a novel method for improved morphologic and functional assessment of breast tumors

Arvid Morell (Uppsala)

Mentors: Atle Bjørnerud, Håkan Ahlström

Quantitative tracer based MRI perfusion – potentials and limitations

Per Selnes (Akershus University Hospital)

Mentors: Tormod Fladby, Atle Bjørnerud

Understanding early events in Alzheimer's disease pathogenesis

Post Doc:

Inge Rasmussen and Kyrre Eeg Emblem

Ongoing projects

EMBRACE

SAILOR

Magnetic Resonance Imaging:
A Novel Method for Improved Morphologic
and Functional Assessment of Breast Tumors

nordicICE integration in PACS

Quantitative MR-perfusion

Automated white matter lesion quantification

Software development – nordicICE

The ANG has over the last years been central in the development of an extensive software package for advanced image processing in MRI, with special focus on dynamic analysis. The software package, called nordicICE, is now a commercial product sold in more than 20 countries. nordicICE is one of very few medical image analysis software packages for advanced perfusion analysis with full FDA-approval (510K).

At Rikshospitalet, nordicICE has been fully integrated into (Sectra) PACS and is now an integral part of routine diagnostic MR procedures, including BOLD fMRI, DTI and perfusion analysis. The ANG is currently preparing the nordicICE software package for integration into the next generation Sectra PACS (IDS7) and also focusing on expanding the functionality of the package towards automated tumor segmentation and implementation of advanced statistical methods for computer aided diagnosis (CAD).

PHYSICS AND IMAGE PROCESSING IN CT, PET-CT AND NUCLEAR MEDICINE

Group leader: Professor Arne Skretting

Within CT this group has carried out work to investigate the effect of different image processing techniques on image reading and measure the point spread function and its relationship with image noise. The group is heavily involved in PET research and works together with the recently formed PET-CT core facility which serves three PET/CT scanners in OUS. The main activity has been connected to improve the understanding of how image formation affects the quantitative data in the images, physiologically gated studies and image processing to extract novel information from the PET-studies.

Ongoing projects

The application of image processing in radiotherapy
Automatic detection of tumor surfaces in FDG-PET for radio therapy planning
Respiration gating by repeated breath-holds during PET data acquisition
Combined ECG and respiration controlled acquisition in PET heart studies
Simulation of image formation and properties by digital intensity diffusion, including small tumours and viable tumour rims around partly necrotic tumours
Investigation into the possibilities of reducing radiation dose and improve image quality in CT diagnostics through the use of advanced image processing
Studies of ⁶⁴ Cu-labeled porphyrines as a possible radiopharmaceutiacl to detect and characterize gliomas and other tumours by PET
Detection of atherosclerotic plaque in the carotid arteries by FDG-PET
Internal radiation dose estimation through serial SPECT and whole body studies in a Phase I clinical study with a new ¹⁷⁷ Lu-labelled antibody
Separation of grey and white matter in FDG-studies of the brain by combining MRI, PET system parameter in the image processing
Development of a multilayer phantom for the quality control of DATscan studies in Parkinsons disease
Regional comparisons of the total performance of bone scans utilizing a transmission phantom

PhD students:

1. Karsten Eilertsen
Department of Medical Physics:
A Beams Eye View on geometric and dosimetric precision in external beam
Mentor: Professor Arne Skretting,
The Intervention Center, Oslo University Hospital
2. Kjersti Johnsrud
Department of Radiology and Nuclear Medicine:
Imaging of Unstable Carotid Artery Plaque
Mentors: Professor David Russel, Department of neurology, Oslo University Hospital and professor Arne Skretting, The Intervention Center, Oslo University Hospital
3. Ingerid Skjei Knudtsen:
The use of FDG-PET in radiation treatment planning and treatment follow-up
Mentors: Professor Eli Olaug Hole and professor Eirik Malinen, The faculty of Mathematical and natural sciences, University in Oslo, and Arne Skretting, The Intervention Centre, Oslo University Hospital
4. Anne Cathrine Trægde Martinsen
The Intervention Centre:
The possibilities of reducing radiation dose and improve image quality in CT diagnostics using advanced image processing
Mentors: Professor Prof Per Skaane, The department of radiology and nuclear medicine, Oslo University Hospital, professor Dag Rune Olsen, The faculty of Mathematical and natural sciences, University in Bergen and Per Kristian Hol, The Intervention Centre, Oslo University Hospital



MEDICAL PHYSICS RESEARCH

PHYSICS AND IMAGE PROCESSING IN CT, PET-CT AND NUCLEAR MEDICINE (continued)

Group leader: Professor Arne Skretting

► MR-PHYSICS:

MRI for blood flow measurement in the brain

Optimizing the non-invasive PCASL-perfusion technique for brain tumor diagnostics. Evaluate whether it can serve as a good alternative to the clinically well-established invasive DSC-perfusion technique. This project runs at the radiological department of OUS, located on a 3T GE MR scanner at Ullevål Hospital on patients who are being assessed for brain tumors. This is a collaboration between physicists, neuroradiologists and radiographers in Department of Radiology and IVS.

Physicist Wibeke Nordhøy, PhD, Prof. Atle Bjørnerud, MR Øystein Bech Gadmar, PhD, Andrés Server Alonso, PhD MD, Till Schellhorn, MD, Anne Hilde Farstad

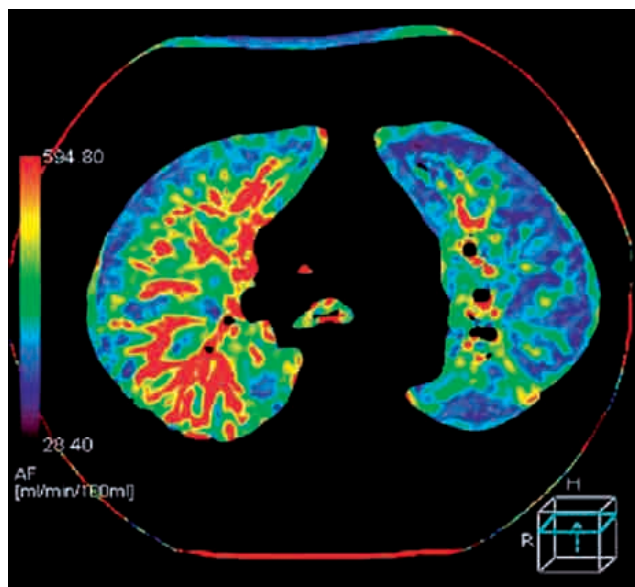
CARDIAC MRI:

Cardiac dysfunction in adjuvant breast cancer therapy; a MRI study

Primary objective: This project is part of the PRADA study which is a collaboration between Akershus University hospital and Oslo University Hospital, Radiumhospitalet

PhD student: MD Siri Heck, Ahus

Mentors: MD Pavel Hoffmann PhD, Department of radiology and nuclear medicine, Oslo University Hospital, Physicist Tryggve Holck Storås PhD, The Intervention Centre, Oslo University Hospital



BOWEL MRI:

MRC and MRI of patients with inflammatory bowel disease

This project is part of the Inflammatory Bowel South Eastern Norway (IBSEN) study which is a long term follow up study (now 20 years) of patients with inflammatory bowel disease. This is a collaboration between seven hospitals located in the south east of Norway.

PhD student: MD Linda Tøften Bakstad, Ahus

Mentor: MD Anne Negård PhD, Ahus

Coworker: Physicist Tryggve Holck Storås PhD, The Intervention Centre, Oslo University Hospital

PROJECTS OF THE CORE FACILITY CARDIAC IMAGING OF THE COMPREHENSIVE HEART FAILURE CENTER (University of Würzburg):

Quantitative multi-voxel 31P MR spectroscopy of the human heart during pharmacologically induced stress (full project)

Aim of this study is to develop, establish and evaluate the quantitative multi-voxel 31P MR spectroscopy of the human heart during pharmacologically induced stress.

Project managers: Prof. Dr. Meinrad Beer and Prof. Dr. Herbert Köstler, University of Würzburg
Participating Scientists: H. Hillenbrand MD, Prof. D. Hahn MD, W. Machann MD, W. Wüst MD, Prof. Jacob PhD, F. Breuer PhD, M. Blaimer PhD, University of Würzburg

Cooperating Partner: Physicist Oliver Geier PhD, The Intervention Centre, Oslo University Hospital

Quantitative high resolution cardiac perfusion measurement by magnetic resonance tomography (associated project)

Project manager: Prof. Dr. Herbert Köstler and Prof. Dr. Meinrad Beer, University of Würzburg
Participating Scientists: Prof. D. Hahn MD, C. Ritter MD, W. Machann MD, University of Würzburg.
Cooperating partners: Prof. P. Jacob, University of Würzburg, Physicist Oliver Geier PhD, The Intervention Centre, Oslo University Hospital, Prof. Griswold, Case Western Reserve University, Cleveland, Ohio

MRI for assessment of hypoxia-induced prostate cancer aggressiveness

Principal investigator: Therese Seierstad, Knut Håkon Hole, Kathrine Røe
Co-investigator: Heidi Lyng, Sigbjørn Smeland, Ljiljana Vlatkovic, Kathrine Lie, Jeroen Sebastiaan Reijnen, Sophie Fosså, Alv A Dahl, Are Hugo Pripp, Oliver Geier

***Towards Clinical Application of MR Renography:
Optimization of technical performance and
evaluation of clinical feasibility***

PhD student: Eli B Eikfjord

Principal investigator: Prof. Jarle Rørvik

Mentors: Arvid Lundevold, Erling Andersen

Cooperating partner: Oliver Geier

PhD-students:

PhD student Line Brennhaug Nilsen

Mentors: Dage Rune Olsen, Therese Seierstad PhD,
Olav Engebråten MD, Heidi Lyng PhD, Oliver Geier PhD

***Functional magnetic resonance imaging in breast
cancer for prediction and monitoring of neoadjuvant
treatment response***

This project is part of the neoadjuvant avastin in breast cancer study (Principle investigator: Olav Engebråten, Steering committee: Olav Engebråten, Bjørn Naume, Erik Løkkevik, Erik Wist, Tone Ik Dahl, Anne Fangberget, Marit Muri Holmen)



CLINICAL RESEARCH | *Section manager: Bjørn Edwin, MD, PhD***IMAGE GUIDED GENERAL SURGERY AND INTERVENTION***Group leader: Bjørn Edwin, MD, PhD*

Several new techniques in laparoscopic surgery have been introduced in Norway through this group. Some of the methods are now routine procedures, like laparoscopic adrenalectomy and laparoscopic prostatectomy. The group validates new procedures and establishes effective training.

Education programs in minimal invasive surgery in both gastrointestinal- and urological surgery are organized in collaboration with other hospitals in Norway, Sweden, Russia and Denmark.

The Department of Surgery is one of our main collaborators with research projects ongoing in:

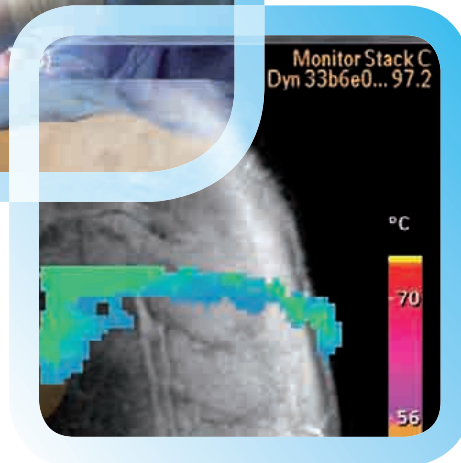
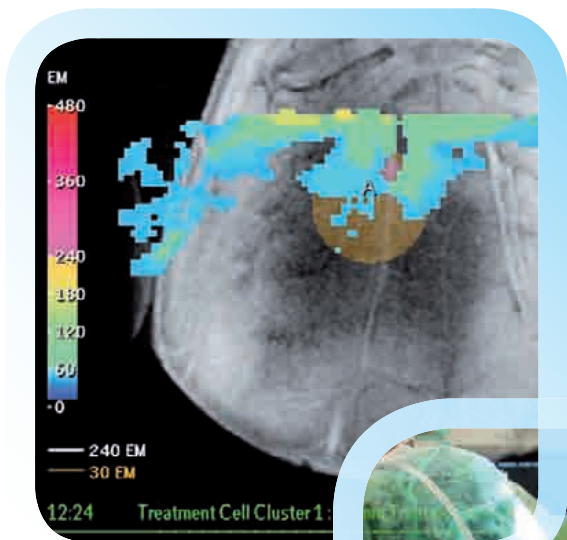
- Minimal invasive surgery on the liver, pancreas, stomach, oesophagus, kidney, adrenal gland and colon/rectum
- Minimal invasive techniques in children
- Thermal liver ablation (HIFU and RF)

PhD students:

Irina Pavlik Mangos, MD, Airazat M. Kazaryan, MD
 Martin Johanson, MSc, Tom Nordby, MD
 Åsmund Avdem Fretland, MD, M Spasojevic, MD
 Kim Vidar Ånonsen, MD, Rahul Prasanna Kumar, MSc
 Brith Andersen, MSc

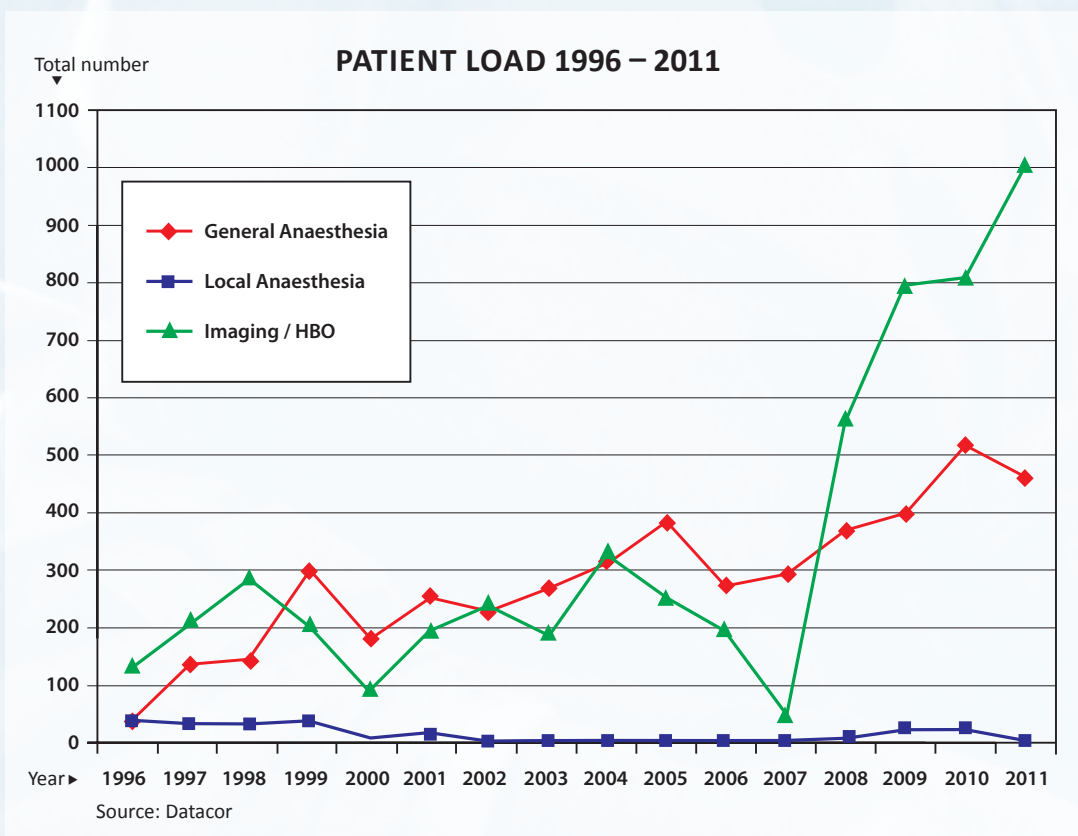
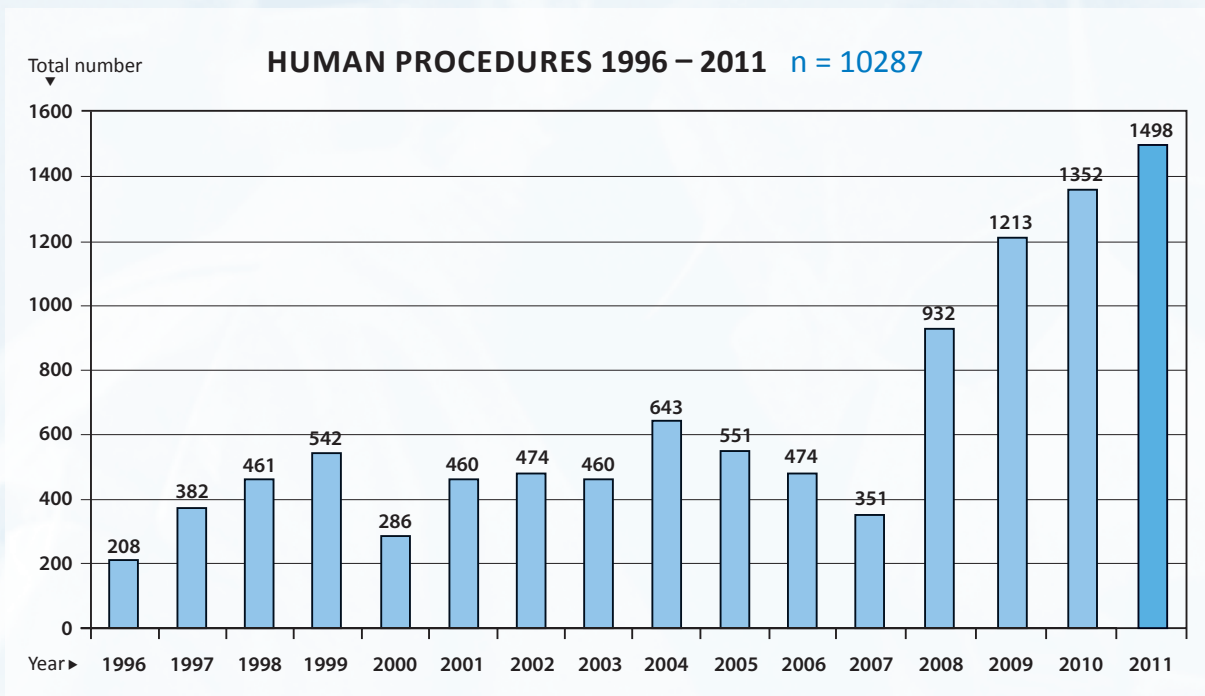
Ongoing projects	Project leader	Funding source
Extracorporeal high intensity focused ultrasound ablation of liver malignancies	Bjørn Edwin	Norwegian Cancer Society (NCS)
Minimal invasive techniques in the treatment of patients with lesions in the endocrine organs of the abdomen	Bjørn Edwin	Other External
Percutaneous access and connection to visceral organs	Bjørn Edwin	NFR, Gothenburg University
CoMet (Randomization between laparoscopic and open liver resection for colorectal metastasis)	Bjørn Edwin	South-East Regional Health Authority

Project-participation	Participant	Project leader
Pancreas in tumors – investigation and clinical care the role of surgery in the treatment pancreatic cancer	Bjørn Edwin, co-mentor PhD study	Trond Buanes
DIVID (Diabetes – caused by virus?)	Bjørn Edwin	Knut Dal Jørgensen
The anatomical/surgical consequences of right colectomy for cancer	Bjørn Edwin, co-mentor PhD study	Dejan Ignjatovic
Managing cystic pancreatic lesions – a challenging task	Bjørn Edwin, co-mentor PhD study	Truls Hauge
Blood vessel visualization and navigation	Bjørn Edwin, co-mentor PhD study	Ole Jakob Elle
Outcomes in patients and their closest relatives treated for congenital heart disease with catheter based or surgical techniques (MEQC)	Erik Fosse, professor, MD	Brith Andersen



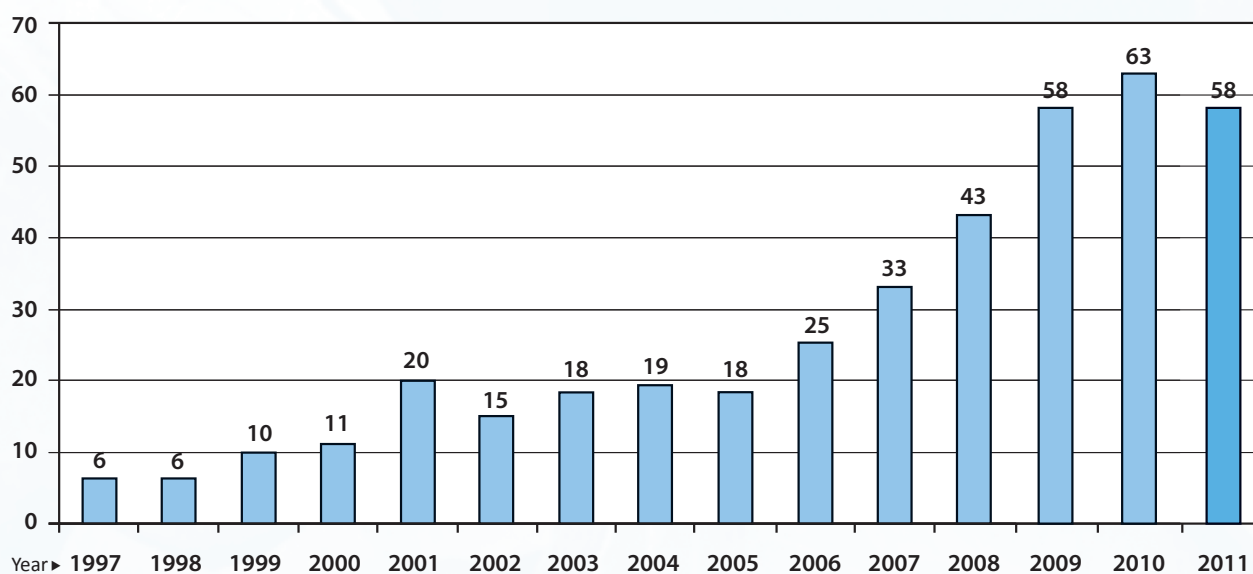
Scientific statistics

The Intervention Centre 2011

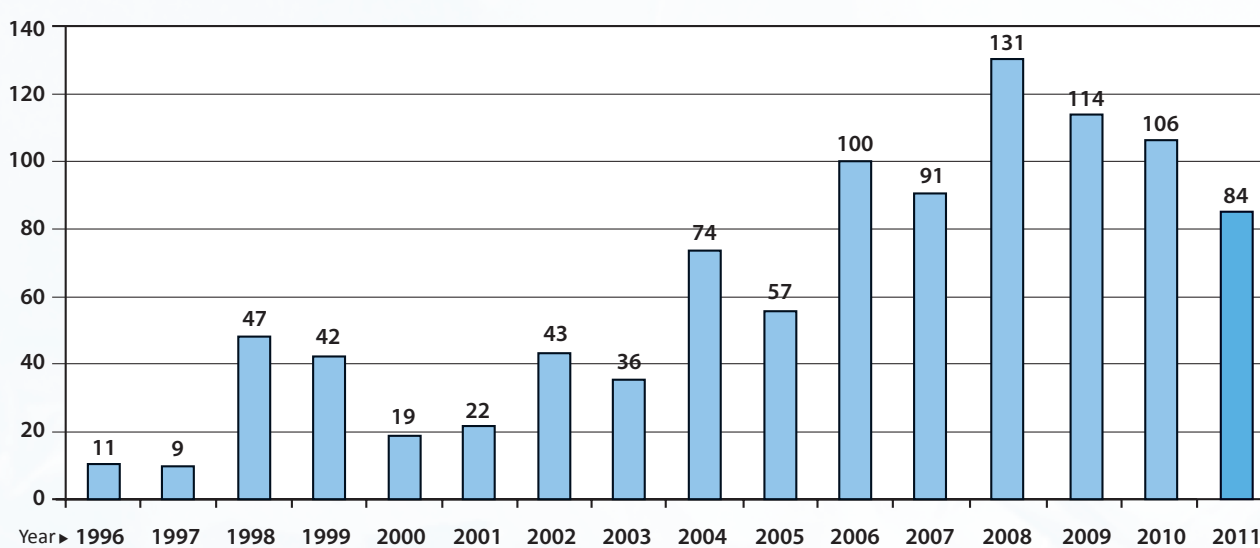




Total number

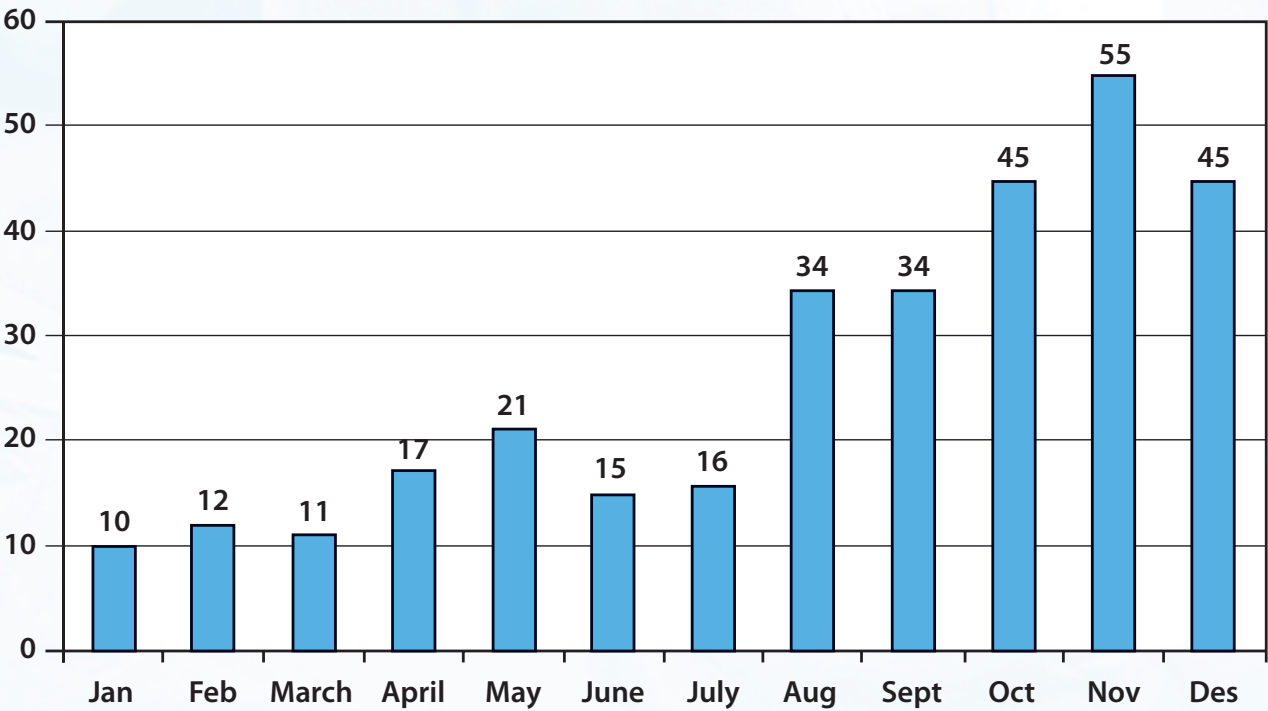
PEER REVIEWED SCIENTIFIC PAPERS 1997 – 2011 $n = 403$ 

Total number

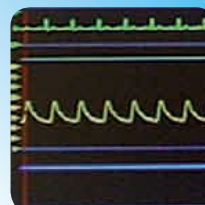
TEST ANIMALS 1996 – 2011 $n = 986$ 

Number
of tests
▼

QUALITY ASSURANCE TESTS PERFORMED IN 2011 Total = 315



Regional radiological equipment quality assurance tests



Academic partners



NATIONAL ACADEMIC PARTNERS

HAUKELAND UNIVERSITY HOSPITAL

Department of Radiology

Jarle Rørvik

Towards clinical application of MR Renography

Pediatric Section

Department of Radiology

Eva Platou Holsen

Optimization of image quality and dose in pediatric radiology

NORWEGIAN SCHOOL OF VETERINARY SCIENCE

Department of Companion Animal Clinical Sciences

Prof. Lars Moe

NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY (NTNU)

Faculty of Medicine

Medical Imaging Laboratory (MI-Lab)

Prof. Olav Haraldset

Norwegian Research school in medical imaging

St. Olavs Hospital

Assoc prof. Asta Håberg

New statistical methods for improved characterization of gliomas

Operating Room of the Future (FOR)

Dr.med Ronald Mårvik

Department of Electronics and Telecommunications

Prof. Tor Ramstad,

Prof. Andrew Perkis, Prof. Geir Øien

Projects: SAMPOS, WISENET, MELODY
Topics: Signal processing algorithms, wireless sensor network, multimedia patient record systems. Supervision of several MSc and PhD students

Department of Computer and Information Science

Prof. Richard Blake, Prof. Hery Ramampiaro

Project: Medical Record

Topics: Image processing, data graphics, medical journal indexing and search engines. MSc student supervision

Department of Engineering Cybernetics

Associate professor Øyvind Stavdal

Robotic technique and ultrasound

OSLO UNIVERSITY COLLEGE

Institute of Radiography and bioengineering

Dean Agnes Vinorum

Post graduating course in CT

Institute of electroengineering

Peyman Mirtaheeri

UNIVERSITY HOSPITAL STAVANGER

Department of Radiology

Kathinka Kurz

Characterization of breast tumors using MR mammography

UNIVERSITY OF BERGEN

Faculty of Mathematics and Natural Sciences

Dean Dag Rune Olsen

The possibilities of reducing radiation dose and improve image quality in CT diagnostics using advanced image processing

UNIVERSITY OF OSLO (UIO)**FACULTY OF MATHEMATICS
AND NATURAL SCIENCES****Centre of Mathematics for Applications***Prof. Knut Mørken*Mathematical methods supporting
minimally invasive therapy in medicine**Department of Informatics***Prof. Jim Tørresen Prof. Morten Dæhlen,**Prof. Tor Sverre Lande, Prof. Olaf Owe,**Prof. Einar Borch Johnsen*

Projects: MELODY, CONNECT

Topics: Image processing, visualisation,
microelectronics, modelling and analysis**Department of Physics***Prof. Eirik Malinen*

Radiation therapy

Prof. Hilde M. Olerud

Diagnostic physics

*Prof. Eivind Bolle*Development of a MR-compatible
small-animal PET*Prof. Sverre Grimnes**Prof. Ørjan G. Martinsen*

Bioelectrical properties of human tissue

Development of a skin moisture sensor.

Two PhD programs

Department of Chemistry*Prof. Svein Stølen, PET-CT**Prof. Per Hoff, PET-CT**Prof. Helmer Fjellvåg*

Nanostructures and Functional Materials

TiO₂-Bactericidal surfaces-Photo catalysis**The School of Pharmacy,
Department of Pharmacy***Prof. Jan Karlsen*Development of a radio-active gel
for bowel tumour treatment**FACULTY OF MEDICINE****The small-animal PET facility***Prof. Jan G. Bjaalie*

PET-CT

Akershus University Hospital**Department of Surgery***Dejan Ignjatovic*

D3 resection

Department of Anatomy*Ass Prof. Trygve Brauns Leergaard*

Brain and nervous system

Department of Nutrition*Prof. Christian A Drevon**Prof. Per Ole Iversen*

Brain growth and maturation

in premature infants

FACULTY OF SOCIAL SCIENCES**Department of psychology***Assoc. prof. Tor Endestad**Prof Svein Magnussen*

Cognitive function and fMRI

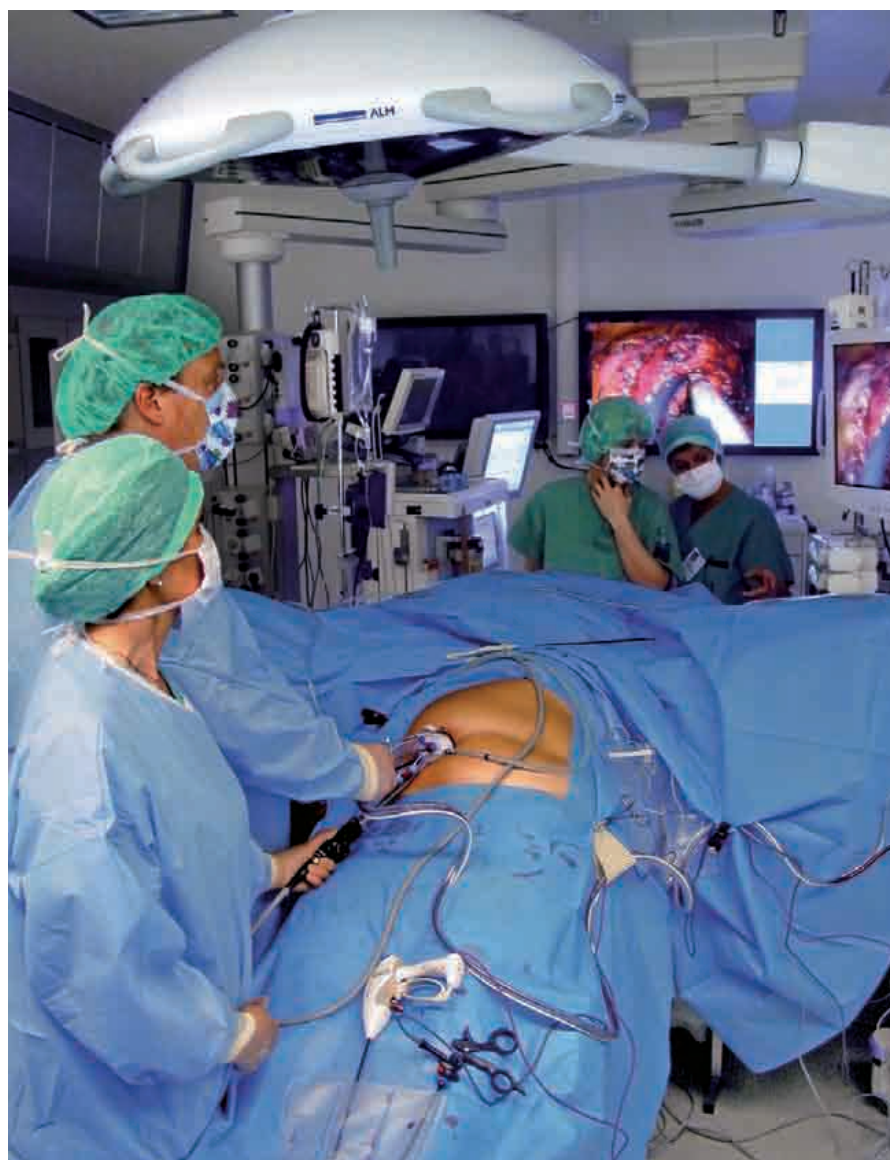
Prof Anders Fjell

fMRI, MR morphometry

and diffusion tensor imaging

Institute of psychiatry*Prof. Ole Andreassen*Neuroplasticity in patients with
bipolar disorders**VESTFOLD UNIVERSITY COLLEGE
HORTEN****Centre for Micro technology***Assoc. Prof. Henrik Jacobsen*

Micro-heart



Academic partners

INTERNATIONAL ACADEMIC PARTNERS

AARHUS UNIVERSITY HOSPITAL THE PET CENTRE, DENMARK

Contact person: Ole Munk

Testing different reconstruction algorithms for reconstruction of small objects

ATHINOULA A. MARTINOS CENTER FOR BIOMEDICAL IMAGING MGH / HARVARD MEDICAL SCHOOL BOSTON, USA

Contact person: Prof. A. Gregory Sorensen

DEPARTMENT OF RADIOLOGY, BRIGHAM AND WOMEN'S HOSPITAL, HARVARD UNIVERSITY, BOSTON, USA

Contact person: Prof. William Wells

Non-rigid image registration
Perfusion mapping of tumours

ECOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE (EPFL), SWITZERLAND

Contact person: Dr. Catherine Dehollain
Collaboration in the ULTRASponder, EU project on ultrasonic communications

EURECOM, SOPHIA-ANTIPOLIS, FRANCE

Contact person: Prof. Raymond Knopp
MELODY project: Sensor Network

FAKULTINI NEMOCINE U SV. ANNY BRNE, CZECH REPUBLIC

Contact person: Dr. Thomas Kara
IIIOS

GRAZ UNIVERSITY OF TECHNOLOGY, INSTITUTE OF BIOMECHANICS, CENTER OF BIOMEDICAL ENGINEERING GRAZ, AUSTRIA

Contact persons: Professor Gerard Holzapfel, Dr. David M. Pierce
SCath

GÖTEBORGS UNIVERSITET, INSTITUTION FÖR KLINISKE VETENSKAPER, SWEDEN

Contact person:

Prof. Peter Thomsen, MD PhD
Oostomy device

IMPERIAL COLLEGE LONDON, UK

Contact person:

Professor Guang-Zhong Yang
SCath

LINKÖPING UNIVERSITY, SWEDEN

Contact person: Prof. Erik G Larsson

MELODY project: Robust communications

NATIONAL INSTITUTE OF ICT YOKOSUKA, JAPAN

Contact person: Prof. Huan-Bang Li

MELODY project: Implantable sensor communications



Photo: Brasiliao / Shutterstock.com

**RISÖ, DENMARK**

Contact person: Mikael Jensen

Development and testing of
64Cu-labelled compounds

**ROYAL INSTITUTE OF TECHNOLOGY
STOCKHOLM, SWEDEN**

Contact person: Prof. Mikael Skoglund

MELODY project: Robust communications

**SAHLGRENSKA UNIVERSITY HOSPITAL
THE COLORECTAL UNIT,
GOTHENBURG, SWEDEN**

Contact person: Prof. Leif Hultén, MD PhD

Oostomy device

**SCHOOL OF COMPUTER AND
COMMUNICATION SCIENCES,
ECOLE POLYTECHNIQUE FÉDÉRALE
DE LAUSANNE (EPFL), SWITZERLAND
and****DEPARTMENT OF ELECTRICAL
ENGINEERING, UNIVERSITY OF
CALIFORNIA, BERKELEY, USA**

Contact person: Prof. Martin Vetterli

Collaboration in the SAMPOS and
WISENET projects on signal processing
in sensor nodes.

**STAVANGER UNIVERSITY HOSPITAL
NORWAY**

Contact person: Katinka Kurz

Collaboration in Split dynamic DCE MR
mammography

**TECHNICAL UNIVERSITY OF DELFT
THE NETHERLANDS**

Contact person: Prof. Jenny Dankelman
IIIOS

**THE KATHOLIEKE UNIVERSITEIT
LEUVEN, BELGIUM**

Contact persons: Professor

Jos Vander Sloten, Mauro Sette

SCath Project

**UNIVERSITY OF BRITISH COLUMBIA
VANCOUVER, CANADA**

Contact person: Prof. Victor Leung

MELODY project: Sensor networks

**UNIVERSITY OF CALIFORNIA
SAN DIEGO, USA**

Contact person: Prof Anders Dale

Novel methods for quantification of
tumor growth

**UNIVERSITY OF CALIFORNIA
SANTA BARBARA, USA**

Contact person: Prof. Ken Rose

MELODY project: joint source-channel
coding and modulations

UNIVERSITY OF DUNDEE, UK

Contact person: Prof. Andreas Melzer

Professor Sir Alfred Cushieri

IIIOS

**UNIVERSITY OF HEIDELBERG
GERMANY**

Contact person: Frank Zoellner

Novel statistical methods for predictive
modeling of tumor grade

**UNIVERSITY OF HOMBURG SAAR
GERMANY**

Contact person: Prof. Arno Bucker

IIIOS

**UNIVERSITY OF LÜBECK
GERMANY**

Contact person: Prof. Hartmut Gehring

IIIOS

**UNIVERSIDAD POLITÉCNICA
DE MADRID, SPAIN**

Contact person: Prof. Enrique J. Gomez

SCath

**UNIVERSITY OF WÜRZBURG
GERMANY**

Contact person: Prof Herbert Köstler

UPPSALA UNIVERSITY, SWEDEN

Contact person: Prof. Anders Rydberg

MELODY project: Ultra wide band
antennas

UPPSALA UNIVERSITY, SWEDEN

Contact person: Prof. Håkan Ahlström

MR based Quantitative perfusion analysis

**ZÜRCHER HOCHSCHULE FÜR
ANGEWANDTE WISSENSCHAFTEN
SWITZERLAND**

Contact person:

Prof. Hans Wernher van de Venn

SCath



Commercial partners



ABB CORPORATE RESEARCH

Oslo, Norway

Contact person: Pål Orten

Collaboration in the SAMPOS, WISENET, MELODY projects on robust wireless communications

ART TEKNIKK AS

Contact person: Arild Brandt
Operating Room Light

CANCER CURE AS

Oslo, Norway

Contact person: Gunnar Myhr CEO

Collaboration for development of a system for targeted drug delivery under MR guidance. Other partners: Institute for Cancer research

CARDIACCS AS

Oslo, Norway

Contact person: Harald Dugstad

Sensors measuring cardiac function

CORTECHS LABS

San Diego, USA

Contact person: Anders Dahle

Novel methods for quantification of tumor growth

DIPS-EVICARE

Contact person: Øystein Eiring

Evidence-based care processes: Integrating knowledge in clinical information systems

ENDONSENSE SA

Geneva, Switzerland

Contact person: Giovanni Leo
Catheter navigation system

EXIT BUSINESS SUPPORT CENTRE

Banja Luka, Bosnia

Contact person: Zoran Gajic

Improving governance and interethnic cooperation in BiH through eHealth

FERMIO

Stockholm, Sweden

Contact person: Prof. Truls Nordby

TiO₂-Bactericidal surfaces-
Photo catalysis

GE HEALTHCARE

Stockholm, Sweden

Contact person: Dr. Bengt Nielsen
IIOS. Image guided surgery

GE VINGMED-SOUND

Horten, Norway

Contact person: Gunnar Hansen

Development of ultra sound equipment for cardiology

HEALTHY POINTERS

Oslo, Norway

Contact person: Stian Aldrin

Pointing device for laparoscopic surgery

HOLOGIC

Contact person: Loren Nicholson

Tomosynthesis in digital mammography

HOSPITALITY AS

Oslo, Norway

Contact person: Flemming Bo Hegerstrøm

Project: MELODY

Bedside computer terminal

IBM HEALTHCARE

Kolbotn, Norway

Contact persons: Jan Fredrik Sagdahl

& Frode Tveit

Project: MELODY

Sensor network infrastructure

**KONGSBERG SIM****Kongsberg, Norway**

Contact person: Øyvind Rideng
Systems in Motion provides the project with a 3Dgraphics library. Their responsibility in the project is parallelized 3D rendering

LIFECARE AS**Bergen, Norway**

Contact person: Dr. Erik Johannessen

MEDTRONIC**BAKKEN RESEARCH CENTER
the Netherlands**

Contact person: Dr. Rogier Receveur
Collaboration in the ULTRASponder, EU project on heart sensors

MR:COMP**Gelsenkirchen, Germany**

Contact person: Gregor Schaefer
IIIOS. Image guided therapy

MULTIHOPP COMMUNICATIONS**Oslo, Norway**

Contact person: Niels Aakvaag
WISENET and MELODY. Robust wireless communications

NANO ROCKS**Oslo, Norway**

Contact person: Stian Hauge
Photocatalytic products

NORDICNEUROLAB AS**Bergen, Norway**

Contact persons: Lars Ersland,
Yngve Kvinnsland, Øyvind Gulbrandsen
Development of comprehensive software package for advanced functional image analysis

NORDIC NANOVECTORS

Development of new radiopharmaca for internal radionuclide treatment

NORWEGIAN COMPUTING CENTER**Oslo, Norway**

Contact person: Dr. Wolfgang Leister
SAMPOS. Security and authentication platform in wireless sensor systems

**NORWEGIAN DEFENSE RESEARCH
ESTABLISHMENT (FFI)**

Contact persons: Prof. Torleiv Maseng
& Prof. Svein Erik Hamran
MELODY project. Medical radar

NOVELDA AS**Oslo, Norway**

Contact person: Eirik Næss-Ulseth
MELODY. Medical radar
WIRED. Ultra wide band impulse radio platform for medical communications and remote sensor

OPTINOSE AS**Norway**

Contact person: Per Djupesland
PET-CT project

OSTOMYCURE**Oslo, Norway**

Contact person: Martin Johansson
Development of medical implants

PHILLIPS MEDICAL SYSTEMS**Oslo, Norway**

Contact person: Jørn Kværnes
Development of systems for MR-guided interventions and surgery

PROSURGICS LTD, HIGH WYCOMBE**United Kingdom**

Contact person: Patrick Finley
Neurosurgical robot PathFinder

PUBGENE AS**Oslo, Norway**

Contact person: Eirik Næss-Ulseth
Coremine Medical. Medical search engine

SECTRA AB**Linköping, Sweden**

Integration of in-house developed software into hospital PACS

SETRED AS

Contact person: Christian Møller
Radiology 3D screen

SHARPVUE AB**Linköping, Sweden**

Contact person: Annie Forsberg
CT image post-processing

SIEMENS MEDICAL IMAGING**Erlangen, Germany**

Contact person: Lutz Bluhm
Integration of the Zeego angiographic system in the OR.

SIMSURGERY AS**Oslo, Norway**

Contact person: M.D. Vidar Sørhus
Surgical simulator

SINTEF HEALTH**Trondheim, Norway**

Contact person: Professor
Torill Nagelhus Hærnes
IIIOS. Image guided therapy

SINTEF ICT**Trondheim, Norway**

Contact person: Knut Grythe
SAMPOS. Quality of Service metric in wireless sensor network

SINTEF ICT**Medical White Board****SOLSYSTEM AS**

Contact person: Per Berg
Photocatalytic Processes

SORIN GROUP**France**

Contact person: Dr. Renzo Dal Molin
MELODY. Medical radar. Wireless heart sensor.

THE ALLOY**Medical White Board****THE HEVESY LABORATORIES****Risø, Denmark**

Managing Director: Mikael Jensen

**THE NORWEGIAN MEDICAL
CYCLOTRON CENTRE****Oslo, Norway**

Contact person: Hans Erik Lie







Budget and expenditures

The Intervention Centre 2011

INTERNAL HOSPITAL FUNDS ADMINISTERED BY THE INTERVENTION CENTRE IN 2011

	BUDGET	EXPENDITURE
Payroll expences	23.514.000	
Other operating expences	4.252.000	
Sum internal finance	37.387.000	37.305.322

EXTERNAL FUNDS ADMINISTERED BY THE INTERVENTION CENTRE IN 2011

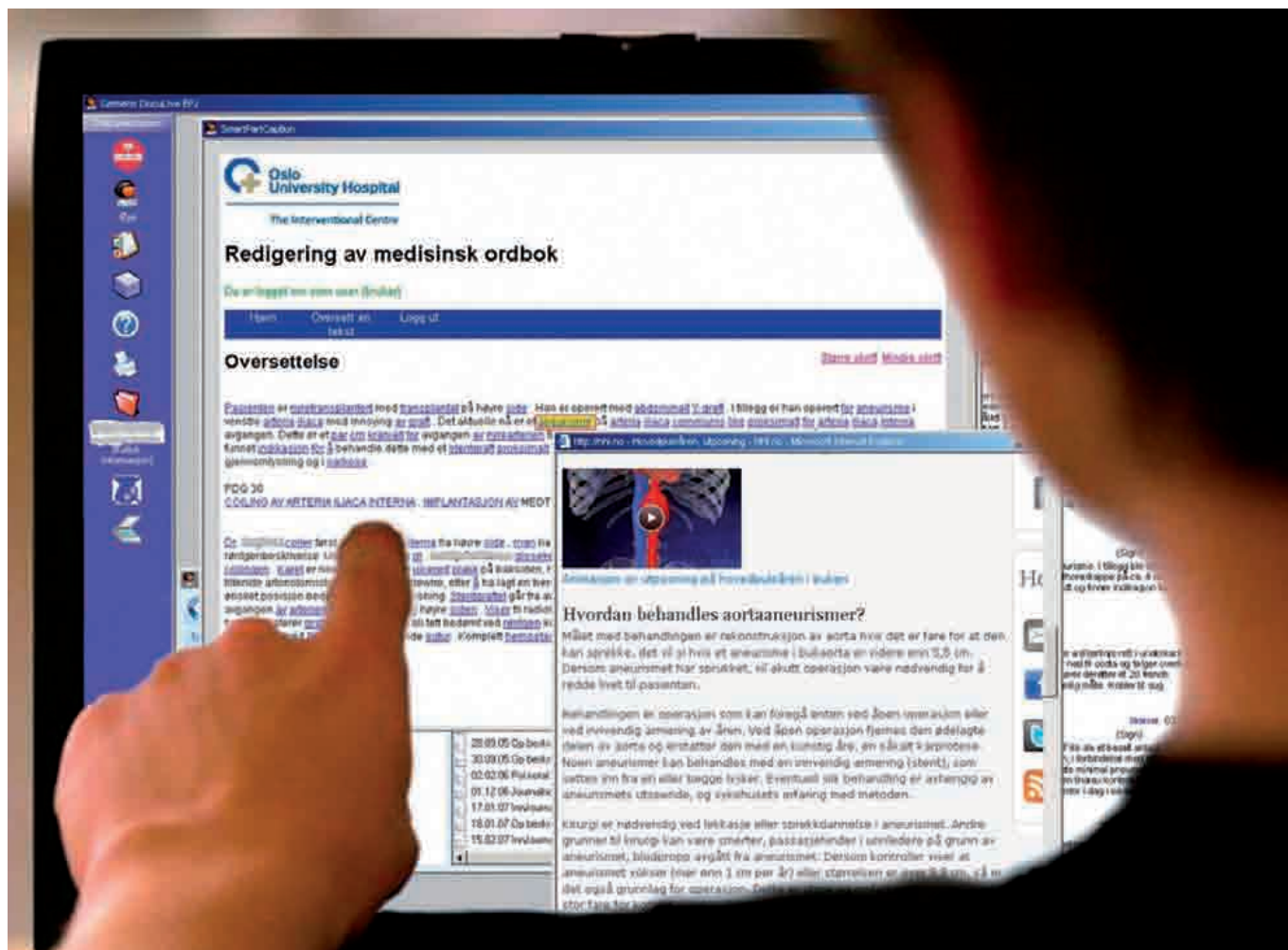
SOURCE	INCOME	EXPENDITURE
Research Council of Norway	8.225.954	
Regional Health Authority	4.027.000	
European Commission	3.904.119	
University of Oslo	520.000	
Research- and pending expenditures		9.307.000



Publications

Scientific publications¹ from The Interventional Centre 2011 – 1997

¹ Scientific channels are journals, series and publishers that fulfill specific criteria given by the Norwegian register for scientific journals, series and publishers (NSD: www.dbh.nsd.uib.no/kanaler). There are two levels: **Ordinary publication channels** (level 1) and **highly prestigious publication channels** (level 2).



2011

Level 2 publications

1. *Bjornerud A, Sorensen AG, Mouridsen K, Emblem KE.*
T(1)- and T(2)(*)-dominant extravasation correction in DSC-MRI: Part I – theoretical considerations and implications for assessment of tumor hemodynamic properties.
J Cereb Blood Flow Metab 2011 Oct;31(10):2041-53.
2. *de Lange C, Brabrand K, Emblem KE, Bjornerud A, Loberg EM, Saugstad OD, Munkeby BH.*
Cerebral perfusion in perinatal hypoxia and resuscitation assessed by transcranial contrast-enhanced ultrasound and 3 T MRI in newborn pigs.
Invest Radiol 2011 Nov;46(11):686-96.
3. *Emblem KE, Bjornerud A, Mouridsen K, Borra RJ, Batchelor TT, Jain RK, Sorensen AG.*
T(1)- and T(2)(*)-dominant extravasation correction in DSC-MRI: part II-predicting patient outcome after a single dose of cediranib in recurrent glioblastoma patients.
J Cereb Blood Flow Metab 2011 Oct;31(10):2054-64.
4. *Kazaryan AM, Rosok BI, Marangos IP, Rosseland AR, Edwin B.*
Comparative evaluation of laparoscopic liver resection for posterosuperior and anterolateral segments.
Surg Endosc 2011 Dec;25(12):3881-9.
5. *Pavlik M, I, Rosok BI, Kazaryan AM, Rosseland AR, Edwin B.*
Effect of TachoSil patch in prevention of postoperative pancreatic fistula.
J Gastrointest Surg 2011 Sep;15(9):1625-9.

6. Tamnes CK, Fjell AM, Ostby Y, Westlye LT, Due-Tønnessen P, Bjørnerud A, Walhovd KB. **The brain dynamics of intellectual development: waxing and waning white and gray matter.** *Neuropsychologia* 2011 Nov;49(13):3605-11.
7. Wibe T, Hellesø R, Slaughter L, Ekstedt M. **Lay people's experiences with reading their medical record.** *Soc Sci Med* 2011 May;72(9):1570-3.

Level 1 publications

1. Awan ZA, Haggblad E, Wester T, Kvernebo MS, Halvorsen PS, Kvernebo K. **Diffuse reflectance spectroscopy: Systemic and microvascular oxygen saturation is linearly correlated and hypoxia leads to increased spatial heterogeneity of microvascular saturation.** *Microvasc Res* 2011 May;81(3):245-51.
2. Barratt-Due A, Johansen HT, Sokolov A, Thorgersen EB, Hellerud BC, Reubsæet JL, Seip KF, Tønnessen TI, Lindstad JK, Pharo A, Castellheim A, Mollnes TE, Nielsen EW. **The role of bradykinin and the effect of the bradykinin receptor antagonist icatibant in porcine sepsis.** *Shock* 2011 Nov;36(5):517-23.
3. Bergsland J, Mujanovic E, Elle OJ, Mirtaheri P, Fosse E. **Minimally invasive repair of the mitral valve: Technological and clinical developments.** *Minim Invasive Ther Allied Technol* 2011 Apr;20(2):72-7.
4. Brekke OL, Hellerud BC, Christiansen D, Fure H, Castellheim A, Nielsen EW, Pharo A, Lindstad JK, Bergseth G, Leslie G, Lambris JD, Brandtzaeg P, Mollnes TE. **Neisseria meningitidis and Escherichia coli are protected from leukocyte phagocytosis by binding to erythrocyte complement receptor 1 in human blood.** *Mol Immunol* 2011 Sep;48(15-16):2159-69.
5. Coello C, Hjørnevik T, Courivaud F, Willoch F. **Anatomical standardization of small animal brain FDG-PET images using synthetic functional template: Experimental comparison with anatomical template.** *J Neurosci Methods*, 199 (1), 166-72.
6. Djenouri D, Balasingham I. **Traffic-Differentiation-Based Modular QoS Localized Routing for Wireless Sensor Networks.** *IEEE Transactions on Mobile Computing* 2011; 10(6):797-809.
7. Edwin B, Nordin A, Kazaryan AM. **Laparoscopic liver surgery: New frontiers.** *Scand J Surg* 2011;100(1):54-65.

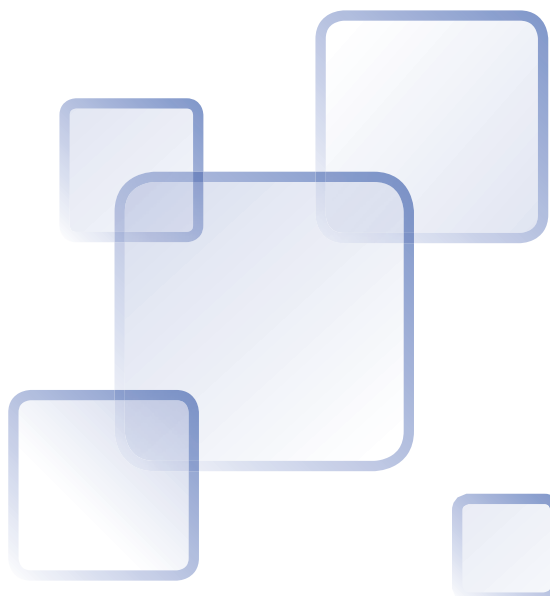


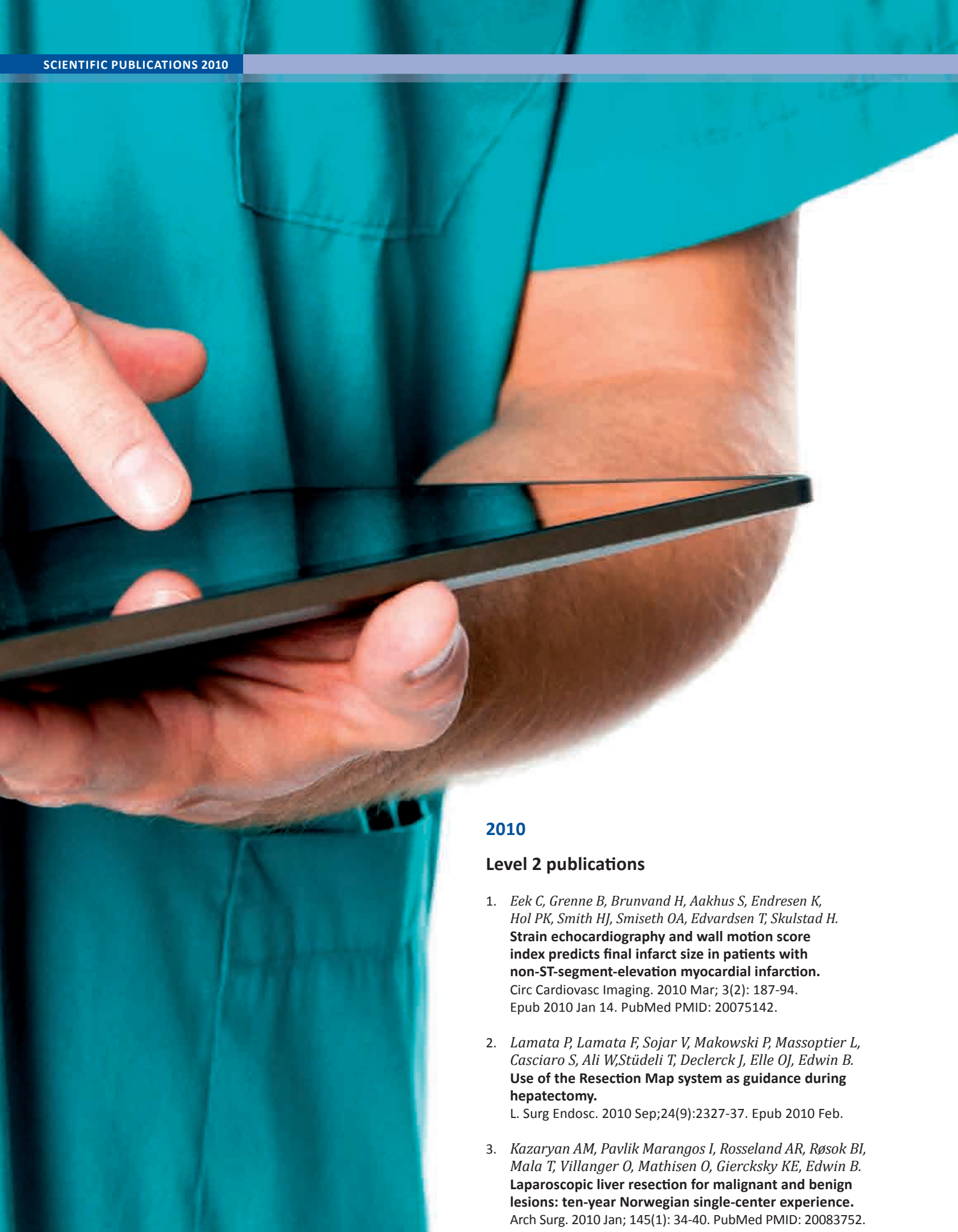
8. Espinoza A, Halvorsen PS, Skulstad H, Lundblad R, Bugge JF, Hoff L, Fosse E, Edvardsen T. **Automated detection of myocardial ischaemia by epicardial miniature ultrasound transducers – a novel tool for patient monitoring during cardiac surgery.** *Eur J Cardiothorac Surg* 2011 Jan;39(1):53-9.
9. Espinoza A, Rosseland LA, Hovdenes J, Stubhaug A. **Paratracheal placement of orotracheal tube: A complication when aborting percutaneous tracheotomy.** *Acta Anaesthesiol Scand* 2011 Aug;55(7):897-8.
10. Garzon B, Emblem KE, Mouridsen K, Nedregaard B, Due-Tønnessen P, Nome T, Hald JK, Bjørnerud A, Haberg AK, Kvinnsland Y. **Multiparametric analysis of magnetic resonance images for glioma grading and patient survival time prediction.** *Acta Radiol* 2011 Nov 1;52(9):1052-60.
11. Grenne B, Eek C, Sjøli B, Dahlslett T, Hol PK, Orn S, Skulstad H, Smiseth OA, Edvardsen T, Brunvand H. **Mean strain throughout the heart cycle by longitudinal two-dimensional speckle-tracking echocardiography enables early prediction of infarct size.** *J Am Soc Echocardiogr* 2011 Oct;24(10):1118-25.
12. Halvorsen FH, Fosse E, Mjaland O. **Unsupervised virtual reality training may not increase laparoscopic suturing skills.** *Surg Laparosc Endosc Percutan Tech* 2011 Dec;21(6):458-61.
13. Jensen K, Zangani L, Martinsen AC, Sandbaek G. **Changes in dose-area product, entrance surface dose, and lens dose to the radiologist in a vascular interventional laboratory when an old X-ray system is exchanged with a new system.** *Cardiovasc Intervent Radiol* 2011 Aug;34(4):717-22.
14. Johansson ML, Thomsen P, Hulten L, Halvorsen PS, Fosse E, Edwin B. **Integration between a percutaneous implant and the porcine small bowel.** *J Biomed Mater Res B Appl Biomater* 2011 Jul;98(1):101-9.
15. Björnsson O, Morell A, Zemgulis V, Lundström E, Tøvedal T, Einarsson GM, Thelin S, Ahlström H, Bjørnerud A, Lennmyr F. **Minimal safe arterial blood flow during selective antegrade cerebral perfusion at 20 degrees centigrade.** *Ann Thorac Surg* 2011 Apr;91(4):1198-205.

16. *Kazaryan AM, Marangos IP, Rosok BI, Rosseland AR, Edwin B.*
Impact of Body Mass Index on Outcomes of Laparoscopic Adrenal Surgery.
Surg Innov. 2011 Dec;18(4):358-67.
17. *Khaleghi A, Balasingham I, Chavez-Santiago R.*
Computational study of ultra-wideband wave propagation into the human chest.
IET Microwaves, Antennas & Propagation 2011;5(5):559-67.
18. *Khaleghi A, Farahani HS, Balasingham I.*
Impulse Radiating Log-Periodic Dipole Array Antenna Using Time-Reversal Technique.
IEEE Antennas and Wireless Propagation Letters 2011;10:967-70.
19. *Khaleghi A, Chavez-Santiago R, Balasingham I.*
Ultra-wideband statistical propagation channel model for implant sensors in the human chest.
IET Microwaves, Antennas & Propagation 2011;5(15):1805-12.
20. *Knudtsen IS, Rodal J, Brustugun OT, Helland A, Skretting A, Malinen E.*
Dynamic respiratory gate(18)FDG-PET of lung tumors – a feasibility study.
Acta Oncol 2011 Aug;50(6):889-96.
21. *Kycina R, Edwin B, Sutiak L, Strelka L, Szepe P, Mikolajcik A, Drgova M, Vojtko M, Mistuna D.*
[Laparoscopic distal pancreatectomy for neuro-endocrine pancreatic tumors – initial experience].
Rozhl Chir 2011 Mar;90(3):200-6.
22. *Malinen E, Røddal J, Knudtsen IS, Søvik Å, Skogmo HK (2011).*
Spatiotemporal analysis of tumor uptake patterns in dynamic (18)FDG-PET and dynamic contrast enhanced CT.
Acta Oncol, 50 (6), 873-82.
23. *Mujanovic E, Bergsland J, Juncic S, Avdic S, Stanimirovic-Mujanovic S, Kabil E*
Calcified right atrial and pulmonary artery mass after ventriculoatrial shunt insertion.
Med Arh, 65 (6), 363-4.
24. *Mujanovic E, Bergsland J, Tursic A, Stanimirovic-Mujanovic S, Kabil E.*
Coronary bypass grafting without use of cardiopulmonary bypass for dextrocardia.
Med Arh 2011;65(1):56-7.
25. *Ramm-Pettersen J, Berg-Johnsen J, Hol PK, Roy S, Bollerslev J, Schreiner T, Helseth E.*
Intra-operative MRI facilitates tumour resection during trans-sphenoidal surgery for pituitary adenomas.
Acta Neurochir (Wien), 153 (7), 1367-73.
26. *Revheim ME, Roe K, Bruland OS, Bach-Gansmo T, Skretting A, Seierstad T.*
Monitoring the effect of targeted therapies in a gastro-intestinal stromal tumor xenograft using a clinical PET/CT.
Mol Imaging Biol 2011 Dec;13(6):1234-40.
27. *Server A, Graff BA, Orheim TE, Schellhorn T, Josefsen R, Gadmar OB, Nakstad PH.*
Measurements of diagnostic examination performance and correlation analysis using microvascular leakage, cerebral blood volume, and blood flow derived from 3T dynamic susceptibility-weighted contrast-enhanced perfusion MR imaging in glial tumor grading.
Neuroradiology 2011 Jun;53(6):435-47.
28. *Server A, Kulle B, Gadmar OB, Josefsen R, Kumar T, Nakstad PH.*
Measurements of diagnostic examination performance using quantitative apparent diffusion coefficient and proton MR spectroscopic imaging in the preoperative evaluation of tumor grade in cerebral gliomas.
Eur J Radiol 2011 Nov;80(2):462-70.
29. *Shafae Z, Kazaryan AM, Marvin MR, Cannon R, Buell JF, Edwin B, Gayet B.*
Is laparoscopic repeat hepatectomy feasible? A tri-institutional analysis.
J Am Coll Surg 2011 Feb;212(2):171-9.
30. *Slaughter L, Oyri K, Fosse E.*
Evaluation of a Hyperlinked Consumer Health Dictionary for reading EHR notes.
Stud Health Technol Inform 2011;169:38-42.
31. *M, Stimec BV, Gronvold LB, Nesgaard JM, Edwin B, Ignjatovic D.*
The anatomical and surgical consequences of right colectomy for cancer.
Dis Colon Rectum 2011 Dec;54(12):1503-9.
32. *Stenset V, Bjørnerud A, Fjell AM, Walhovd KB, Hofoss D, Due-Tønnessen P, Gjerstad L, Fladby T.*
Cingulum fiber diffusivity and CSF T-tau in patients with subjective and mild cognitive impairment.
Neurobiol Aging 2011 Apr;32(4):581-9.
33. *Thormødsen R, Jensen J, Holmen A, Juuhl-Langseth M, Emblem KE, Andreassen OA, Rund BR.*
Prefrontal hyperactivation during a working memory task in early-onset schizophrenia spectrum disorders: An fMRI study.
Psychiatry Res 2011 Dec 30;194(3):257-62.
34. *Wester T, Haggblad E, Awan ZA, Barratt-Due A, Kvernebo M, Halvorsen PS, Mollnes TE, Kvernebo K.*
Assessments of skin and tongue microcirculation reveals major changes in porcine sepsis.
Clin Physiol Funct Imaging 2011 Mar;31(2):151-8.
35. *Nguyen TH, Balasingham I, Ramstad TA.*
A Wireless Sensor Communication System Based on Direct-Sum Source Coder.
IET Wireless Sensor Systems 2011.
Vol. 1, no. 2, p. 96-104.
36. *Wang Q, Balasingham I, Zhang M, Huang X.*
Improving RSS-Based Ranging in LOS-NLOS Scenario Using GMMs.
IEEE Communications Letters 2011;15(10):1065-7.

Level 1 Int. Conference Proceedings

1. Byun SS, Balasingham I, Vasilako A.
Networks. Proceedings of the Twelfth ACM International Symposium on Mobile Ad Hoc Networking and Computing.
ACM Press; 2011. p. 1-6.
2. Chavez-Santiago R, Balasingham I.
Cognitive Radio for Medical Wireless Body Area Networks.
IEEE 16th International Workshop on Computer Aided Modeling and Design of Communication Links and Networks (CAMAD). IEEE Communications Society; 2011. p. 148-52.
3. Chavez-Santiago R, Øyri K, Støa S, Balasingham I, Fosse E.
Evaluation of the Reliability of Blood Pressure Data Transmission through an IEEE 802.11 Link in the Presence of IEEE 802.15.4 Interference.
4th International Symposium on Applied Sciences in Biomedical and Communication Technologies.
ACM Press; 2011. p. 1-5.
4. Kazemeyni FS, Johnsen EB, Owe O, Balasingham I.
Group Selection by Nodes in Wireless Sensor Networks Using Coalitional Game Theory.
16th IEEE International Conference on Engineering of Complex Computer Systems, ICECCS 2011. IEEE Computer Society; 2011. p. 253-62.
5. Floor PA, Kim AN, Ramstad TA, Balasingham I, Wernersson N, Skoglund M.
Transmitting Multiple Correlated Gaussian Sources over a Gaussian MAC using Delay-Free Mappings.
4th International Symposium on Applied Sciences in Biomedical and Communication Technologies.
ACM Press; 2011.
6. Floor PA, Kim AN, Wernersson N, Ramstad TA, Skoglund M, Balasingham I.
Distributed Zero-Delay Joint Source-Channel Coding for a Bi-Variate Gaussian on a Gaussian MAC.
Proceedings of the European Signal Processing Conference 2011;19:2084-8.
7. Jabbari A, Balasingham I.
Modeling Nano-communication Networks Using Neurocomputing Algorithm.
4th International Symposium on Applied Sciences in Biomedical and Communication Technologies.
ACM Press; 2011.
8. Kim AN, Ramstad TA, Balasingham I.
Very Low Complexity Low Rate Image Coding for the Wireless Endoscope.
4th International Symposium on Applied Sciences in Biomedical and Communication Technologies.
ACM Press; 2011.
9. Mesiti F, Balasingham I.
Novel Treatment Strategies for Neurodegenerative Diseases based on RF exposure.
4th International Symposium on Applied Sciences in Biomedical and Communication Technologies.
ACM Press; 2011.
10. Moussakhani B, Balasingham I, Chavez-Santiago R.
Multi Model Tracking for Localization in Wireless Capsule Endoscope.
ISABEL 2011 Conference Proceedings. ACM Press; 2011.
11. Moussakhani B, Flåm JT, Balasingham I, Ramstad TA.
On the CRLB for source localization in a lossy environment.
Proceedings of IEEE SPAWC, 2011. IEEE Signal Processing Society; 2011. p. 151-5.
12. Sarbandi Farahani H, Khelegheh A, Balasingham I.
A Novel Approach for Dispersion Engineering of an LPDA Antenna Based on Time reversal Technique.
Antennas and Propagation Conference (LAPC), 2011 Loughborough. IEEE Communications Society; 2011.
13. Solberg LE, Hamran SE, Balasingham I.
Realistic Simulations of Aorta Radius Estimation.
4th International Symposium on Applied Sciences in Biomedical and Communication Technologies.
ACM Press; 2011.
14. Chávez-Santiago R, Øyri K, Støa S, Balasingham I, Fosse E.
Experimental Assessment of Interference in the 2.4 GHz ISM Band from Wireless Medical Sensors on the Imaging System of an Advanced Operating Room.
The IEEE Asia Pacific EMC Symposium, 2011. p. 1-4.
15. Greisiger R, Tvete O, Shallop J, Elle OJ, Hol PK, Jablonski GE.
Cochlear implant-evoked electrical auditory brainstem responses during surgery in patients with auditory neuropathy spectrum disorder.
Cochlear Implants Int 2011 May;12 Suppl 1:S58-S60.





2010

Level 2 publications

1. *Eek C, Grenne B, Brunvand H, Aakhus S, Endresen K, Hol PK, Smith HJ, Smiseth OA, Edvardsen T, Skulstad H.*
Strain echocardiography and wall motion score index predicts final infarct size in patients with non-ST-segment-elevation myocardial infarction.
Circ Cardiovasc Imaging. 2010 Mar; 3(2): 187-94.
Epub 2010 Jan 14. PubMed PMID: 20075142.
2. *Lamata P, Lamata F, Sojar V, Makowski P, Massoptier L, Casciaro S, Ali W, Stüdeli T, Declerck J, Elle OJ, Edwin B.*
Use of the Resection Map system as guidance during hepatectomy.
L. Surg Endosc. 2010 Sep;24(9):2327-37. Epub 2010 Feb.
3. *Kazaryan AM, Pavlik Marangos I, Rosseland AR, Røsok BI, Mala T, Villanger O, Mathisen O, Giercksky KE, Edwin B.*
Laparoscopic liver resection for malignant and benign lesions: ten-year Norwegian single-center experience.
Arch Surg. 2010 Jan; 145(1): 34-40. PubMed PMID: 20083752.



4. *Røsok BI, Marangos IP, Kazaryan AM, Rosseland AR, Buanes T, Mathisen O, Edwin B.*
Single-centre experience of laparoscopic pancreatic surgery.
Br J Surg. 2010 Jun; 97(6): 902-9.
PubMed PMID: 20474000.
5. *Hellerud BC, Nielsen EW, Thorgersen EB, Lindstad JK, Pharo A, Tønnessen TI, Castellheim A, Mollnes TE, Brandtzaeg P.*
Dissecting the effects of lipopolysaccharides from nonlipopolysaccharide molecules in experimental porcine meningococcal sepsis.
Crit Care Med. 2010 Jun; 38(6): 1467-74.
PubMed PMID:20400898.
6. *Halvorsen PS, Remme EW, Espinoza A, Skulstad H, Lundblad R, Bergsland J, Hoff L, Imenes K, Edvardsen T, Elle OJ, Fosse E.*
Automatic real-time detection of myocardial ischemia by epicardial accelerometer.
J Thorac Cardiovasc Surg. 2010 Apr; 139(4): 1026-32.
Epub 2009 Aug 29. PubMed PMID: 19717169.
7. *Storås TH, Gjesdal KI, Gadmar OB, Geitung JT, Kløw NE.*
Three-dimensional balanced steady state free precession imaging of the prostate: flip angle dependency of the signal based on a two component T2-decay model.
J Magn Reson Imaging. 2010 May; 31(5): 1124-31.
PubMed PMID: 20432347.
8. *Westlye LT, Walhovd KB, Dale AM, Bjørnerud A, Due-Tønnessen P, Engvig A, Grydeland H, Tamnes CK, Østby Y, Fjell AM.*
Differentiating maturational and aging-related changes of the cerebral cortex by use of thickness and signal intensity.
Neuroimage. 2010 Aug 1;52(1): 172-85. Epub 2010 Mar 27.
PubMed PMID:20347997.
9. *Westlye LT, Walhovd KB, Dale AM, Bjørnerud A, Due-Tønnessen P, Engvig A, Grydeland H, Tamnes CK, Østby Y, Fjell AM.*
Life-span changes of the human brain White matter: diffusion tensor imaging (DTI) and volumetry.
Cereb Cortex. 2010 Sep; 20(9): 2055-68. Epub 2009 Dec 23.
PubMed PMID: 20032062.
10. *Bjørnerud A, Emblem KE.*
A fully automated method for quantitative cerebral hemodynamic analysis using DSC-MRI.
J Cereb Blood Flow Metab. 2010 May; 30(5): 1066-78.
Epub 2010 Jan 20. PubMed PMID: 20087370;
PubMed Central PMCID: PMC2949177.
11. *Kazaryan AM, Marangos IP, Røsok BI, Rosseland AR, Villanger O, Fosse E, Mathisen O, Edwin B.*
Laparoscopic resection of colorectal liver metastases: surgical and long-term oncologic outcome.
Ann Surg. 2010 Dec; 252(6): 1005-12. PubMed PMID: 21107111.
12. *Fjell AM, Amlie IK, Westlye LT, Stenset V, Fladby T, Skinningsrud A, Eilertsen DE, Bjørnerud A, Walhovd KB.*
CSF biomarker pathology correlates with a medial temporo-parietal network affected by very mild to moderate Alzheimer's disease but not a frontostriatal network affected by healthy aging.
Neuroimage. 2010 Jan 15; 49(2): 1820-30.
PubMed PMID: 20032062.

Level 1 publications

1. *Revheim ME, Røe K, Bruland OS, Bach-Gansmo T, Skretting A, Seierstad T.*
Monitoring the Effect of Targeted Therapies in a Gastrointestinal Stromal Tumor Xenograft using a Clinical PET/CT.
Mol Imaging Biol. 2010 Dec 16. [Epub ahead of print]
PubMed PMID: 21161686.
2. *Eldevik K, Nordhøy W, Skretting A.*
Relationship between sharpness and noise in CT images reconstructed with different kernels.
Radiat Prot Dosimetry. 2010 Apr-May; 139(1-3): 430-3.
Epub 2010 Feb 24. PubMed PMID: 20181647.
3. *Skretting A, Glomset O, Bogsrud TV.*
A phantom for investigation of tumour signal and noise in PET reconstruction with various smoothing filters: experiments and comparisons with simulated intensity diffusion.
Radiat Prot Dosimetry. 2010 Apr-May; 139(1-3): 191-4.
Epub 2010 Feb 22. PubMed PMID: 20176733.
4. *Skretting A.*
A method for on-site measurements of the effective spatial resolution in PET image volumes reconstructed with OSEM and Gaussian post-filters.
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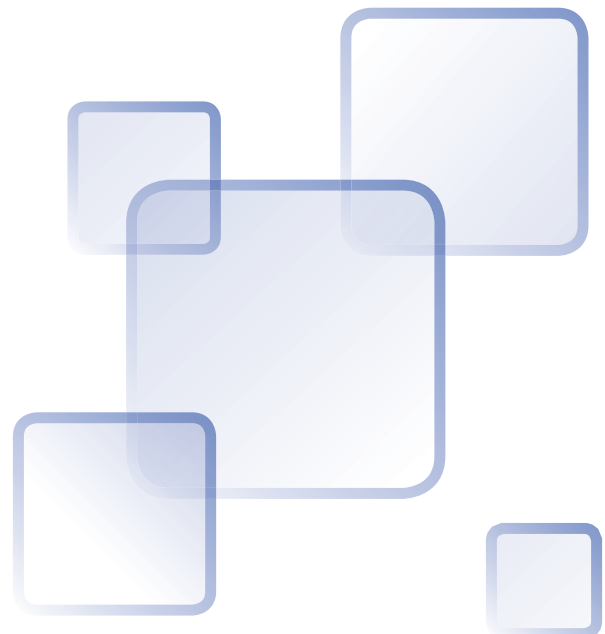
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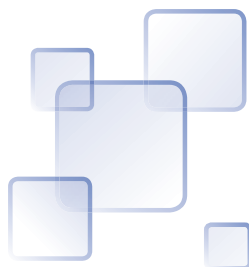
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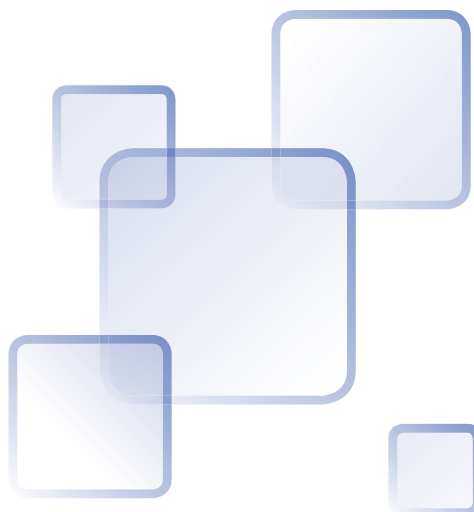
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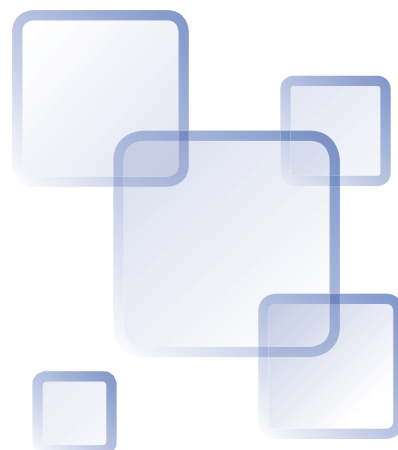
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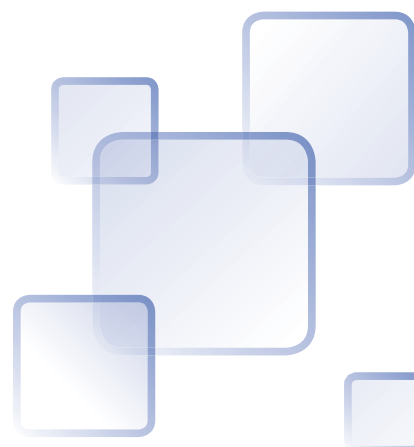
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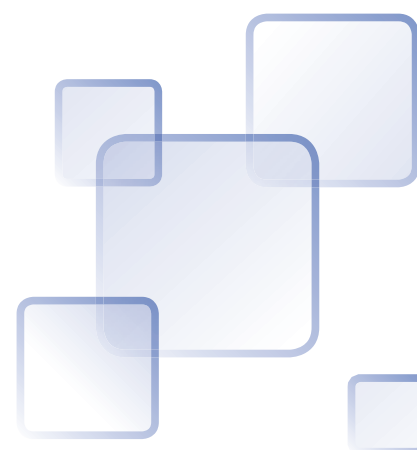
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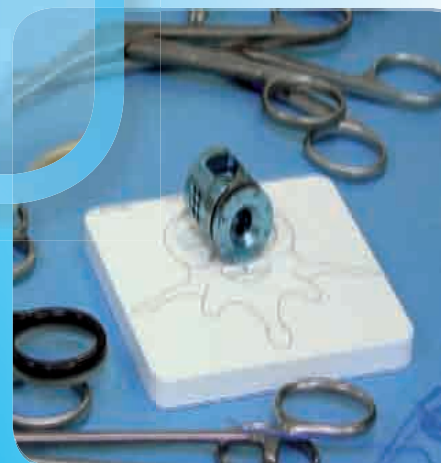
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PATENT NR.	TITLE	INVENTORS
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WO 0169130	Light system for use especially by operating theatre	Erik Fosse, Frode Lærum, Ole Jakob Elle
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NO 20016385	System for monitoring changes in movements of an organ, preferably a heart muscle	Erik Fosse, Martin G. Gulbrandsen, Ole Jakob Elle
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US PCT/EP2008/058437	Method and kit for sweat activity measurement	Ørjan Grøttem Martinsen, Sverre Grimnes

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US Patent: 20030114876	Device for use by brain operations	Eigil Samset, Henry Hirschberg, Åge Kristiansen
IPCS 8 class: AA61 1B603FI; USPC class: 600425	Tumor grading from blood volume maps	Kyrre Emblem, Atle Bjørnerud
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