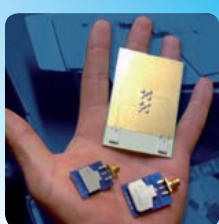




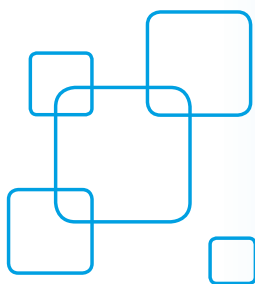
The Intervention Centre Annual report 2010

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



THE INTERVENTION CENTRE

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



ANNUAL REPORT 2010

The Intervention Centre



- 4 Organisation chart
- 5 Image guided treatment and diagnostic physics
- 6 Main goals and objectives
- 8 Diagnostic physics
- 10 Research groups
- 26 Scientific statistics
- 30 Academic partners
- 32 Commercial partners
- 35 Budget and expenditures
- 36 Patents
- 38 Publications
- 67 Members of the Advisory Board



ANNUAL REPORT 2010

More information at the web pages: www.ivs.no

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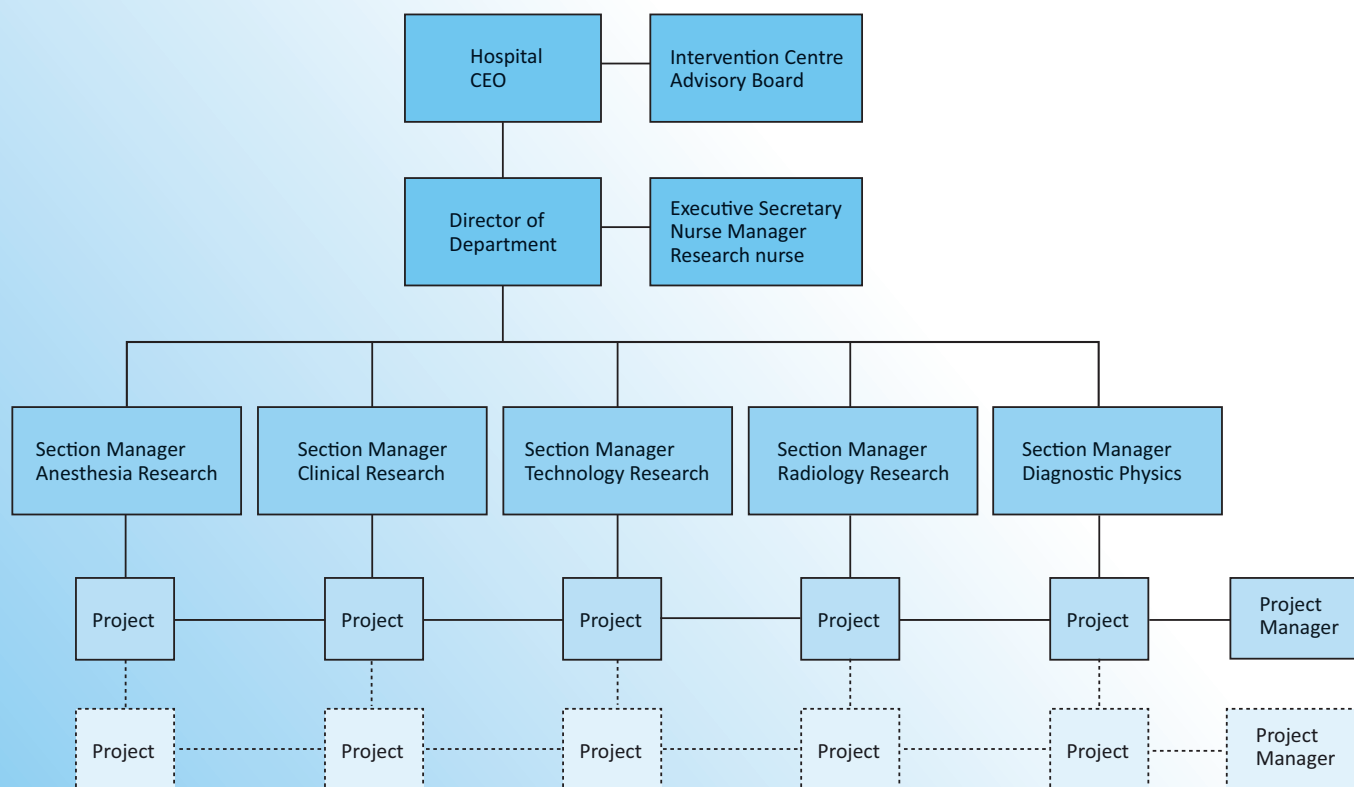
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The Intervention Centre

Organisation chart 2010



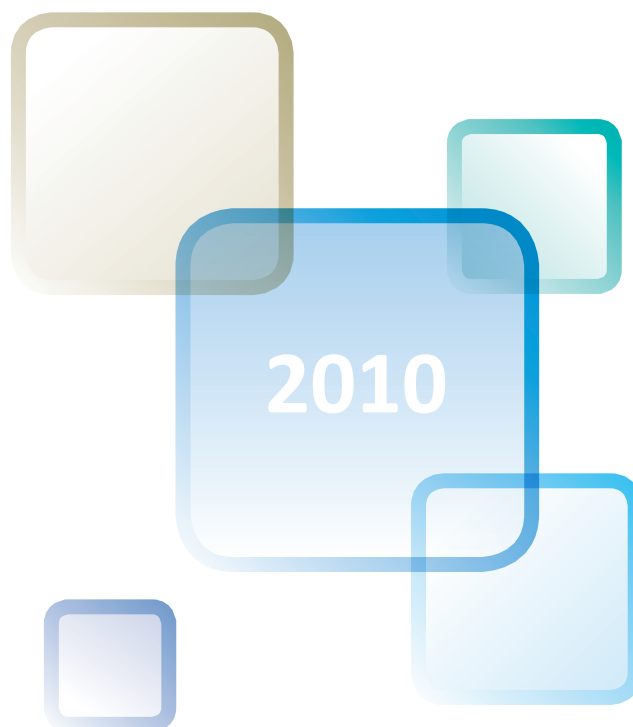


Image guided treatment and diagnostic physics

In 2010 the new organization of Oslo University Hospital after the merge, came into full effect. The hospitals that were merged had each a staff of physicists dedicated to diagnostic imaging. In the new organization all image physicists were allocated to a new section for Diagnostic physics at the Intervention Centre.

The section serves the entire radiology field in the hospital as well as in several other hospitals in the region. The scope of our physicist services comprises research and education as well as technical assistance to the radiology field.

The inclusion of a section for diagnostic physics broadened the cross-disciplinary character of the Intervention Centre and led to an increase in research fields and activities.

Image guided treatment is developing constantly in most medical disciplines, and the activity in the Intervention Centres' advanced operation theatres reached an all time high in 2010 and there is a need for expansion both of hybrid operation theatres and staff.

There is an increasing call for more information than clinical outcome when new methods are introduced in clinical practice. Today information of patient experience, as well as total costs and cost utility, is required for determining the consequences of the new method. The Intervention Centre works with the clinical departments in providing such information.

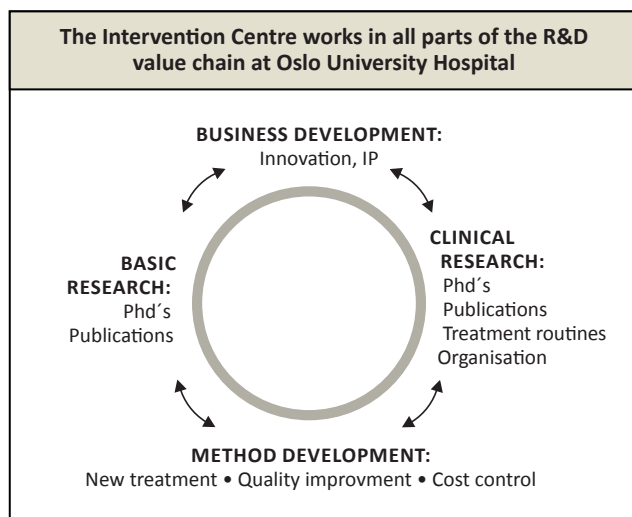
Erik Fosse
Head of Department

Main goals and objectives

The Intervention Centre is a research and development centre for medical imaging, image guided and minimally invasive therapy at Oslo University Hospital in Oslo, Norway and Faculty of Medicine at the University of Oslo. The Centre was established in 1996 to create a link between clinical practice, applied-, and basic research in the fields pertaining to minimally invasive and image guided therapy.

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



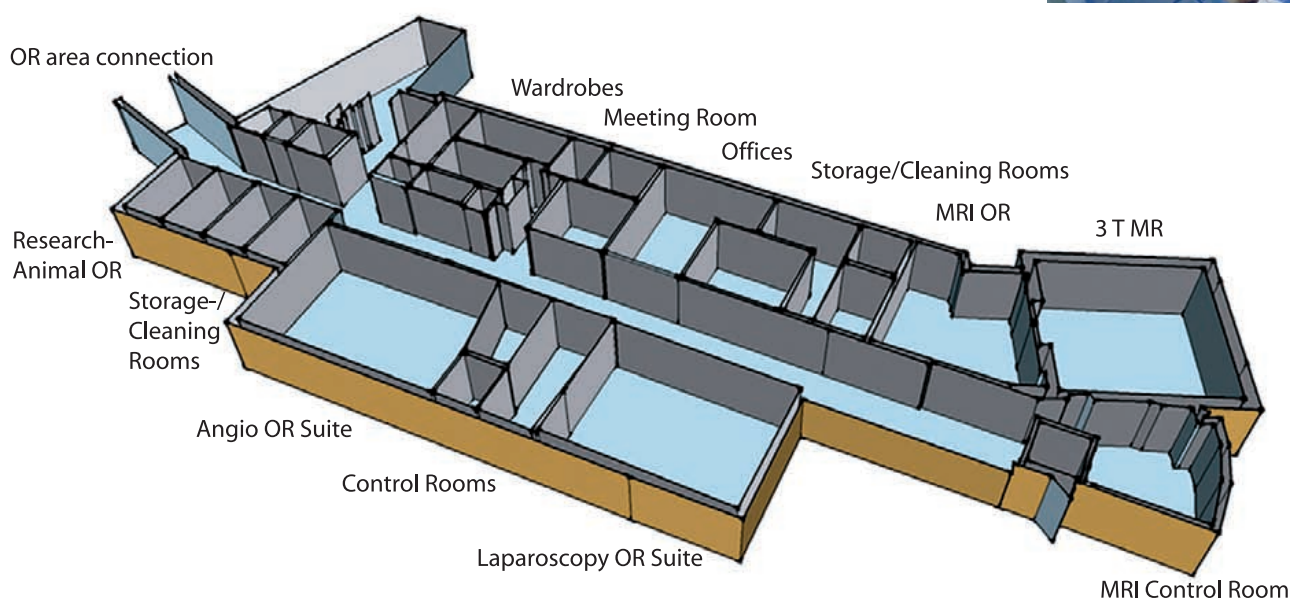
STRATEGY

- The Intervention Centre is a research and development resource for all the clinical and laboratory departments at Oslo University Hospital.
- The Intervention Centre shall actively offer similar services to the health care community in Norway outside the hospital.
- The Intervention Centre shall work as a link between technology institutions (*commercial and academic*) and the clinical medical environment in the hospitals.
- The Intervention Centre shall promote and work actively to protect new knowledge and facilitate commercial exploitation.

AREAS OF ACTIVITY

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





FACILITIES

The Centre has a unique architectural structure. In the three suites advanced imaging equipment was 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 the Siemens Zeego system, based on robotic technology and containing new advances in imaging and functionality. Our MRI suite was completely rebuilt into a dual room suite where a 3T MR was installed in one room beside a state of the art OR. The two rooms were separated by a sliding door, allowing surgery with standard equipment and intermittent MRI imaging. In the videoscropy room all systems were replaced by Olympus HD equipment.

ORGANISATION MODEL

The Intervention Centre is an independent hospital department. The Head of department reports directly to the CEO of the Clinic for Diagnostics and Intervention. A National Advisory board with representatives from all universities and university hospitals in Norway and the main departments at Rikshospitalet monitors and gives advice on research and activity. In 2010 the Intervention Centre has a cross-disciplinary staff of 45 employees including doctors, nurses, radiographers, physicists and engineers employed by other departments, worked regularly at the Centre while a large number of

medical staff from most departments in the hospital worked at a less regular basis at the Centre.

The staff includes university-employed professors from:

- Faculty of Medicine, University of Oslo
- Department of Informatics, University of Oslo
- Department of Medical Physics, University of Oslo
- Division of Biophysics and Medical Technology (NTNU)
- Department of Electronics and Telecommunication (NTNU)

MATRIX ORGANISATION

In order to facilitate effective execution of cross-disciplinary projects, the personnel and equipment at the Centre were allocated to four sections in a matrix organisation. Each section is headed by a section manager. Each project has a project manager and the project manager reports to the section manager in charge of the project. The head of department and the section managers constitute the management group where new projects are approved. Both the equipment and the staff are available as a common resource for departments and research groups aiming at developing and quality assessment of new methods.

Diagnostic physics

The section offers a regional physicist service in the South Eastern part of Norway and is responsible for the radiation protection in Oslo University Hospital. In addition to quality assurance and radiation protection, the section is co-responsible for the daily follow-up and management of the PET-CT core facility and involved in research in topics as advanced MR-physics, CT-physics, intervention radiology, nuclear medicine including PET-CT, image processing and radiation protection.

FIELDS OF RESEARCH

One professor in physics at the University of Oslo is employed in the section. PhDs and postdocs in MR-physics, CT-physics and PETCT are related to the section. In addition, comparison studies of different modalities, optimisation of radiation protection in paediatrics, interventional radiology and internal dosimetry are also fields of research.

QUALITY ASSURANCE

Methodology for acceptance tests and quality assurance on CT, Planar X-ray and Fluoroscopy laboratories, PET-CT, nuclear medicine were revised and further developed.

In 2010 QA on 216 X-ray and nuclear medicine modalities were performed: 34 CT scanners, 56 planar X-ray laboratories, 20 fluoroscopy laboratories and 22 angio/intervention laboratories from all vendors at the Norwegian market.



COURSES

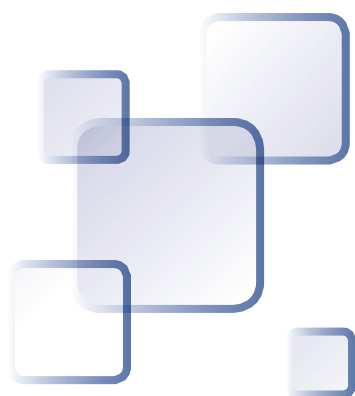
The section arranged a national course in CT physics for bioengineers working with SPECT- and PET-CT, and was co-responsible for a Nordic Course in CT colonography in Oslo and a Nordic CT course for physicists in Aarhus, Denmark (*Nordic Association of Clinical Physicists, NACP*) in 2010.

The section is responsible for two master courses in physics at the University of Oslo: “Fys 4760 Physics in diagnostic X-ray” and “Fys-KJM9740 MR-theory and medical diagnostics” and one CT post educating course for radiographers at the University college of Oslo.

300 lectures in diagnostic physics, radiation protection and radiation dosimetry were performed.

REGIONAL PHYSICIST SERVICE

In 2005 Oslo University Hospital (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 2010 the section had commitments at all the hospitals in OUS and also at 12 hospitals and radiological institutes at 25 locations outside the Oslo University Hospital. Collaborating hospitals and institutes in 2010 were AHUS, Lovisenberg, Sunnås, Feiringklinikken, Glittre-klinikken, Martina Hansens Hospital, Diakonhjemmet, Sykehuset Østfold, Vestre Viken avd Ringerike, Sykehuset Telemark, 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.



SERVICES

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

BENEFITS

The economical benefits of a regional physicist service are that less personnel is needed because of recirculation of lectures, reports and knowledge between the physicists in the group. Also less measuring equipment is needed in the region due to centralised pool of equipment. Other regional benefits are the achievement 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 corresponding problems in other sites, and development of QA methods and procedures are consolidated in the group of physicists.



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 pace-maker leads. The idea of using 3-axis accelerometer in perioperative ischemia detection is patented: Patent number: NO 20016385.

The biologic basis has been studied through animal experiments.

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	
Development of a sensor for sweat measurement	Professor Sverre Grimnes	NFR
Ultrasonic diagnostics in acute and chronic heart failure	Professor Thor Edvardsen	HSØ
Biosensors for detecting cardiac ischemia	Professor Tor Inge Tønnessen	HSØ
New clinical methods for detection of ischemia	Professor Tor Inge Tønnessen	HSØ
Microdialysis monitoring in transplanted patients	Professor Tor Inge Tønnessen	HSØ
Accuracy of accelerometer measurements in cardiac monitoring	Professor Erik Fosse	IVS
Wireless sensor communication in advanced medical settings	Professor Erik Fosse	IVS

Ongoing PhD programs in 2010:

Karl Øyri, Cand San:

Wireless sensor communication in advanced medical settings

Mentors: Professor Erik Fosse, The intervention Centre, professor Ilanko Balasingham, The Intervention Centre, professor Ørjan Grøttem Martinsen, Inst. of Physics, University of Oslo

Post Doc:

Espen Remme, MSc, PhD



BIOSENSOR RESEARCH GROUP

Leader: Professor Tor Inge Tønnessen MD, PhD

The Biosensor research group has three main branches of interest, namely the biologic basis for ischemia and the choice of parameters for detection thereof, the second is the development of a specific pCO₂ sensor and the third is 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 2010:

1. Lars Wælgård, 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. Current clinical and experimental animal projects focus on allo- and xenotransplant rejection, pulmonary dysfunction and systemic inflammatory response syndrome of the newborn, infection and septicaemia, ischemia-reperfusion injury, biocompatibility of extracorporeal circulation devices, and rheumatic tissue damage.

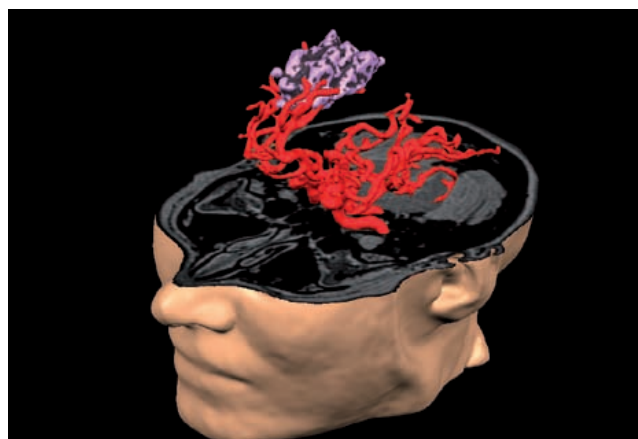
Web site:

www.med.uio.no/rh/immi/research/complementgroup/index.html

DIAGNOSTIC PHYSICS RESEARCH | *Section manager: Anne Catrine Trægde Martinsen,***ADVANCED MR NEURO IMAGING***Group leader: Professor Atle Bjørnerud*

The main research focus of the Advanced Neuro-imaging Group (ANG) is related to functional MRI applied to different neuropathological 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 currently being launched, 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 OUH 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 (*NordicNeuro-Lab, 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.

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).

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

PhD students:

Paulina Due-Tønnessen

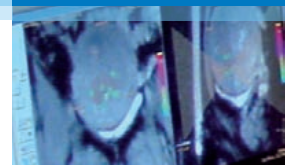
Arvid Morell (Uppsala)

Per Selnes (Akershus University Hospital)

Post Doc:

Inge Rasmussen

Kyrre Eeg Emblem (Harvard Medical School, Boston)



Cand Scient

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

Group leader: Physicist, 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

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
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

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.

PhD students:

1. Kjersti Johnsrud.
Department of Radiology and Nuclear Medicine:
Imaging of Unstable Carotid Artery Plaque
Mentor: Professor Arne Skretting,
The Intervention Center, Oslo University Hospital
2. 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
3. Anne Cathrine Trægde Martinsen, Cand Scient.
The Intervention Centre, Oslo University Hospital:
The possibilities of reducing radiation dose and improve image quality in CT diagnostics using advanced image processing
Mentors: Professor Arne Skretting and professor Per Skaane, Dr. med, Oslo University Hospital.
Dean Dag Rune Olsen, PhD, University of Bergen.
Per Kristian Hol, Dr. med, Oslo University Hospital



CLINICAL RESEARCH | Section manager: Bjørn Edwin, MD, PhD

IMAGE GUIDED GENERAL SURGERY AND INTERVENTION*Group leader: Professor 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

**Ongoing PhD programs in 2010:**

1. PhD. research fellow
Airazat M. Kazaryan, MD:
Extracorporeal high intensity focused ultrasound ablation of liver malignancies.
Mentors: Bjørn Edwin, MD, PhD and Erik Fosse, MD, PhD, Oslo University Hospital
2. PhD research fellow Martin Johansson:
Percutaneous access and connection to visceral organs
Mentors: Peter Thomsen MD PhD, Institution for Clinical Sciences, University of Gothenburg, Bjørn Edwin, MD, PhD, The Intervention Centre, Oslo University Hospital, Leif Hulten, MD, PhD, The ColoRectal Unit, Sahlgrenska University Hospital
3. PhD research fellow Irina Pavlic Marangos:
Minimally invasive surgery in the abdominal endocrinal glands
Mentors: Bjørn Edwin, MD, PhD, The Intervention Centre and Faculty of Clinical Science, University of Oslo, Bård Røsok, MD, PhD, Surgical Department, Oslo University Hospital, Truls Hauge, MD, PhD, Medical Department, Oslo University Hospital

The Intervention Centre, in cooperation with cardiology and cardiac surgery departments within Oslo University Hospital, has an ongoing research program on trans-aortic valve implantation (TAVI) for the treatment of patients with severe aortic stenosis (*cost issues and studies related to quality of life*).

In 2010 the project received funding for one PhD program concerning acute and long time circulatory and cardiac effects of TAVI.

Projects	Project leader	Financing
Circulatory and cardiac effects of transaortic valve implantation (TAVI)	Professor Erik Fosse	HSØ



CARDIAC IMAGING

Group leader: Professor Thor Edvardsen MD, PhD

The Intervention Centre has great facilities and support for research on myocardial function and different cardiac imaging modalities. The operating theatres are perfect for research on cardiac function and imaging. The 3T MRI scanner at the Intervention Centre has further augmented research possibilities in cardiac imaging of structure and function of the heart. Several PhD students have ongoing projects that include cardiac MR. One big project in collaboration with Sørlandet Hospital, Arendal, is exploring myocardial function in patients with NSTEMI (*non ST-elevation myocardial infarct*) before and after PCI treatment. Another ongoing project is studying patients with stable angina pectoris.

The development of epicardial accelerometers and ultrasound probes for continuous monitoring of myocardial ischemia has so far resulted in one completed PhD in 2010. The development of these devices has been in close collaboration with Dept of Cardiology. The idea behind the project is to improve per and post operative monitoring of myocardial function. ECG leads and invasive monitoring of pressures are not capable of detecting myocardial ischemia early enough to prevent damage.

One PhD project will describe myocardial function in sepsis. Myocardial function will be assessed by advanced monitoring including myocardial sensors and echocardiography. This project includes large animal models and studies in patients.

There is widespread clinical use of therapeutic hypothermia in comatose survivors of an out-of-hospital cardiac arrest. Hypothermia has been demonstrated to improve outcome in these patients, but there is sparse knowledge of cardiac function during hypothermia. This PhD project will elucidate myocardial function during hypothermia.

These programs have resulted in 4 published papers in scientific journals during 2010 and 12 abstracts presentations at international conferences.

Ongoing PhD programs:

1. Andreas Espinoza, MD:
Miniaturized epicardial ultrasound probes for perioperative myocardial monitoring
Mentors: Thor Edvardsen, Dept of Cardiology, Oslo University Hospital. Erik Fosse, The Intervention Centre, Oslo University Hospital, Halfdan Ihlen, Dept of Cardiology, Oslo University Hospital
2. Marit Kristine Smedsrud, MD:
Myocardial viability in patients with stable angina pectoris
Mentors: Thor Edvardsen, Dept of Cardiology, Oslo University Hospital. Otto A. Smiseth, Dept of Cardiology, Oslo University Hospital
3. Christian Eek, MD:
Diagnostic and therapeutic stratification of patients with acute coronary syndrome (Echo-str-acs)
Mentors: Helge Skulstad and Thor Edvardsen, Dept of Cardiology, Oslo University Hospital
4. Siv Hestenes, MD:
Cardiomyopathy in sepsis
Mentors: Thor Edvardsen, Dept of Cardiology, Oslo University Hospital. Erik Fosse, The Intervention Centre, Oslo University Hospital. Erik W Nilsen, IMMI, Oslo University Hospital
5. Stefan Hyler, MD:
Myocardial function in graded ischemia assessed by myocardial sensors
Mentors: Erik Fosse, The Intervention Centre, Oslo University Hospital, Helge Skulstad, Dept of Cardiology, Oslo University Hospital
6. Viesturs Kerans, MD:
Myocardial function in therapeutic hypothermia
Mentors: Jan F. Bugge, Dept of Anesthesiology, Oslo University Hospital, Helge Skulstad and Thor Edvardsen, Dept of Cardiology, Oslo University Hospital
7. Wasim Sahid, MD:
Ultrasonic diagnostics in acute and chronic heart failure
Mentors: Thor Edvardsen, Dept of Cardiology, Oslo University Hospital. Erik Fosse, The Intervention Centre, Oslo University Hospital

RADIOLOGY RESEARCH | *Section manager: Per Kristian Hol, MD, PhD*

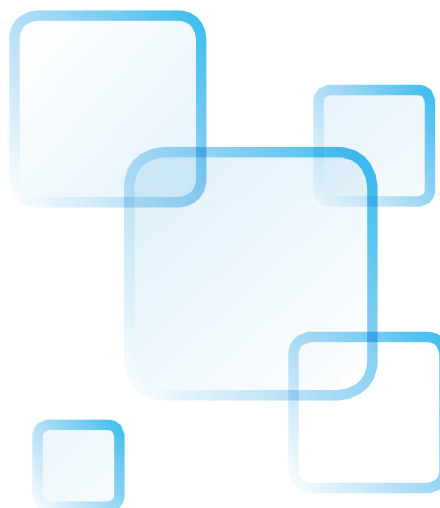
RADIOLOGY RESEARCH AND IMAGE GUIDED INTERVENTION

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 Stavanger University Hospital, The Institute for Paediatric Research, 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. Programs for using the 3T MR scanner for characterization of carotid artery plaque and the Flat-detector Computed Tomography technology of the angiographic system for brain perfusion studies are under preparation.

A total of 8 PhD programs used the angiographic suite or the MR scanner for their research in 2010:

1. Cand. Med. Trygve Kjelstrup:
Axillary plexus block, nervestimulatur, ultrasound and MRI
Mentors: Øivind Klaastad and Harald Breivik, Department of Anaesthesiology/ The Intervention Centre, Oslo University Hospital, Albert Castellheim, Department of Anaesthesiology, Diakonhjemmet 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. Shalloo, 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. 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
7. Astrid Almaas, Elin Blakstad, Sissel Moltou and Kenneth Strømme:
Nutrition, growth and development of premature children
Mentor: Christian A. Drevon, Department of Nutrition, Institute of Basic Medical Sciences, University of Oslo
8. 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 2010 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



RADIOLOGY RESEARCH

NEURO COGNITIVE IMAGING

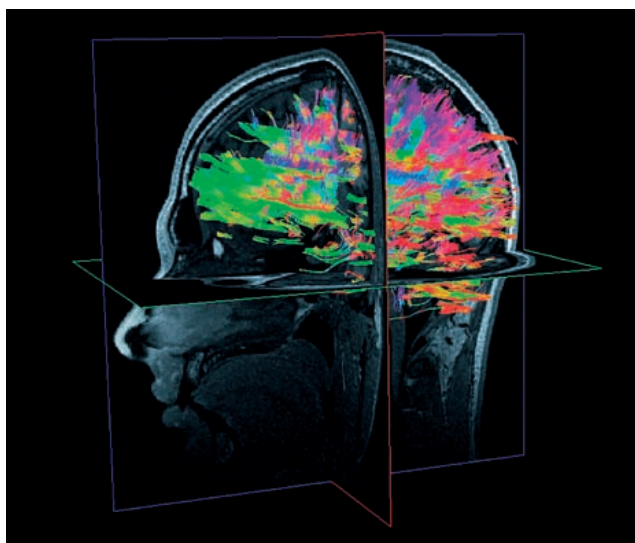
Group leader: Associate professor Tor Endestad

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.

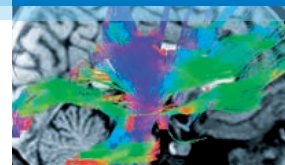
In addition to basic research, the group participate in the development of functional MRI as part of pre-surgical planning and improvement of neuropsychological diagnostics.



Ongoing projects that continue in 2011:

PhD Projects:

1. ***Can the brain make sense of nothing, fill in of the Blind spot***
PhD student: Markus Sneve
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. ***Parametric BOLD activation in multiple object tracking: Prediction of individual differences in attentional performance***
 Post Doc: Thomas Espeseth
 PhD: Markus Sneve
2. ***Decision making***
 Post Doc: Guido Guido Biele
 PhD: Renata Suter

Master students:

1. ***Unconscious processing of emotions***
 Master students: Erik Normann Andersen,
 Laura Bakke
 Principal Res: Tor Endestad, Bruno Laeng
2. ***Hippocampus and temporal lobe activation***
 Master Students: Dag Alnes, Laura Bakke
 Principle Res: Tor Endestad
3. ***Multiple object tracking and visual neglect***
 Master Students: Dag Alnes, Laura Bakke
 Principle Res: Tor Endestad, Thomas Espeseth,
 Bruon Laeng



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

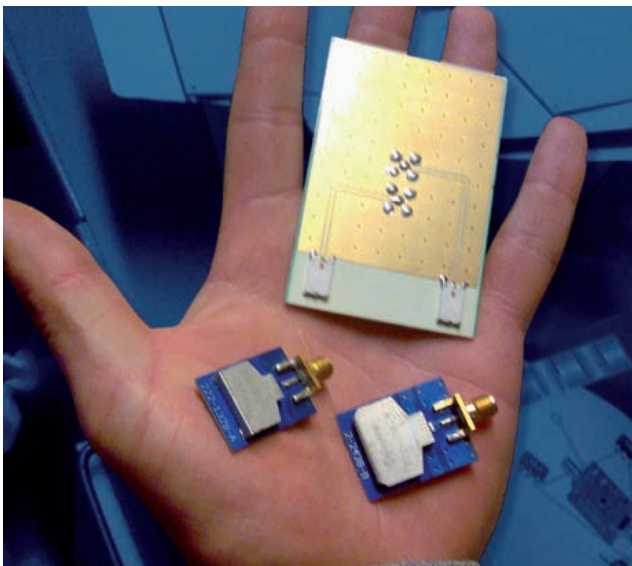
research institutions and companies participate in different projects.

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 successfully submitted a proposal on Center for Research based Innovation (SFI) on Wireless Systems for Healthcare and Industrial Automation with some 12 industrial partners to the Research Council of Norway. Unfortunately the proposal did not get funding.

The group organized two special sessions on “ultra wideband technology for medical applications” and “wireless technology for medicine” at the ACM Fifth International Conference on Body Area Networks, BodyNets, Greece, Sept. 2010 and the IEEE 3rd International Symposium on Applied Sciences in Bio-medical and Communication Technologies (ISABEL), Italy, Nov. 2010, respectively.

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 March 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 will be hired in 2011.

PhD programs:

The Robotic research group had three PhD projects running in 2010:

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



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.

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 2010:

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

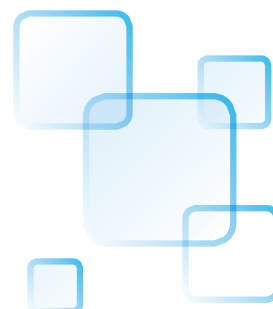
4. Eivind Lyche Melvær (MATMED PhD student):
Reconstruction of 3D images from free-hand 2D ultrasound.
Mentors: Prof. Knut Mørken, CMA/UiO and Prof. Eigil Samset, The Intervention Centre, Oslo University Hospital
5. Egil Bae (MATMED PhD student):
Image Segmentation and Reconstruction using level sets 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

Postdoctoral fellow:

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

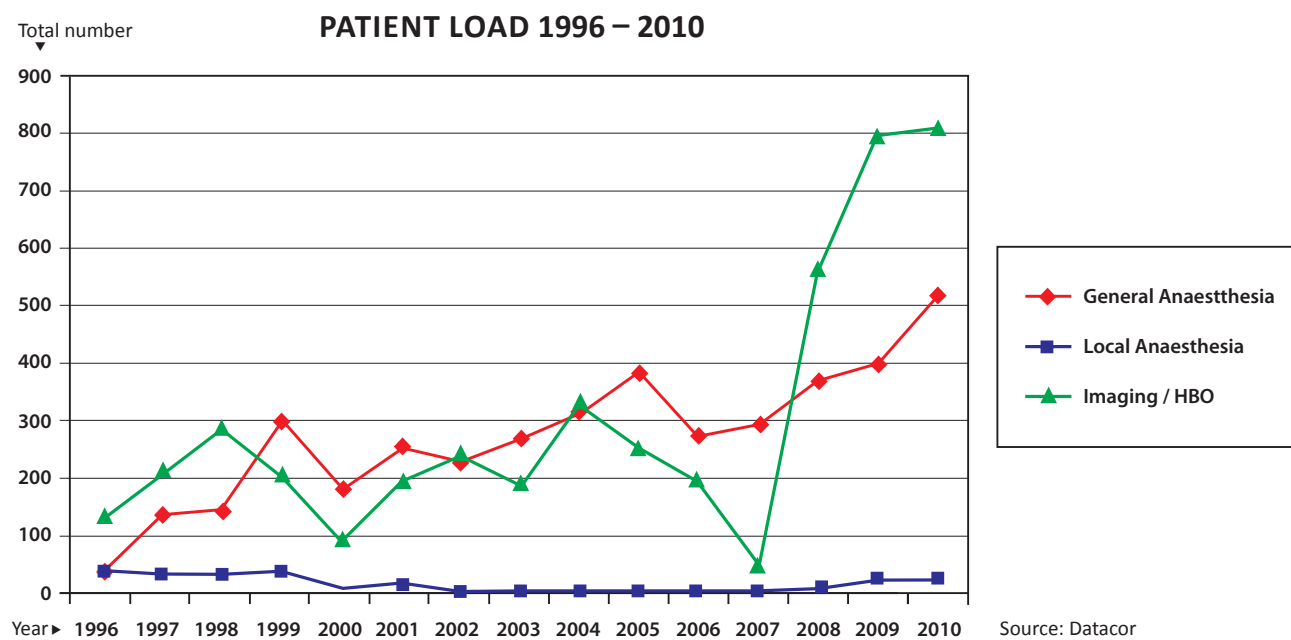
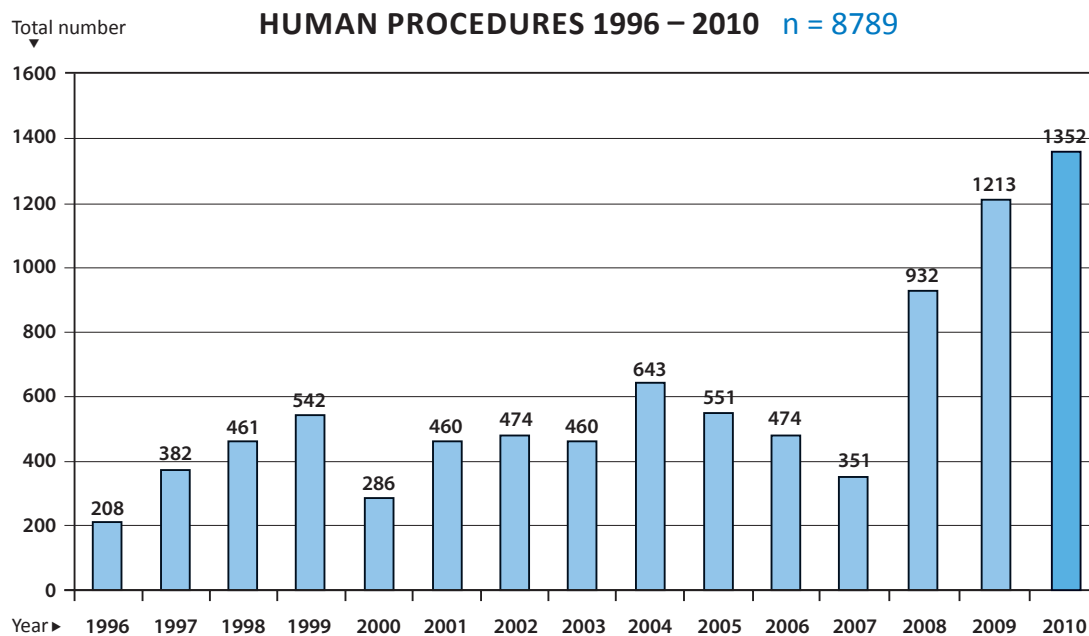
Software Developer:

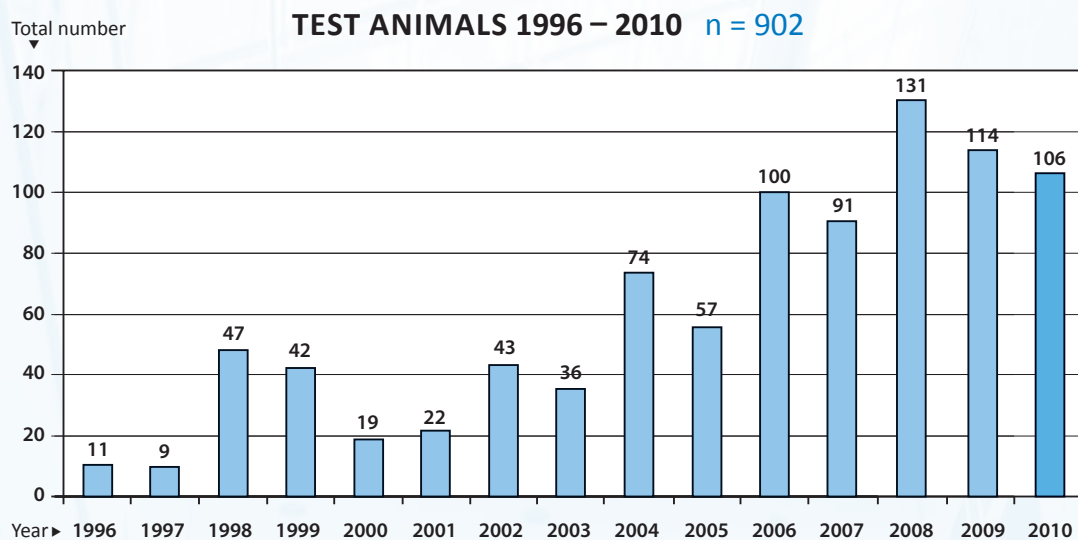
Rafael Palomar (SCath):
Implementation of navigation platform and the development of methods for compensation of motion and deformation in catheter navigation.



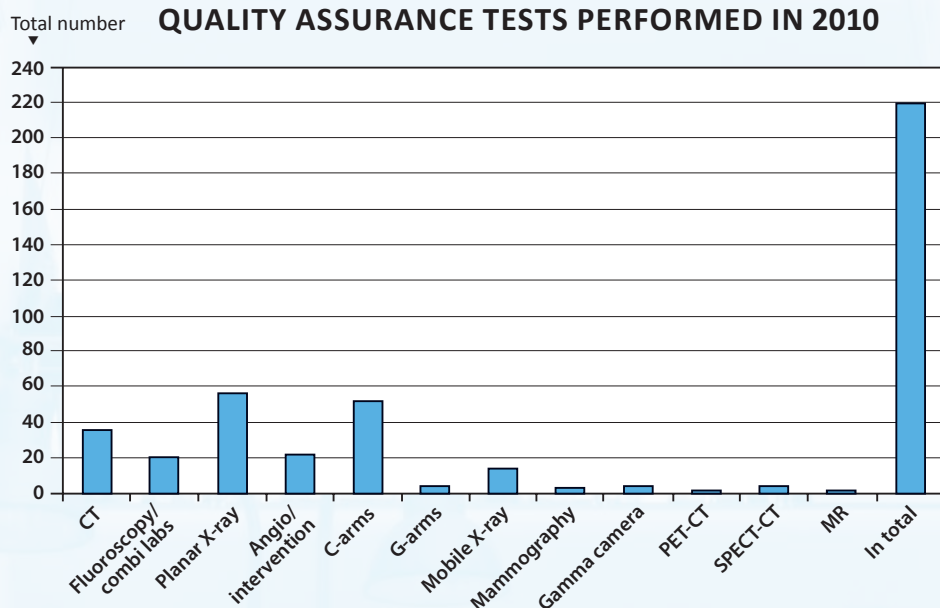
Scientific statistics

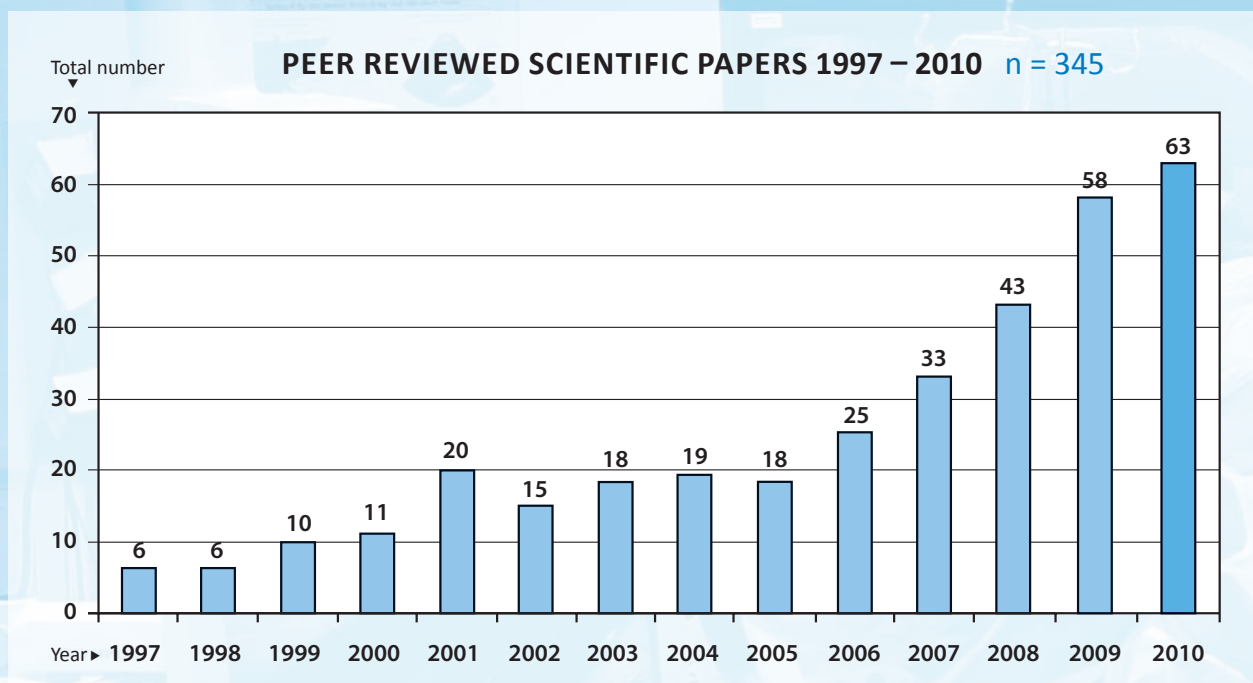
The Intervention Centre 2010





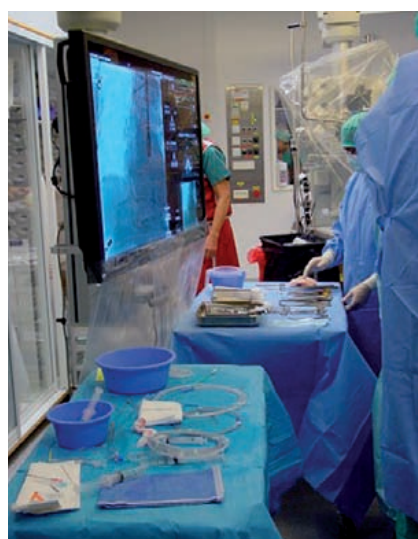
QUALITY ASSURANCE TESTS PERFORMED IN 2010







Academic partners



NATIONAL ACADEMIC PARTNERS

UNIVERSITY OF OSLO (UiO)

Centre of Mathematics for Applications, Faculty of Mathematics and Natural Sciences

Prof. Knut Mørken

Mathematical methods supporting minimally invasive therapy in medicine

Department of Informatics, Faculty of Mathematics and Natural Sciences

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, Faculty of Mathematics and Natural Sciences

Prof Eirik Malinen (Radiation therapy)

Prof Hilde M. Olerud (Diagnostic physics)

Prof. Sverre Grimnes,

Prof. Ørjan G. Martinsen

Bioelectrical properties of human tissue.

Development of a skin moisture sensor.

Two PhD programs

Department of Chemistry, Faculty of Mathematics and Natural Sciences

Svein Stølen

PET-CT

The small-animal PET facility, Faculty of Medicine

Jan G. Bjaalie

PET-CT

Department of psychology, Faculty of Social Sciences

Assoc. prof. Tor Endestad,

Prof. Svein Magnussen

Cognitive function and fMRI

Prof Anders Fjell

MR morphometry and diffusion tensor imaging

Institute of psychiatry

Prof. Ole Andreassen

Neuroplasticity in patients with bipolar disorders

The School of Pharmacy, Faculty of mathematics and natural sciences

Prof. Jan Karlsen

Development of a radioactive gel for treatment of bowel tumours

NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY (NTNU)

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 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

St. Olavs Hospital

Assoc. prof. Asta Håberg

New statistical methods for improved characterization of gliomas.

Prof. Hans Olav Myhre

Prof. Ronald Mårvik

Fremtidens operasjonsrom

(The operating theatre of the future)

Department of Engineering Cybernetics

Associate professor Øyvind Stavdal

Robotic technique and ultrasound

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

HAUKELAND UNIVERSITY HOSPITAL

Pediatric Section, Department of Radiology

Eva Platou Holsen

Optimization of image quality and dose in pediatric radiology

UNIVERSITY HOSPITAL STAVANGER

Kathinka Kurz

Characterization of breast tumors using MR mammography

OSLO UNIVERSITY COLLEGE

Institute of Radiography

Dean Agnes Vinorum

Post graduating course in CT

Oslo University College

Peyman Mirtaheri

VESTFOLD UNIVERSITY COLLEGE, HORTEN

Centre for Micro technology

Assoc. Prof. Henrik Jacobsen

Micro-heart





INTERNATIONAL ACADEMIC PARTNERS

AUSTRIA

**Graz University of Technology,
Institute of Biomechanics,
Center of Biomedical Engineering, Graz**
*Prof. Gerard Holzapfel,
Dr. David M. Pierce*
SCath

CANADA

**University of British Columbia,
Vancouver**
Prof. Victor Leung
MELODY project: sensor networks

CZECH REPUBLIC

Fakultini Nemocine u sv. Anny Brne
Dr. Thomas Kara
IIIOS

BELGIUM

The Katholieke Universiteit Leuven
Prof. Jos Vander Sloten, Mauro Sette
SCath Project

FRANCE

EURECOM, Sophia-Antipolis
Prof. Raymond Knopp
MELODY project: Sensor Network

GERMANY

University of Heidelberg
Frank Zoellner
Novel statistical methods for predictive
modeling of tumor grade

University of Homburg SAAR
Prof. Arno Bucker
IIIOS

University of Lübeck
Prof. Hartmut Gehring
IIIOS

JAPAN

National Institute of ICT, Yokosuka
Prof. Huan-Bang Li
MELODY project: implantable sensor
communications

SPAIN

Universidad Politecnica de Madrid
Prof. Enrique J. Gomez
SCath

SWEDEN

**Göteborgs Universitet
Institution för kliniska vetenskaper**
Prof. Peter Thomsen MD PhD
Oostomy device

Linköping University
Prof. Erik G Larsson
MELODY project: robust communications

Royal Institute of Technology, Stockholm
Prof. Mikael Skoglund
MELODY project: robust communications

**Sahlgrenska University Hospital
The ColoRectal Unit, Gothenburg**
Prof. Leif Hultén MD PhD
Oostomy device

Uppsala University
Prof. Anders Rydberg
MELODY project: ultra wide band antennas
Prof. Håkan Ahlström
MR based Quantitative perfusion analysis

SWITZERLAND

**School of Computer and Communication
Sciences, Ecole Polytechnique Fédérale
de Lausanne (EPFL)**
Prof. Martin Vetterli
Collaboration in the SAMPOS and
WISNET projects on signal processing
in sensor nodes

**Ecole Polytechnique Fédérale de
Lausanne (EPFL)**
Dr. Catherine Dehollain
Collaboration in the ULTRASponder,
EU project on ultrasonic communications

Zürcher Hochschule für Angewandte Wissenschaften

Prof. Hans Wernher van de Venn
SCath

THE NETHERLANDS

Technical University of Delft
Prof. Jenny Dankelman
IIIOS

UK

Imperial College London
Prof. Guang-Zhong Yang
SCath

University of Dundee
Prof. Andreas Melzer
Prof. Sir Alfred Cushieri
IIIOS

USA

**Athinoula A. Martinos Center
for Biomedical Imaging
MGH / Harvard Medical School
Boston**
Prof. A. Gregory Sorensen

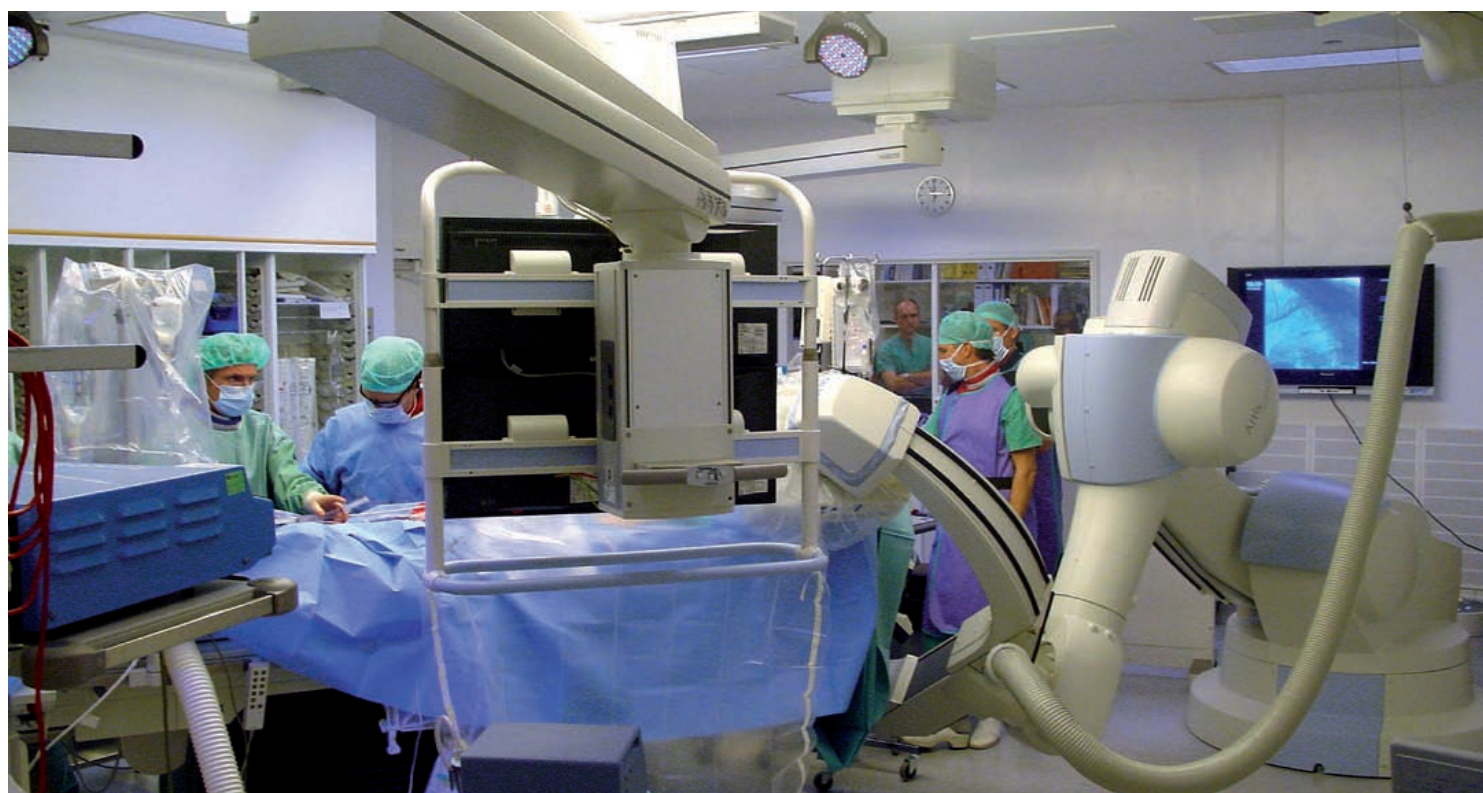
**Department of Radiology
Brigham and Women's Hospital
Harvard University, Boston**
Prof. William Wells
Non-rigid image registration
Perfusion mapping of tumours

**Department of Electrical Engineering
University of California, Berkeley**
Prof. Martin Vetterli
Collaboration in the SAMPOS and
WISNET projects on signal processing
in sensor nodes

University of California San Diego
Prof. Anders Dale
Novel methods for quantification of
tumor growth

University of California Santa Barbara
Prof. Ken Rose
MELODY project: joint source-channel
coding and modulations

Commercial partners



THE HEVESY LABORATORIES

Risø, Denmark

Managing Director: Mikael Jensen
PET-CT

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

Contact person:
EVICARE

ENDONSENSE SA

Geneva, Switzerland

Contact person: Giovanni Leo
Catheter navigation system

EVICARE

EXIT BUSINESS SUPPORT CENTRE

Banja Luka, Bosnia

Contact person: Zoran Gajic
Improving governance and interethnic cooperation in BiH through eHealth

GE HEALTHCARE

Stockholm, Sweden

Contact person: Dr. Bengt Nielsen
IIIOS. 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

SINTEF ICT

Contact person:
Medical White Board

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

NORDICNEUROLAB AS**Bergen, Norway**

Contact persons: Lars Erslund,
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
WIREMED. 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**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

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: Prof. Torill Nagelhus
Hærnes
IIIOS. Image guided therapy

SINTEF ICT**Trondheim, Norway**

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

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 2010

INTERNAL HOSPITAL FUNDS ADMINISTERED BY THE INTERVENTION CENTRE IN 2010

	BUDGET	EXPENDITURE
Payroll expences	28.400.000	
Other operating expences	7.629.000	
Sum internal finance	36.029.000	35.561.000

EXTERNAL FUNDS ADMINISTERED BY THE INTERVENTION CENTRE IN 2010

SOURCE	INCOME	EXPENDITURE
Research Council of Norway	10.650.682	
Regional Health Authority	2.050.235	
European Commission	3.904.119	
University of Oslo	421.875	
National Heart and Lung Association	575.000	
Ministry of Foreign Affairs	1.000.000	
Norwegian Cancer Society	565.000	
Research- and pending expenditures		17.196.000

Patents

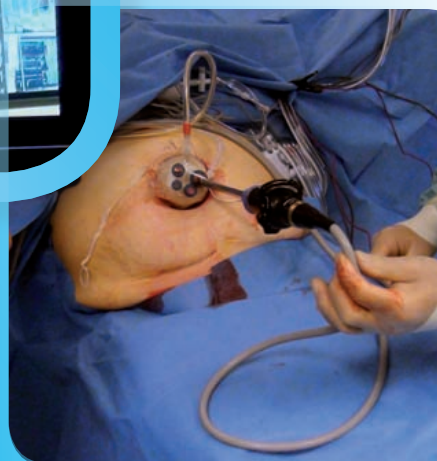
The Intervention Centre 1998 – 2010

ACTIVE PATENTS (GRANTED)

PATENT NR.	TITLE	INVENTORS
EP 1063923	Method and device for suturless anastomosis	Sumit Roy, Erik Fosse
WO 0169130	Light system for use especially by operating theatre	Erik Fosse, Frode Lærum, Ole Jakob Elle
WO 0004386	Device for PCO ₂ detection	Tor Inge Tønnessen, Peyman Mirtaheri
WO 9211823	Filtering device for preventing embolism and/or distension of blood vessel walls	Frode Lærum
NO 20016385	System for monitoring changes in movements of an organ, preferably a heart muscle	Erik Fosse, Martin G. Gulbrandsen, Ole Jakob Elle
NO 20023605	Method and device for connecting two tubular organs	Erik Fosse, Ole Jakob Elle, Sumit Roy
US PCT/EP2008/058437	Method and kit for sweat activity measurement	Ørjan Grøttem Martinsen, Sverre Grimnes

PENDING PATENTS

PATENT	TITLE	INVENTORS
US PCT patent application: 2007	Method and apparatus for visualization of a flexible body	Eigil Samset
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
EP1632201 Implant. 5/10 2004	Implant	Bjørn Edwin, Erik Fosse
PCT/IB2007/050646 (also filed as EP1825839 "Implant" and WO2007/099500). 28/2 2006	Implant and method for its manufacture	Bjørn Edwin, Erik Fosse
PCT/EP2008/060837 (also filed as EP2027835 "Implant" and WO2009/024568 "Percutaneous abdominal implant"). 21/8 2007	Percutaneous abdominal implant	Bjørn Edwin, Erik Fosse
US 61/173494. Priority 28/4 2009	Percutaneous port for a continent ostomy	Bjørn Edwin
WO2009027522A1	Automated monitoring of myocardial function by ultrasonic transducers positioned on the heart	Ole Jakob Elle, Erik Fosse, Halfdan Ihlen, Andreas Espinoza, Lars Hoff
WO03061473A1	Use of sensor and system for monitoring heart movements	Ole Jacob Elle, Erik Fosse, Martin G. Gulbrandsen
US20080281214A1	Method for estimating cardiac pumping capacity	Ole Jakob Elle, Erik Fosse, Steinar Halvorsen
PCT/EP2009/055570. 8/5 2008	Vessel segmentation in DCE MR imaging	Atle Bjørnerud, Kyrre Emblem
Priority date: 3 April 2009 EPO filing number: 09157255.2	Computer aided diagnosis tools for longitudinal tumor monitoring	Atle Bjørnerud, Kyrre Emblem
Priority date: 27 May 2009 EPO filing number: 2009 2068	Method of identifying activated brain regions for a single subject	Glenn Lawyer, Atle Bjørnerud



Publications

Scientific publications¹ from The Intervention Centre 2010 – 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).

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.



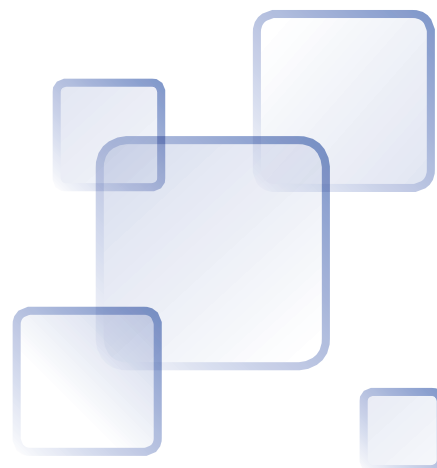


4. *Røsok BI, Marangos IP, Kazaryan AM, Rosseland AR, Buanes T, Mathisen O, Edwin B.*
Single-centre experience of laparoscopic pancreatic surgery.
Br J Surg. 2010 Jun; 97(6): 902-9.
PubMed PMID: 20474000.
 5. *Hellerud BC, Nielsen EW, Thorgersen EB, Lindstad JK, Pharo A, Tønnessen TI, Castellheim A, 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
13. *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.
 14. *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.
 15. *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.
 16. *Skretting A.*
A method for on-site measurements of the effective spatial resolution in PET image volumes reconstructed with OSEM and Gaussian post-filters.
Radiat Prot Dosimetry. 2010 Apr-May; 139(1-3): 195-8.
Epub 2010 Feb 17. PubMed PMID: 20164108.
 17. *Walhovd KB, Westlye LT, Moe V, Slinning K, Due-Tønnessen P, Bjørnerud A, van der Kouwe A, Dale AM, Fjell AM.*
White matter characteristics and cognition in prenatally opiate- and polysubstance-exposed children: a diffusion tensor imaging study.
RAJNR Am J Neuroradiol. 2010 May; 31(5): 894-900.
Epub 2010 Mar 4. PubMed PMID: 20203117.

18. *Quirce S, Lemièrre C, de Blay F, del Pozo V, Gerth Van Wijk R, Maestrelli P, Pauli G, Pignatti P, Raulf-Heimsoth M, Sastre J, Storaas T, Moscato G.*
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PubMed PMID: 19958319.
19. *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. 2010 Aug 12. [Epub ahead of print]
PubMed PMID: 20708868.
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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. 2010 Sep 21. [Epub ahead of print]
PubMed PMID: 20857284.
21. *Server A, Josefsen R, Kulle B, Maehlen J, Schellhorn T, Gadmar Ø, Kumar T, Haakonsen M, Langberg CW, Nakstad PH.*
Proton magnetic resonance spectroscopy in the distinction of high-grade cerebral gliomas from single metastatic brain tumors.
Acta Radiol. 2010 Apr; 51(3): 316-25.
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22. *Server A, Orheim TE, Graff BA, Josefsen R, Kumar T, Nakstad PH.*
Diagnostic examination performance by using microvascular leakage, cerebral blood volume, and blood flow derived from 3-T dynamic susceptibility-weighted contrast-enhanced perfusion MR imaging in the differentiation of glioblastoma multiforme and brain metastasis.
Neuroradiology. 2010 Jul 13. [Epub ahead of print]
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Feasibility of contrast-enhanced cone-beam CT for target localization and treatment monitoring.
Radiother Oncol. 2010 Dec; 97(3): 521-4.
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24. *Sæther HK, Lagesen B, Trægde Martinsen AC, Holsen EP, Øvrebø KM.*
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25. *Martinsen AC, Saether HK, Olsen DR, Wolff PA, Skaane P.*
Improved image quality of low-dose thoracic CT examinations with a new postprocessing software.
J Appl Clin Med Phys. 2010 May 25; 11(3): 3242.
PubMed PMID: 20717095.
26. *Nilsen L, Fangberget A, Geier O, Olsen DR, Seierstad T.*
Diffusion-weighted magnetic resonance imaging for pretreatment prediction and monitoring of treatment response of patients with locally advanced breast cancer undergoing neoadjuvant chemotherapy.
Acta Oncol. 2010 Apr; 49(3): 354-60.
PubMed PMID: 20397769.
27. *Gutherlet M, Geier O, Stäb D, Ritter C, Beer M, Hahn D, Köstler H.*
SNR-optimized myocardial perfusion imaging using parallel acquisition for effective density-weighted saturation recovery imaging.
Magn Reson Imaging. 2010 Apr; 28(3): 341-50. Epub 2010 Jan 21. PubMed PMID: 20096527.
28. *Jensen K, Zangani L, Martinsen AC, Sandbæk G.*
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Cardiovasc Intervent Radiol. 2010 Nov 11.
[Epub ahead of print] PubMed PMID: 21069332.
29. *Furtado H, Stüdeli T, Sette M, Morita T, Trunk P, Freudenthal A, Samset E, Bergsland J, Gersak B.*
Endoclamp balloon visualization and automatic placement system.
Heart Surg Forum. 2010 Aug; 13(4): E205-11.
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30. *Espinoza A, Halvorsen PS, Hoff L, Skulstad H, Fosse E, Ihlen H, Edvardsen T.*
Detecting myocardial ischaemia using miniature ultrasonic transducers – a feasibility study in a porcine model.
Eur J Cardiothorac Surg. 2010 Jan; 37(1): 119-26.
Epub 2009 Jul 5. PubMed PMID: 19581103.
31. *Tronstad C, Pischke SE, Holhjem L, Tønnessen TI, Martinsen OG, Grimnes S.*
Early detection of cardiac ischemia using a conductometric pCO₂ sensor: real-time drift correction and parameterization.
Physiol Meas. 2010 Sep; 31(9): 1241-55.
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32. *Thorgersen EB, Hellerud BC, Nielsen EW, Barratt-Due A, Fure H, Lindstad JK, Pharo A, Fosse E, Tønnessen TI, Johansen HT, Castellheim A, Mollnes TE.*
CD14 inhibition efficiently attenuates early inflammatory and hemostatic responses in *Escherichia coli* sepsis in pigs.
FASEB J. 2010 Mar; 24(3): 712-22. Epub 2009 Oct 19.
PubMed PMID: 19841036; PubMed Central PMCID: PMC2830134.

33. *Wibe T, Ekstedt M, Hellesø R, Slaughter L.*
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Stud Health Technol Inform. 2010; 160(Pt 1): 676-80. PubMed PMID: 20841772.
 34. *Brochhausen M, Slaughter L, Stenzhorn H, Graf N.*
User-specific perspectives on ontologies.
Stud Health Technol Inform. 2010; 156: 114-21. PubMed PMID: 20543346.
 35. *Kazarian AM, Marangos IP, Røsok BI, Rosseland AR, Edwin B.*
[Laparoscopic resection of primary and metastatic malignant tumors of the adrenals].
Vestn Khir Im I I Grek. 2010; 169(4): 80-5. Russian. PubMed PMID: 20973194.
 36. *Pomianowska E, Gladhaug IP, Grzyb K, Røsok BI, Edwin B, Bergestuen DS, Mathisen O.*
Survival following resection of pancreatic endocrine tumors: importance of R-status and the WHO and TNM classification systems.
Scand J Gastroenterol. 2010 Aug; 45(7-8): 971-9. PubMed PMID: 20441530.
 37. *Mathisen L, Lingaas PS, Andersen MH, Hol PK, Fredriksen PM, Sundet K, Rokne B, Wahl AK, Fosse E.*
Changes in cardiac and cognitive function and self-reported outcomes at one year after coronary artery bypass grafting.
J Thorac Cardiovasc Surg. 2010 Jul; 140(1): 122-8. Epub 2009 Dec 16. PubMed PMID: 20018306.
 38. *Mujanovic E, Kabil E, Bergsland J, Stanimirovic-Mujanovic S, Caluk J.*
Ruptured aneurysm of the noncoronary sinus of valsalva into the right atrium.
Med Arh. 2010; 64(5): 307-8. PubMed PMID: 21287960.
 39. *Grenne B, Eek C, Sjøli B, Dahlslett T, Uchto M, Hol PK, Skulstad H, Smiseth OA, Edvardsen T, Brunvand H.*
Acute coronary occlusion in non-ST-elevation acute coronary syndrome: outcome and early identification by strain echocardiography.
Heart. 2010 Oct; 96(19): 1550-6. Epub 2010 Jul 18. PubMed PMID: 20643662.
 40. *Byun SS, Vasilakos A, Balasingham I.*
An Investigation of Stochastic Market Equilibrium in Cognitive Radio Networks.
IEEE Communications Letters 2010; 14(12): 1122-4.
 41. *Kazemeyni FS, Johnsen EB, Owe O, Balasingham I.*
Grouping Nodes in Wireless Sensor Networks Using Coalitional Game Theory.
Lecture Notes in Computer Science = Lecture notes in artificial intelligence 2010; 6119: 95-109.
 42. *Solberg LE, Hamran SE, Berger T, Balasingham I.*
Minimum Variance Signal Selection for Aorta Radius Estimation Using Radar.
EURASIP Journal on Advances in Signal Processing 2010; ID 682037: 1-13.
 43. *Khaleghi A, Chavez-Santiago R, Balasingham I.*
Ultra-wideband pulse-based data communications for medical implants.
IET Communications 2010; 4(15): 1889-97.
 44. *Liang X, Chen M, Xiao Y, Balasingham I, Leung V.*
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International Journal of Sensor Networks (IJSNet) 2010; 8(2): 98-108.
 45. *Sande EPS, Martinsen ACT, Hole EO, Olerud HM.*
Interphantom and interscanner variations for Hounsfield units – an establishment of reference values for HU in a commercial QA phantom.
Phys Med Biol (2010) 55: 1–13.
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46. *Byun SS, Balasingham I.*
A Measurement Allocation Scheme for Reliable Data Gathering in Spatially Correlated Sensor Networks.
IEEE Global Telecommunications Conference (GLOBECOM 2010). IEEE conference proceedings; 2010. p. 1-5.
 47. *Byun SS, Balasingham I.*
Approximations of Multiobjective Optimization for Dynamic Spectrum Allocation in Wireless Sensor Networks.
2010 Digest of Technical Papers International Conference on Consumer Electronics (ICCE). IEEE Consumer Electronics Society; 2010. p. 427-428.
 48. *Chavez-Santiago R, Khaleghi A, Balasingham I.*
An ultra wideband propagation model for wireless cardiac monitoring devices.
5th International ICST Conference on Body Area Networks. The Institute for Computer Sciences, Social Informatics and Telecommunications Engineering (ICST); 2010. p. 1-5.
 49. *Djenouri D, Balasingham I.*
Power-aware QoS geographical routing for wireless sensor networks & Implementation using Contiki.
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 50. *Floor PA, Balasingham I, Ramstad TA, Meurville E, Peisino M.*
Compression Schemes for In-body and On-body UWB Sensor Networks.
3rd International Symposium on Applied Sciences in Biomedical and Communication Technologies (ISABEL). IEEE conference proceedings; 2010. p. 1-5.

51. *Gordillo AC, Balasingham I.*
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Wireless and Optical Communications Conference (WOCC), 2010 19th Annual. IEEE conference proceedings; 2010. p. 1-5.
 52. *Gordillo AC, Balasingham I.*
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Wireless and Optical Communications Conference (WOCC), 2010 19th Annual. IEEE conference proceedings; 2010. p. 1-5.
 53. *Kazemeyni FS, Johnsen EB, Owe O, Balasingham I.*
Power-Efficient Sensor Networks: Modeling, Simulation and Verification.
Proceedings of the 22nd Nordic Workshop on Programming Theory, NWPT'10. TUCS; 2010. p. 76-8.
 54. *Khaleghi A, Balasingham I.*
Characterization of ultra-wideband wave propagation inside human body.
Antennas and Propagation Society International Symposium (APSURSI), 2010 IEEE. IEEE conference proceedings; 2010. p. 1-4.
 55. *Khaleghi A, Chavez-Santiago R, Liang X, Balasingham I, Leung V, Ramstad TA.*
On ultra wideband channel modeling for in-body communications.
IEEE International Symposium on Wireless Pervasive Computing. IEEE conference proceedings; 2010. p. 140-5.
 56. *Liang X, Chen M, Balasingham I, Leung V, Liang X.*
Soft QoS Provisioning for wireless sensor networks: A cooperative communications approach.
2010 5th International ICST Conference on Communications and Networking in China (CHINACOM). IEEE conference proceedings; 2010. p. 1-8.
 57. *Moussakhani B, Balasingham I, Ramstad TA.*
Distributed Signal Estimation Using Binary Sensors with Multiple Thresholds.
IEEE Vehicular Technology Conference Proceedings (VTC 2010-Spring), 2010 IEEE 71st. IEEE Press; 2010. p. 1-5.
 58. *Moussavinik H, Balasingham I.*
Interference mitigation using pulse position and frequency modulation for multiband systems.
Industrial Electronics and Applications (ISIEA), 2010 IEEE Symposium on. IEEE conference proceedings; 2010. p. 176-80.
 59. *Solberg LE, Balasingham I, Hamran SE.*
Candidate Estimators for Aorta Diameter Estimation Using Monostatic Radar.
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 60. *Støa S, Chavez-Santiago R, Balasingham I.*
An Ultra Wideband Communication Channel Model for Capsule Endoscopy.
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 61. *Støa S, Chavez-Santiago R, Balasingham I.*
An Ultra Wideband Communication Channel Model for the Human Abdominal Region.
IEEE Proceedings of the 2010 IEEE Globecom Workshops. IEEE conference proceedings; 2010. p. 246-250.
 62. *Wang Q, Balasingham I.*
Non-Line-of-Sight Error Mitigation for Range Estimation in Dynamic Environments.
3rd International Symposium on Applied Sciences in Biomedical and Communication Technologies (ISABEL). IEEE conference proceedings; 2010. p. 1-5.
 63. *Øyri K, Støa S, Fosse E.*
A Biomedical Wireless Sensor Network for Hemodynamic Monitoring.
I: 5th International ICST Conference on Body Area Networks: The Institute for Computer Sciences, Social Informatics and Telecommunications Engineering (ICST) 2010 ISBN 978-963-9995-01-7. s.1-6
- Not classified:**
Balasingham I, Chavez-Santiago R, Bergsland J, Fosse E.
Ultra Wideband Wireless Body Area Network for Medical Applications.
RTO-MP-HFM-182 Use of Advanced Technologies and New Procedures in Medical Field Operations. NATO Research and Technology Organisation; 2010. p. 1-24.
- Commentaries:**
Kazaryan AM, Røsok BI, Edwin B.
Laparoscopic and open liver resection for colorectal metastases: different indications?
HPB (Oxford). 2010 Aug; 12(6): 434; author reply 435.
PubMed PMID: 20662795; PubMed Central PMCID: PMC3028585.



2009

Level 2 publications

1. Emblem KE, Nedregaard B, Hald JK, Nome T, Due-Tønnessen P, Bjørnerud A.
Automatic Glioma Characterization from Dynamic Susceptibility Contrast Imaging: Brain Tumor Segmentation Using Knowledge-Based Fuzzy Clustering.
Journal of Magnetic Resonance Imaging 2009 Jul; 30(1): 1-10.
2. Gilbert M, Fosse E.
Inside Gaza's Al-Shifa hospital.
Lancet 2009 Jan 17; 373(9659): 200-2.
3. Hamidi V, Andersen MH, Oyen O, Mathisen L, Fosse E, Kristiansen IS.
Cost Effectiveness of Open Versus Laparoscopic Living-Donor Nephrectomy.
Transplantation 2009 Mar 27; 87(6): 831-8.
4. Kullberg J, Johansson L, Ahlstrom H, Courivaud F, Koken P, Eggers H, Bornert P.
Automated Assessment of Whole-Body Adipose Tissue Depots From Continuously Moving Bed MRI: A Feasibility Study.
Journal of Magnetic Resonance Imaging 2009 Jul; 30(1): 185-93.
5. Kvarstein G, Mawe L, Indahl A, Hol PK, Tennoe B, Digernes R, Stubhaug A, Tønnessen TI, Beivik H.
A randomized double-blind controlled trial of intra-annular radiofrequency thermal disc therapy – A 12-month follow-up.
Pain 2009 Oct; 145(3): 279-86.
6. Mathisen L, Lingaas PS, Andersen MH, Hol PK, Fredriksen PM, Sundet K, Rokne B, Wahl AK, Fosse E.
Changes in cardiac and cognitive function and self-reported outcomes at one year after coronary artery bypass grafting.
J Thorac Cardiovasc Surg 2009 Dec 15.
7. Walhovd KB, Fjell AM, Amlie I, Grambaite R, Stenset V, Bjørnerud A, Reinvang I, Gjerstad L, Cappelen T, Due-Tønnessen P, Fladby T.
Multimodal imaging in mild cognitive impairment: Metabolism, morphometry and diffusion of the temporal-parietal memory network.
Neuroimage 2009 Mar; 45(1): 215-23.
8. Westlye LT, Walhovd KB, Bjørnerud A, Due-Tønnessen P, Fjell AM.
Error-Related Negativity is Mediated by Fractional Anisotropy in the Posterior Cingulate Gyrus-025EFA Study Combining Diffusion Tensor Imaging and Electrophysiology in Healthy Adults.
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Level 1 publications

9. Bergsland J, Lingaas PS, Skulstad H, Hol PK, Halvorsen PS, Andersen R, Smastuen M, Lundblad R, Svennevig J, Andersen K, Fosse E.
Intracoronary Shunt Prevents Ischemia in Off-Pump Coronary Artery Bypass Surgery.
Annals of Thoracic Surgery 2009 Jan; 87(1): 54-60.
10. Brochhausen M, Slaughter L.
Patient Empowerment by Ontology-Based Multi-lingual Systems.
432-9. (IEEE)
11. Chavez-Santiago R, Khaleghi A, Balasingham I, Ramstad TA.
Architecture of an ultra wideband wireless body area network for medical applications. Applied Sciences in Biomedical and Communication Technologies, 2009.
ISABEL 2009. 2nd International Symposium on: 1-6. (IEEE)
12. Djenouri D, Balasingham I.
LOCALMOR: Localized multi-objective routing for wireless sensor networks.
Personal, Indoor and Mobile Radio Communications, 2009 IEEE 20th International Symposium on: 1188-92. (IEEE)
13. Djenouri D, Balasingham I.
New QoS and geographical routing in wireless biomedical sensor networks.
Broadband Communications, Networks, and Systems, 2009. BROADNETS 2009. Sixth International Conference on: 1-8. (IEEE)
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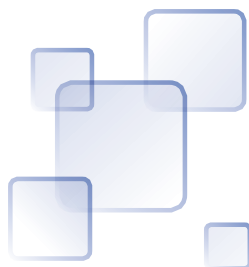
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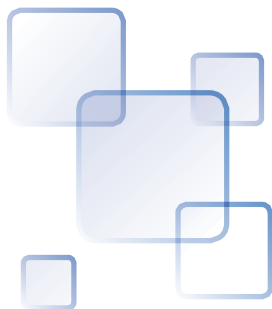
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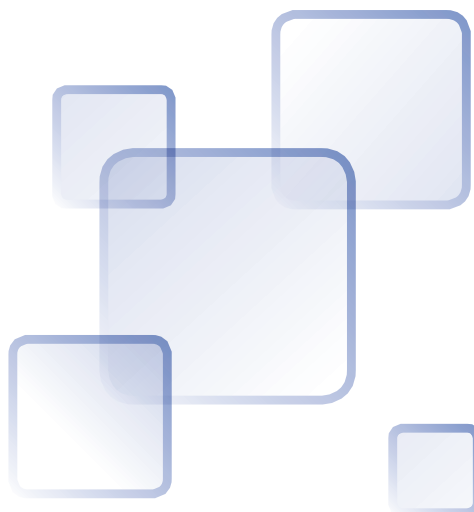
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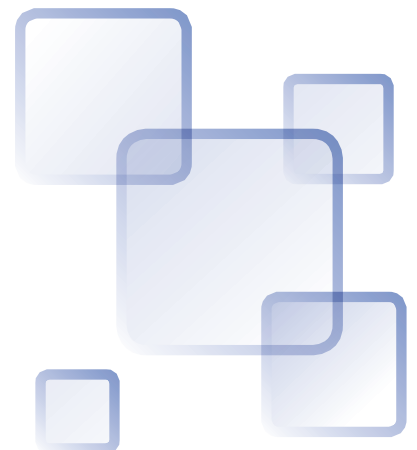
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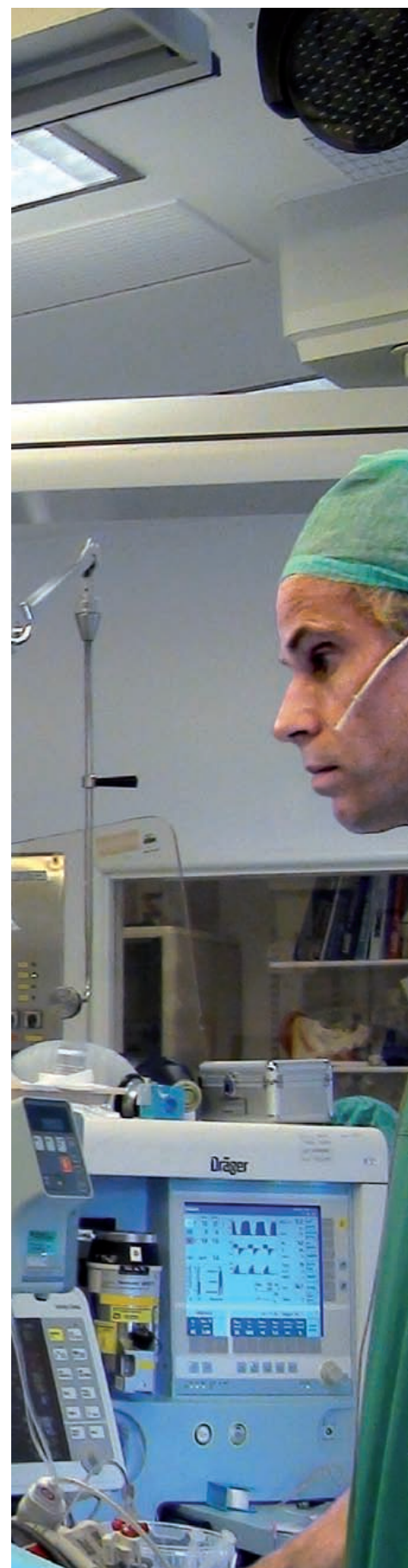
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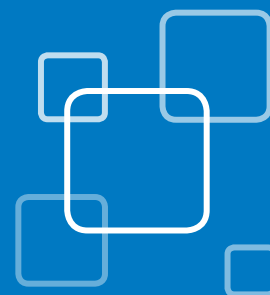
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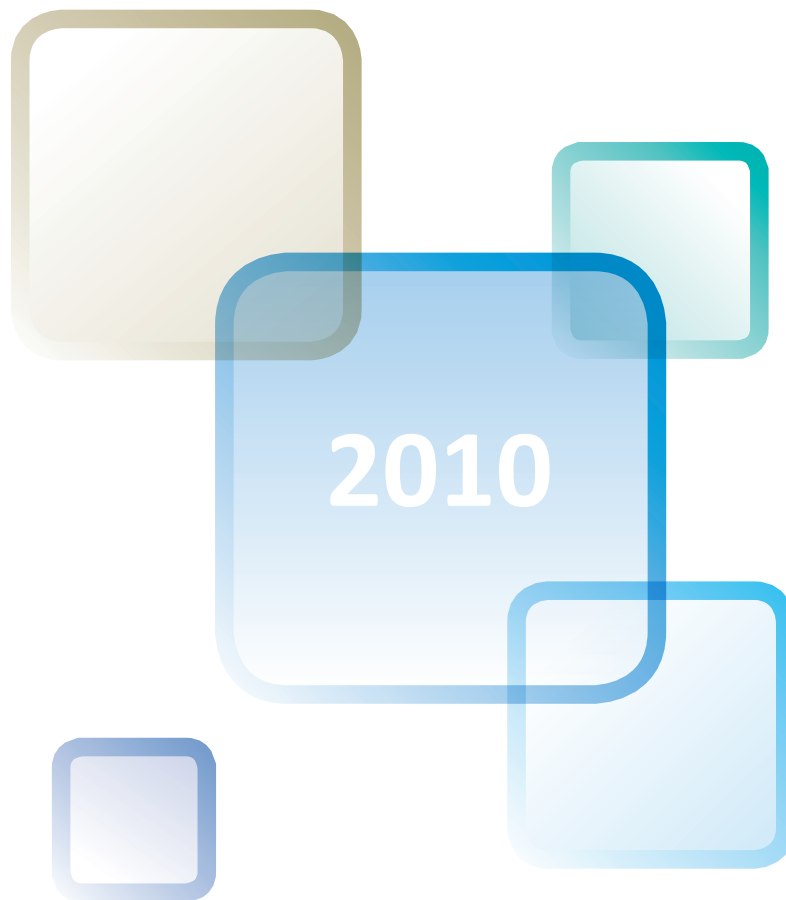
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