Nationellt möte om sjukhusfysik 2015

Falkenberg strandbad

11-13 november

SVENSKA SJUKHUSFYSIKER FÖRBUNDET

SVENSK FÖRENING FÖR RADIOFYSIK
SWEDISH SOCIETY OF RADIATION PHYSICS
(Member of IOMP)

Vi tackar våra utställare

CANBERRA

C-RAD

TESIKA Teknik AB
Test Simulering Kalibrering

HOY SCANDINAVIAN

SAM NORDIC

MICROPOS MEDICAL

VARIAN medical systems
A partner for life

visionrt

ELEKTA

Mallinckrodt Pharmaceuticals

NUKLEX
WWW.NUKLEX.SE

RaySearch Laboratories

YourRad
Din radioterapileverantör

Radeq
Radiotherapy equipment

Scanflex | *Medical*

ScandiDos

SIEMENS

gammadata

Program: Nationellt möte om sjukhusfysik 2015

Falkenberg Strandbad, Falkenberg

Tisdag 10/11

11.30	**Lunch**	
EM	Kurser enligt separat schema	
19.30	**Middag**	

Onsdag 11/11

FM	Fortsättning kurser, cheffysikermöte, arbetsgrupperna, ämnesföreträdarmöte	
11.30	**Lunch**	
12.30	**Välkommen**	***Anders Tingberg och Ylva Larsson***
Session 1 ***(Bryggan B-C)***		***Moderator: Anders Tingberg***
12.45	*Holger Sköldborn-pristagare:* Tillämpad dosimetri för datortomografi	*Love Kull & Jonas Andersson*
13.15	Kvalitetskontroll med virtuella patienter	*David Minarik*
14.00	Rörelse under strålbehandling	*Sofie Ceberg*
14.30	A concept study and framework for assuring basic safety and essential performance of X-ray equipment based on cooperation and dialogue with the vendors	*Johan Sjöberg*
14.45	**Kaffe och utställning**	
Session 2 ***(Bryggan B-C)***		***Moderator: Michael Ljungberg***
15.30	*Kurt Lidén-pristagare:* Från salt till socker	*Linda Knutsson*
16.00	Kursrådet informerar	*Sofie Ceberg*
16.15	ST-programmet, statusuppdatering och frågestund	*Sara Olsson*
	Spa & mingel	
19.00	**Middag**	

Torsdag 12/11

Session 3: Parallella sessioner

	Strålterapi ***Mod: Sofie Ceberg*** *(Bryggan B)*	Röntgen och strålskydd ***Mod: Anders Tingberg*** *(Bryggan A)*	Nuklearmedicin ***Mod: Michael Ljungberg*** *(Bryggan C)*	MR ***Mod: Karin Åberg*** *(Stranden B)*
08.15		Overview, practical tips and potential pitfalls of using automatic exposure control in CT - Siemens Care Dose 4D *Marcus Söderberg*		
08.30	Total marrow irradiation using helical tomotherapy *Per Engström*	A novel phantom to evaluate longitudinal and angular automatic tube current modulation (ATCM) in CT *Deborah Merzan*	Nuclear medicine imaging and dosimetry for ^{177}Lu and something about nuclear medicine in South Africa *Michael Ljungberg*	EMF-direktivet - Vad innebär det för MR-verksamheten? *Jonna Wilén*
08.45	Can biological margin definition improve target definition in prostate cancer? *Andreas Johansson*	The use of ultra-high purity aluminium filters for the determination of half value layer in mammography *Jörgen Nilsson*		
09.00	Flattening filter free volumetric modulated arc therapy for extreme hypofractionation of prostate cancer *Minna Ahlström*	Quantitative assessment of X-ray imaging detector performance in a clinical setting - a simple approach using a commercial instrument *Johan Sjöberg*		
09.15	Sjukhusfysikerns närvaro vid strålbehandling *Torsten Cederlund*	A novel method for the control of the light field - radiation field congruence in diagnostic radiology: development and evaluation *Markus Hulthén*		Developing a semi-automatised tool for grading brain tumours with susceptibility-weighted MRI *Maria Duvaldt*
09.30	**Kaffe och utställning**			
10.15	Dose evaluation to risk organs using enhanced inspiration gating for supra-diaphragmatic Hodgkin's lymphoma radiotherapy *Anneli Edvardsson*	Nytt system för registrering och analys av DSD *Stefan Thunberg*	Preparing a SPECT/CT department for clinical implementation of PET/CT at Norway's newest hospital *Julie Haglund*	Intraoperativ MR på Sahlgrenska *Åsa Carlsson*

10.30	Evaluation of risks for positioning the patient using the CatalystTM system during the radiation treatment *Jehangir Khan*	A strategy to reduce image reading time in breast tomosynthesis *Hannie Petersson*	Evaluation of Hermes Medical solutions distance dependent collimator correction - A phantom study *Annie Olsson*
10.45	Development and validation of a scanned proton beam model for dose distribution verification using Monte Carlo *David Boersma*	Evaluation of the effective dose of cone beam CT and multislice CT for temporomandibular joint examinations at optimised exposure levels *Nils Kadesjö*	Monte Carlo-simuleringar av GE Discovery Alcyone CZT SPECT kamera *Mikael Peterson*
11.00	RFID, a new technique to increase patient safety in radiotherapy *Sture Eklund*	Estimates of breast cancer growth rate from mammograms and its relation to histopathology *Daniel Förnvik*	SIMIND Monte Carlo based image reconstruction *Michael Ljungberg*

11.15 *Årsmöte*: Svensk Förening för Radiofysik

12.00 Lunch

Session 4 *(Bryggan B-C)*

Moderator: Karin Åberg

13.00 *Kalle Vikterlöf-föreläsning*: Radiobiologi och effekter av strålning — *Bo Stenerlöw*

14.00 *SSFF:s inbjudna föreläsare*: Joniserande strålning i rymden och en studie av planeten Mars — *Maria Sundin*

15.00 Workshops (inkl. kaffe)

A - Kontroll efter service *(Bryggan A)*	**B - Vardag på MR? Runda-bordsdiskussion** *(Stranden B)*	**C - Ungt forum - livet efter legitimationen** *(Bryggan BC)*
Övergripande projekt *Jonas Andersson*	QA - Vad gör vi och varför?	Info om Svensk Förening för Radiofysik *Sara Olsson*
Lednings- och inventarie-system *Jonas Arrefalk*	Implantat - vem bestämmer vad som ska undersökas i MR?	Info om Sjukhusfysiker-förbundet *Annie Olsson*
Praktiska exempel från genomförande *Christoffer Granberg*	Universitetssjukhus vs. icke-universitetssjukhus - finns etablerade samarbeten?	Info om Kursrådet *Sofie Ceberg*
	Bildoptimering - vem gör vad och när?	Hur blir man specialist? *Sofie Ceberg*

16.30 *Årsmöte*: Svenska Sjukhusfysikerförbundet

19.30 Fördrink

20.00 Konferensmiddag med dans och underhållning

Fredag 13/11

Session 5 *(Bryggan B-C)*		***Moderator: Sofie Ceberg***
09.00	MonitorXA: Automatic daily monitoring of Key Performance Indicators (KPI's) for QA of X-ray angiographic and interventional (XA) equipment	*Johan Sjöberg*
09.15	Bästa examensarbete 1: Monte Carlo simulations of cylindrical ionisation chamber response to high-energy photon beams in external radiotherapy	*Peter Andersson*
09.30	Bästa examensarbete 2: Breathing adapted radiotherapy of breast cancer: Investigation of two different gating techniques and visual guidance using optical surface scanning and pressure monitoring	*Lovisa Bergh*
	Bästa examensarbete 3: Optimisation of reconstructions on a SIEMENS Biograph mCT for whole body PET/CT examinations following the EARL recommendations	*Ted Nilsson*
09.45	Rapport från Ämnesföreträdarna och Cheffysikergruppen	
10.00	**Kaffe och avslutning på tipspromenaden**	

Session 6 *(Bryggan B-C)*		***Moderator: Torsten Cederlund***
10.30	Status föreskriftsprojektet	*Anders Frank*
10.50	Nordiska och svenska riktlinjer och rekommendationer om strålskydds-åtgärder under tidig fas av en nukleär eller radiologisk nödsituation	*Jan Johansson*
11.20	Öppen frågestund med SSM	
11.30	**Avslutning** • SSFF's pris till bästa föreläsning • Vinnare i tipspromenaden	***Anders Tingberg & Ylva Larsson***
12.00	**Lunch och hemresa**	

SVENSKA SJUKHUSFYSIKER FÖRBUNDET

SVENSK FÖRENING FÖR RADIOFYSIK

A concept study and framework for assuring basic safety and essential performance of X-ray equipment based on cooperation and dialogue with the vendors

J. Sjöberg*[1], P. Nowik[1], T. Wiberg[1], C. Kihlström[1], M. Goodliffe[2], A. Andersson[3] and H. Andersson[1]

[1]Dept. of Medical Physics, Karolinska University Hospital, Stockholm, Sweden
[2]Philips Healthcare, Philips, Stockholm, Sweden
[3]Siemens Healthcare, Siemens, Stockholm, Sweden

Purpose: Lack of dialogue between healthcare providers and vendors risk an inefficient and suboptimal use of resources as tasks associated with assuring basic and essential performance of imaging equipment may be repeated, or omitted, which is detrimental to radiation safety. Mapping and understanding of the processes and roles concerning QA provides the means to finding overlaps, or gaps, in established QA programs which can then be eliminated. The purpose of this concept study is to identify overlaps in routines and methods for two selected vendors and modalities and to suggest control mechanisms for counteracting any risks associated with the proposed workflow.

Methods: Two key modalities from two of the largest vendors of X-ray equipment and services in the Swedish market were selected for inclusion. Specifically, a computed tomography system and an X-ray angiographic and interventional system were included. The vendors shared their documentation regarding their QA programs for the selected X-ray equipment with Karolinska University Hospital. The methods and tolerance levels were checked against the corresponding entities in local procedures as well as against national and international regulations. All identified overlaps and discrepancies were documented and analysed.

Results: No critical discrepancies in the implemented QA methods have been identified regarding either specific tests or frequency of tests, which is translated into that a complete overlap has been identified. The vendors have for several instances implemented more rigorous and complete testing procedures than Karolinska University Hospital. A suggestion for a risk management system has been formulated tending to risks such as changing QA programs and discrepancies in the application of them. A system for monitoring the consistency of the practical implementation of the QA programs has been suggested, as well as outlining situations eligible for reporting to either The Swedish Radiation Safety Authority or and/or the Medical Products Agency.

Conclusion: A workflow where the QC processes are performed and communicated by the vendors is supported for the included modalities and vendors, as the QA programs are sufficiently complete regarding assurance of basic safety and essential performance. Control mechanisms in a risk management system have been suggested.

**Presenting author: johan.sjoberg@karolinska.se*

Total Marrow Irradiation using Helical Tomotherapy

P Engström*[1] and J Engellau[1]

[1]Strålningsfysik och Onkologi, Skånes Universitetssjukhus, Lund, Sweden

Purpose: Implementing a technique of Total marrow Irradiation (TMI) instead of Total Body Irradiation (TBI), as conditioning for Stem Cell Transplantation (SCT) for leukaemia. The intent of adopting TMI is to attempt to reduce long-term side effects in survivors of SCT. We report the technique used, and experiences of treating the first four patients with TMI.

Method: Until August 2015, four patients have been treated with TMI using Helical Tomotherapy. The patients were immobilised in a whole body vac. fix bag with individually moulded head and neck support. CT-sets were acquired with the patient positioned head-first supine followed by a feet-first supine scan with the patient rotated 180 degrees between the scans. All relevant structures were outlined by the oncologist for planning and recording purpose. Optimisation was performed by targeting all bone marrow structures and minimising dose to particularly radiosensitive organs such as lungs, kidneys, bowel and heart. Two plans where prepared; one for treatment of the upper body covering apex to mid-thigh, and one plan to treat the lower limbs. Before treatment, the patient position was verified by mega-voltage CT (MVCT) and a body surface scanning system. The 50% penumbral doses of the superior and inferior field were matched against each other by using radiopaque markers. A conventional TBI plan was also done for back-up purposes in case of machine breakdown.

Compared with the TBI-plans, dose reduction of 30-40% to kidneys, heart and bowel is achievable using Total Marrow Irradiation. Dose homogeneity to target structures was also improved with little or no dose exceeding 115% regardless of patient anatomy or BMI. Although the treatment time for Tomotherapy TMI is longer than for conventional TBI, all patients completed their treatments as planned with only mild sedation.

**Presenting author: per.e.engstrom@skane.se*

Can biological margin definition improve target definition in prostate cancer?

A Johansson*[1,2], B Lennernäs[3], U Isacsson[1]

[1]Department of Radiology, Oncology and Radiation Sciences, Section of Oncology, Uppsala University, Sweden
[2]The Centre of Clinical Research Sörmland, Uppsala University and Uppsala University Hospital, Sweden
[3]Deparment of Oncology, Örebro University Hospital, Örebro, Sweden

Purpose: In modern radiotherapy such as 3D-CRT, IGRT, IMRT and VMAT/ RapidArc, it is possibility to reduce the PTV by margin reduction. Typically the PTV margin has decreased from 15-20 mm to 3-7 mm with a more conformal dose distribution. However, according to several trials (1, 2) local control was reduced using IMRT vs the ”old” box technique. It has also been shown (3) that the microscopic spread of tumor cells in the neuro vascular bundles (NVB) is dependent on the differentiation of the tumor.
We have studied the relative difference of tumor control probability (TCP) in the NVB for different PTV margins (1-15 mm in steps of 1 mm) using 3D-CRT and VMAT treatment planning techniques.

Method: PTV margins from 1 to 15 mm, increasing with 1 mm for each PTV, have been created related to the prostate (CTV), excluding the NVB. For each PTV, one 3D- CRT and one VMAT plan has been optimized with a minimum dose of 95% of the ordinated dose (78 Gy) to 98% of the PTV. TCP for the NVB was calculated for each plan and compared for the different PTVs and treatment techniques.

Results and discussion: For the first three patients (of total 14), the TCP for the NVB is similar for both 3D- CRT and VMAT when the PTV margin is 8-15 mm. The TCP for NVB for PTV margin of 1 mm relative to 7 mm was 90% and 14% for 3D-CRT and VMAT, respectively.

Major findings: The TCP is more rapidly decreased with decreased PTV for VMAT then for 3D-CRT. Also, due to the steeper dose gradient, changes in patient positioning will affect IMRT/VMAT plans more than 3D-CRT plans. This emphasis the need for a biological approach in target definition.

**Presenting author: andreas.johansson@dll.se*

[1]Heemsbergen WD, Al-Mamgani A, Witte MG. Radiotherapy with rectangular fields is associated with fewer clinical failures than conformal fields in the high-risk prostate cancer subgroup: Results from a randomized trial. Rad & Oncol 2013 107 134-139

[2]Witte MG, Heemsbergen WD, Bohoslavsky R, Pos FJ, Al-Mamgani A, Lebesque JV, van Herk M. Relating dose outside the prostate with freedom failure in the Dutch trial 68 Gy vs. 78 Gy. Int J Radiat Oncol Biol Phys. 2010 May 1;77(1):131-8

[3]Chao KK, Goldstein NS, Yan D et al. Clinicopathological analysis of extracapsular extension in prostate cancer: should the clinical target volume be expanded posterolaterally to account for microscopic extension? IJROBP 2006 65(4) 999-1007

Flattening Filter Free Volumetric Modulated Arc Therapy for Extreme Hypofractionation of Prostate Cancer

M. Ahlström*[1,3], P. Nilsson[1,2], T. Knöös[1,2], C. Ceberg[1], H. Benedek[1,2]

[1]Department of Medical Radiation Physics, Clinical Sciences, Lund University, Lund, Sweden
[2]Department of Oncology and Radiation Physics, Skåne University Hospital, Lund, Sweden
[3]ScandiDos AB, Uppsala, Sweden

Purpose: To examine the feasibility of flattening filter free (FFF) volumetric modulated arc therapy (VMAT) for extreme hypofractionation of prostate cancer and investigate the potential decrease in treatment time per fraction while preserving or improving the treatment. To investigate the impact of intrafractional prostatic displacement.
Material and methods: Single arc treatment plans with photon beam qualities 10 MV with flattening filter (FF), 6 MV FFF and 10 MV FFF were created for nine patients treated with conventional fractionation (78 Gy, 2 Gy/fraction) and hypofractionation (42.7 Gy, 6.1 Gy/fraction), respectively. Dose-volume histograms (DVH) for all beam qualities were statistically evaluated using a paired sample Student's t-test. Treatment delivery was evaluated through measurements on a Varian TrueBeam™ using a Delta⁴ PT system (ScandiDos AB). The beam-on time for each plan was recorded. A motion study, including one FF and one FFF hypofractionated treatment plan, was also performed using the HexaMotion (ScandiDos AB) and with trajectory data from six authentic prostate movement patterns.

Results: All treatment plans were approved by a senior radiation oncologist. Evaluating the DVHs, no significant differences between beam qualities or between fractionation schedules were observed. All objectives were met for all plans. At the treatment delivery all plans passed the gamma criterion 3%, 2 mm with a pass rate of 98.8% or higher. The beam-on time for all conventional treatment plans was 1.0 minute. The mean beam-on time was 2.3 minutes for the hypofractionated 10 MV FF plan, 1.3 minutes for the 6 MV FFF and 1.0 minute for the 10 MV FFF. In the motion study, no or little effect was observed on the pass rate for displacements ≤1mm. The shorter treatment delivery was superior for three patterns, while the longer treatment was preferred in the case of temporal displacement of the prostate.

Conclusions: The treatment time for extreme hypofractionation of prostate cancer is reduced to less than half the time per fraction by combining FFF-technique with VMAT. The treatment plan quality was preserved for the FFF beams. Finally, a shorter beam-on time also seems advantageous for the majority of prostate motion patterns investigated.

**Presenting author: minna.ahlstrom@scandidos.com*

Dose evaluation to risk organs using enhanced inspiration gating for supra-diaphragmatic Hodgkin's lymphoma radiotherapy

M Kügele[1]*, A Edvardsson[2]*, E Kjellén[1], S Engelholm[1], S Ceberg[1]

[1]Department of Oncology and Radiation Physics, Skåne University Hospital, Lund, Sweden
[2]Department of Medical Radiation Physics, Lund University, Lund, Sweden

Introduction: Hodgkin's lymphoma patient are a relative young patient group that shows excellent long- term cure rates but suffer from late effects of the treatment, such as pulmonary dysfunction, cardiovascular disease and secondary cancers. The purpose of this ongoing study was to investigate if the absorbed dose to the lungs and heart could be decreased while maintaining target coverage using enhanced inspiration gating (EIG) for supra- diaphragmatic Hodgkin's lymphoma patients.

Material and Method: Twelve patients (seven female, five male), median age 29 years (20-58 years), was enrolled in this study. The patients had a staging PET/CT in free breathing (FB) prior to chemotherapy and a planning CT in both FB and EIG. During EIG, where the patients repeatedly are deep breathing following audio instructions, the breathing motion was monitored using the RPM system (Varian Medical Systems). The median breathing amplitude was 10.7 mm monitored on the chest wall with an associated median gating window of 3.6 mm. A CTV to PTV margin of 8 mm and an isotropic margin from the PTV to the MLC leafs of 7 mm were used for all patients. Involved-node radiotherapy plans were constructed in each CT set using AAA version 10.0.28 in Eclipse (Varian Medical Systems). AP/PA field orientation (6 MV) was used and additional fields with lower weight were added for dose homogenization. The prescribed dose varied between the patients, the most common protocol used was 30 Gy in 17 fractions.

Results and discussion: Dosimetric results for EIG and FB are presented in table 1. The $D_{mean,lungs}$ and $V_{20Gy,lungs}$ decreased for 11/12 and 10/12 patients, respectively. Less reduction was observed for the heart where $D_{mean,heart}$ and $V_{20Gy,heart}$ decreased for 6/12 and 5/12 patients, respectively.

Table 1. Comparison of dosimetric parameters to OARs for EIG and FB, presented as median values and range.

		EIG	FB
$D_{mean,lungs}$	(Gy)	8.5 (2.6-21.2)	10.4 (2.8-25.2)
$V_{20Gy,lungs}$	(%)	20.8 (0.1-49.4)	26.2 (0.0-61.3)
$D_{mean,heart}$	(Gy)	10.1 (0.9-35.9)	11.8 (1.3-30.3)
$V_{20Gy,heart}$	(%)	27.4 (0.0-96.1)	30.4 (0.0-78.2)
$V_{95\%,PTV}$	(%)	91.5 (87.6-97.1)	92.6 (87.3-97.3)

The median PTV volume was 10 % higher for EIG which implies difficulties in delineation. Acquisition of both FB and gated PET can possibly reduce the delineation uncertainties and offer a higher reduction in dose to OARs.

Conclusion: Breathing adapted EIG shows the potential to reduce the absorbed dose to the lungs and heart while maintaining target coverage for radiotherapy of supra-diaphragmatic Hodgkin´s lymphoma.

**Presenting author: Malin.Kugele@skane.se and Anneli.Edvardsson@med.lu.se*

Evaluation of risks for positioning the patient using the CatalystTM system during the radiation treatment

J Khan*, S Jonsson, J Jonsson and T Nyholm

Department of Radiation Physics, Umeå University, Umeå, Sweden

In radiation therapy the one of most important factors is positioning of the patient. There are two possibilities available at Norrland University Hospital (NUS) in Umeå: the C-Rad Catalyst™ system and external lasers in combination with skin marks. The aim of this study was to investigate if replacement of the laser based positioning technique with a surface scanning for primary positioning of the patient could be safely introduced. Also hazards related to the Catalyst™ system were directly compared with a laser based system.

To identify the potential hazards, a mapping of the work-flow at the radiation therapy department has been made by interviewing and auscultation at the radiation therapy department at NUS. In order to evaluate the hazards two analysis methods were used: Fault Tree Analysis (FTA) and Action Error Analysis (AEA).

A diversity of hazards has been identified, and the hazards considered more relevant have been thoroughly evaluated. According to FTA wrong positioning of a patient is due to user, collection of data, hardware and due to a patient itself. According to AEA additional hazards were identified and evaluated, for example selection of wrong patient by user or wrong patient enter into room can results in mistreatment. The risks associated with the Catalyst™ system work-flow were measured based on probability and severity of different potential hazards. The probability and severity factors were defined by numbers 1 to 5. The low probability number represents an unlikely event and a high value indicates an events that is deemed more frequently occuring. Similarly the low severity factor values represent no extension of positioning time or mistreatment while the high value of the severity factor stands for severe or permanent damages due to mistreatment. Additionally risk numbers were calculated based on the probability and severity of the hazards associated to the Catalyst™ system. The highest risk is related to the Catalyst™ system due to physical change of a patient body. The risk priority number (RPN) is calculated using the risk number and detectability factor. Where detectability factors were represented by value 1 to 5. The low number represents the high probability and the high number represents the low probability of detecting the error before causing potential harm. The highest value for RPN stands for higher risk and less detectability to find out an error.

The comparison between using laser and the Catalyst™ system to position the patient, shows that the Catalyst™ system has more check points with lower RPN number compared to the laser technique. The Catalyst™ is safer and flexible both for staff and patient compared to laser technique.

The project was a part of the hospital physicist program at Umeå University.

**Presenting author: jekh0005@student.umu.se*

Development and validation of a scanned proton beam model for dose distribution verification using Monte Carlo

E. Almhagen*[1,3], D.J. Boersma†[2], H. Nyström[3] and A. Ahnesjö[2]

[1]Medical Radiation Physics, Stockholm Universitet and Karolinska Institutet, Stockholm, Sweden
[2]Medical Radiation Physics, Inst. for IGP, Uppsala University, Uppsala, Sweden
[3]Skandionkliniken, Uppsala, Sweden

Although proton therapy is becoming increasingly common as a radiotherapy modality, facilities offering proton therapy are still scarce in comparison to photon therapy. Sweden's new proton therapy facilitiy, Skandionkliniken, employing the pencil beam scanning technique, has been taken into operation during 2015.

Computation of dose distributions using Monte Carlo (MC) simulations can be helpful in many ways. Since beam time is scarce, verification of dose distributions through MC simulations can remove the need for some of the dose verification measurements and thereby improve the efficiency of the treatment workflow. Simulations may also be a powerful tool in studying e.g. treatment strategies to deal with patient motion. For the simulations we are using GATE, a Geant4 application for medical imaging and radiation therapy.

In this work we developed a beam model based on calibration measurements performed during the commissioning phase of Skandionkliniken. Our beam model provides for each available beam energy (60-235 MeV) a probability distribution for the proton kinematics (lateral deviation, angular spread, emittance and energy spread) at nozzle exit. With this beam model, dose distributions can be simulated (with GATE) using either log file data or a treatment plan as an input.

The beam model can reproduce the calibration measurements with satisfactory accuracy, with simualated spot sizes and ranges at almost all energies within acceptable margins from the measurements. For validation, gamma index tests were performed comparing measured and simulated dose distributions using 3D spread-out Bragg peak plans. The measurements were taken with an IBA MatriXX dosimeter at several depths in an IBA Digiphant. After correction of a slight setup error, pass rates of 90% or above were obtained at all measured depths.

**This presentation is based on the master thesis project of Erik Almhagen eral8095@student.su.se*

†*Presenting author david.boersma@igp.uu.se*

RFID, a new technique to increase patient safety in radiotherapy

Sture Eklund*

Radiofysik, Onkologikliniken Västmanlands sjukhus Västerås

RFID, radio frequency identification, is a wellknown technique in the everyday life. It´s used in stores as a theft alarm, in libraries to identify books, to register cars passing a road toll etc. In health care, however, the use of this technology has been very limited.

When we looked for a check-in system, we found a RFID based system that could meet our requirements. Very soon we realized that the same system also could give us a new level of patient safety. The system from Xecan, a Boston based small company, is linked with the EMR. In our department that means it´s using the original database in ARIA (Varian Medical System). To track the patients and the accessories we use RFID tags and readers.

Upon entering for the daily treatment the RFID reader automatically identifies and check-in patients in the daily schedule treatment queue.

Before starting the treatment, the system checks that patient ID and accessories are the same as for the loaded plan.

In addition to the increased patient safety the system gives us better control of patient flow, which is of great importance when we use a drop-in system. It is also possible to get information about waiting times etc.

The staff are very satisfied with the system. They feel more safe knowing that the system makes all these extra checks. They are also very pleased with the automatic check-in that gives them full control over the waiting area.

The patients are also very pleased with the system, both the automatic check-in and the ID and accessory check. They feel more secure.

**Presenting author: sture.l.eklund@ltv.se*

Overview, practical tips and potential pitfalls of using automatic exposure control in CT – Siemens CARE DOSE 4D

Marcus Söderberg*

Medical Radiation Physics Malmö, Department of Translational Medicine, Lund University, Skåne University Hospital, Malmö, Sweden

Today, computed tomography (CT) systems routinely use automatic exposure control (AEC), which modulates the tube current. However, for optimal use, there are several aspects of an AEC system that need to be considered. The purpose of this study was to provide an overview of the Siemens AEC system, called the CARE Dose 4D, and discuss and exemplify practical tips and potential pitfalls. Two adult anthropomorphic phantoms were examined using two different Siemens CT systems. When optimizing the CT radiation dose and image quality, the projection angle of the localizer, patient centring, protocol selection, scanning direction, and the use of protective devices require special attention.

**Presenting author: marcus.soderberg@med.lu.se*

A novel phantom to evaluate longitudinal and angular automatic tube current modulation (ATCM) in CT

D. Merzan*, R. Bujila, P. Nowik

Dept. of Medical Physics, Karolinska University Hospital, Stockholm, Sweden

Purpose: To manufacture a phantom specifically designed for the purpose of evaluating the performance of the longitudinal and angular automatic tube current modulation (ATCM) on modern CT scanners and to use the phantom to investigate the effects of miscentering during a CT scan on the ATCM performance.

Methods: In order to evaluate angular ATCM, the phantom has an elliptical cross section (aspect ratio 3:2). To evaluate longitudinal ATCM, the phantom consists of 3 sections, with different major axes (25 cm, 30 cm and 35 cm). Each section is 15 cm long in the longitudinal direction. Between each section is a smooth transition. The phantom was milled from a solid block of PMMA. ATCM performance is evaluated by 1) analyzing the applied tube current for each slice of the phantom and 2) analyzing the distribution of image noise (σ) along the scan direction at different positions in the phantom. A demonstration of the ATCM performance evaluation is given by investigating the effects of miscentering during a CT scan on the latest CT models from three major vendors.

Results: The developed phantom has proven useful for evaluating both the longitudinal and angular ATCM on modern CT scanners (spiral collimations ≥ 4 cm). The homogeneity of the phantom makes image noise at different positions along the scan direction easy to quantify, which is crucial to understand how well the applied ATCM can produce a desired image quality. It was found that for two of the scanners miscentering of the phantom affected the applied tube current while for one of the scanners the tube current remained unchanged when the phantom was displaced from the centered position. For all scanners miscentering affected the image noise.

Conclusion: It is important to understand how ATCM is applied on CT scanners as it can directly affect dose and image quality. The phantom that has been developed is a valuable tool to understand how different variables during a scan, including miscentering, can affect the outcome of the longitudinal and angular ATCM. This work is part of the XQuality project at Karolinska University Hospital.

**Presenting author: deborah.merzan@karolinska.se*

The use of ultra-high purity Aluminium filters for the determination of half value layer in Mammography

J Scherp Nilsson, J Sjöberg* and J Lindström

Medical Physics, Karolinska University Hospital, Stockholm, Sweden

In the guidelines for the determination of the half value layer (HVL) in Mammography there is a requirement to use Aluminium (Al) filters of at least 99.9% purity. By comparison, in general radiography/fluoroscopy the requirements are usually somewhat lower, i.e. a purity level of at least 99.5%. The claimed justification for the use of ultra-high purity Al is due to an increased uncertainty which can be as large as 7% if using a purity of only 99.0% in Mammography. However, there is published research by a Brazilian research group (BRG) describing an alternative where recycled Aluminium (Al) is used. The HVL results are claimed to be equivalent to the high- purity Al-procedure normally recommended.

The purpose of this study is to audit the results of the BRG and further investigate what these results may imply for a more optimized choice of Al filter purity in the future. The purpose is also to get a better understanding of the designation of wrought Al Alloys and their potential use in Radiology.

By using the data from the BRG and determining the HVL and the corresponding effective linear attenuation coefficient, (μ_{eff}), the relative difference was calculated for two different Al purity levels. Information on the Al properties used in beverage cans as well as on high purity Al types was obtained from the suppliers and the international organisation, “The Aluminum Association” (AA).

The relative difference in HVL between using foils of ultra-high purity (99.999%) Al and foils of recycled Al (approximately 95- 97 % purity) was calculated to be 4.5%, using the data from BRG. Al foil for domestic use is usually of the 1100 Al type having a purity of at least 99.0%. Beverage cans are normally made of 3004 Al Alloy which has a purity of approximately 95- 97% according to AA.

The results in this study confirm that the use of recycled Al and the 1100 Al is good enough for the determination of the HVL in Mammography. Additionally, the asserted 7% difference between using 1100 (99.00%) and 1190 (99.90%) Al is not supported in this assessment.

**Presenting author: johan.sjoberg@karolinska.se*

Quantitative assessment of X-ray imaging detector performance in a clinical setting – a simple approach using a commercial instrument

J. Sjöberg*, R. Bujila, A. Omar, P. Nowik, S. Mobini-Kesheh and J. Lindström

Dept. of Medical Physics, Karolinska University Hospital, Stockholm, Sweden

Purpose: To measure and compare the performance of X-ray imaging detectors in a clinical setting using a dedicated instrument for the quantitative determination of detector performance.

Methods: The DQEPro (DQE Instruments Inc., London, Ontario Canada) was used to determine the MTF, NPS and DQE using an IEC compliant methodology for three different imaging modalities: conventional radiography (CsI-based detector), general- purpose radioscopy (CsI-based detector), and mammography (a-Se based detector). The radiation qualities (IEC) RQA-5 and RQA-M-2 were used for the CsI-based and a-Se- based detectors, respectively. The DQEPro alleviates some of the difficulties associated with DQE measurements by automatically positioning test devices over the detector, guiding the user through the image acquisition process and providing software for calculations.

Results: A comparison of the NPS showed that the image noise of the a-Se detector was less correlated than the CsI detectors. A consistently higher performance was observed for the a-Se detector at all spatial frequencies (MTF: 0.97@0.25 cy/mm, DQE: 0.72@0.25 cy/mm) and the DQE drops off slower than for the CsI detectors. The CsI detector used for conventional radiography displayed a higher performance at low spatial frequencies compared to the CsI detector used for radioscopy (DQE: 0.65 vs 0.60 @0.25 cy/mm). However, at spatial frequencies above 1.3 cy/mm, the radioscopy detector displayed better performance than the conventional radiography detector (DQE: 0.35 vs 0.24 @2.00 cy/mm).

Conclusion: The difference in the MTF, NPS and DQE that was observed for the two different CsI detectors and the a-Se detector reflect the imaging tasks that the different detector types are intended for. The DQEPro has made the determination and calculation of quantitative metrics of X-ray imaging detector performance substantially more convenient and accessible to undertake in a clinical setting.

**Presenting author: johan.sjoberg@karolinska.se*

A novel method for the control of the light field – radiation field congruence in diagnostic radiology; development and evaluation

M Hulthén* and J Lindström

Dept. of Medical Physics, Karolinska University Hospital, Stockholm, Sweden

The purpose of this work was to develop and evaluate a novel method for the control of the light field – radiation field congruence in diagnostic radiology. The locations of the respective field edges were determined utilizing a high resolution CCD line camera (Mightex USB, 3648 pixels (W×L) 200 µm × 8 µm pixel size) originally intended for light spectroscopy. By modifying the line camera with a scintillator strip (terbium doped gadolinium oxysulfide, Gd_2O_2S:Tb or GOS) it was also made sensitive to X-rays. After acquiring the edge profiles, five parameter logistic (5PL) functions were fitted to the profiles and the edge locations (and deviations) calculated and presented using a MATLAB (The MathWorks Inc.) script. This resulted in a high accuracy method not previously obtained by existing control devices in a digital radiology department. The evaluation of the method showed an overall uncertainty better than ±0.12 mm (k = 2). Since the method has the ability to localize the light field edge in an objective manner, it eliminates the subjective process of manual estimation which is present in all other known methods. The newly developed method was compared to existing methods (in a digital radiology department) in terms of functionality, uncertainty and other cost / benefit factors. The methods included in the comparison were products typically found on the market; RTI Visi-X (*fluorescent and phosphorescent screen*), Gafchromic XR-M2 (*irreversible radiochromatic film*) and Unfors DXR+ (*photodiode array*). Although the comparison largely came out in favor of the novel method, it needs further development to obtain full clinical functionality. An additional finding during the evaluation was that of *focal spot wandering* between exposures due to thermal expansion of the anode rod. It was seen that this phenomenon was able to shift the location of the X-ray field edge on mammographic equipment on the chest wall side up to nearly 1 mm during X-ray tube warm up.

**Presenting author: markus.hulthen@karolinska.se*

A strategy to reduce image reading time in breast tomosynthesis

H Petersson*, M Dustler, A Tingberg and P Timberg

Medical Radiation Physics, Department of Translational Medicine, Lund University, Malmö, Sweden

A breast tomosynthesis (BT) exam produces an image volume with a large number of slices. The large amount of data and the increased workload is a major concern when considering BT as an alternative or complement to conventional mammography in breast cancer screening. A possible way to decrease the number of slices in BT is to combine adjacent image planes, so called slabbing. Increased slab thickness leads to decreased depth resolution, which affects the detection of lesions. However, a relatively thick slabbing of the outer part of the image volume (where few lesions are present) could be a successful approach. The purpose of this work was to assess if a relatively thick slabbing of the outer slices could be a viable alternative in order to reduce the number of slices in BT image volumes, hence data size and reading time.

An image volume with thick outer slabs, and thin slices between, was evaluated. A survey of the depth location of 65 cancer lesions within the breast was performed to estimate how many lesions would be affected by outer slabs with varying thickness. Also, a selection of 24 lesions was reconstructed with various slab thickness to evaluate how lesion appearance would be affected in the thick outer slabs.

Preliminary results indicate that few malignant breast lesions are located at a depth less than 10 mm from the skin (especially for breast thicknesses of 50 mm and above). Reconstruction with 5 mm slab thickness yielded an image quality that was sufficient for lesion detection in the majority of the investigated cases. In conclusion, relatively thick slabbing of the outer slices is a promising option in order to reduce the number of slices in BT image volumes.

**Presenting author: hannie.petersson@med.lu.se*

Evaluation of the effective dose of cone beam CT and multislice CT for temporomandibular joint examinations at optimized exposure levels

N Kadesjö*[1,2], D Benchimol[1], B Falahat[3], K Nässtrom[1], XQ Shi[1]

[1]Department of Dental medicine, Karolinska Institutet, Stockholm, Sweden
[2]Medical Radiation Physics, Karolinska University Hospital, Stockholm, Sweden
[3]Department of Radiology in Huddinge, Karolinska University Hospital, Stockholm Sweden

Study objectives: To compare the effective dose to patients from temporomandibular joint examinations using a dental cone-beam CT device and a multi-slice CT device, both before and after dose optimization.

Methods and material: During this study a Promax3D cone-beam CT and a GE Lightspeed VCT multi-slice CT where used. For both x-ray devices, the effective dose was measured for our clinically used protocols. Radiation dose was measured using thermoluminescent dosimeters inside an Alderson Rando anthropomorphic phantom. Optimized exposure protocols were obtained through an optimization study using a phantom comprised of a dry skull inside simulated soft tissue. In the optimization study four observers, specialists in oral and maxillofacial radiology, rated images taken at different exposure levels regarding four different image quality criteria. The optimal exposure level was obtained when all included criteria were rated as acceptable or better by all observers.

Results: The effective dose from a bilateral examination was 180 µSv for Promax3D and 110 µSv for Lightspeed VCT before optimization. Post optimization the bilateral effective dose was 90 µSv for Promax3D and 120 µSv for Lightspeed VCT.

Conclusion: For the previously clinically used protocols, the cone-beam CT gives about 60% higher dose compared to the multi-slice CT. This goes contrary to the commonly held belief that cone-beam CT always gives a lower dose than multi-slice CT. Post optimization the multi-slice CT gives about 30% higher dose compared to the cone-beam CT. This difference is minor, compared to the large range of effective does from temporomandibular joint examinations previously reported in the literature.

**Presenting author: nils.kadesjo@karolinska.se*

Estimates of Breast Cancer Growth Rate from Mammograms and its Relation to Histopathology

D Förnvik*[1,2], K Lång[3], I Andersson[3], M Dustler[1], S Borgqvist[4] and P Timberg[1]

[1]Medical Radiation Physics, Lund University, Malmö, Sweden
[2]Oncology and Radiation Physics, Skåne University Hospital, Lund, Sweden
[3]Diagnostic Radiology, Lund University, Malmö, Sweden
[4]Division of Pathology, Skåne University Hospital, Malmö, Sweden

Mammography contains potentially useful prognostic information on the growth rate of malignant tumours, information that is rarely used in treatment planning. This is particularly true for patients participating in mammography screening programs that imply repeated examinations at regular intervals. This study aimed to investigate the growth rate of 31 consecutive invasive breast cancers based on volume measures on at least two mammograms and its relation to histopathological findings. The average tumour volume doubling time in all invasive breast cancer subtypes was 282 days (range 46-749 days). Grade III breast cancers had a significantly shorter average tumour volume doubling time of 105 days (range 46-157 days) compared to grade I & II tumours (average of 296 days, range 147-531 days and average of 353 days, range 139-749 days, respectively) ($p = 0.002$). Lobular carcinomas had significantly longer average tumour volume doubling time compared to ductal types: 431 days (range 229-749) days) vs. 236 days (range 46- 531 days), respectively ($p = 0.007$). Patients with axillary lymph node involvement had significantly shorter tumour volume doubling time compared to lymph node negative patients: 146 days (range 46-326) days) vs. 334 days (range 123-749 days), respectively ($p = 0.005$). Multiple linear regression identified that tumour volume doubling time was positively associated with patient age, histological grade and progesterone receptor expression, and inversely associated with axillary lymph node involvement, HER2 and Ki-67 expression ($p < 0.001$).

In conclusion, tumour volume doubling time as estimated on serial mammography may provide important prognostic information relevant for clinical decision-making.

**Presenting author: daniel.fornvik@med.lu.se*

Preparing a SPECT/CT department for clinical implementation of PET/CT at Norway's newest hospital

Julie Haglund*

Department of Imaging Diagnostics/Nuclear Medicine Section, Østfold Hospital, Kalnes, Norway

The challenge of installing and starting clinical operations of PET/CT in a hospital requires cooperation from a multidisciplinary team, as described by the AAPM Task Group 108 and IAEA. When not only the PET/CT modality is new to the department, but also the entire hospital facility is new, even greater efforts are required in order to successfully begin clinical activity.

At the new Østfold Hospital Kalnes, the decision to install a PET/CT in the nuclear medicine department required starting from scratch in every possible context. The decision to install a PET/CT was made after designing and planning a room for SPECT/CT, which meant modifying the physical buildings of the new hospital during a late phase of construction. Shielding had to be modified in order to accommodate positron annihilation radiation energy. Østfold Hospital Kalnes had the opportunity to choose among three manufacturers of PET/CT machines. In order to decide which machine to purchase, extensive research and evaluation by a multidisciplinary team was necessary in order to choose a machine that will be suitable for the present and future ambitions of the hospital. The staff of the nuclear medicine department is well experienced in clinical SPECT/CT, but nobody had previously worked with PET/CT. Training became a critical part of preparing for the installation and clinical implementation. Department seminars highlighted radiation safety and clinical PET/CT protocols, and visits to other hospitals were made in order to observe clinical routines and quality control procedures.

Since Østfold Hospital Kalnes is not a university hospital and is completely new to PET/CT, it was decided to join the EARL FDG quality assurance program from the European Association of Nuclear Medicine. Participation in EARL will enhance confidence in both the staff and the public. Accreditation shows that the department performs PET/CT studies at a level that is comparable to university hospitals that have a long clinical history with clinical PET/CT and increases possibilities for collaboration and research.

**Presenting author: haglundj@aol.com*

Evaluation of Hermes Medical solutions distance dependent collimator correction – A phantom study

A Olsson*, M Holstensson and A Gustafsson

Enheten för Nuklearmedicinsk fysik, VO Sjukhusfysik,Karolinska Universitetssjukhuset Huddinge, Stockholm, Sweden

Background: Almost all software manufacturers within Single photon emission computed tomography (SPECT) offers a solution for the distance dependent collimator correction. This correction both improves spatial resolution and deals with noise in a beneficial way which enables either dose reduction or reduced acquisition time. The correction that is collimator specific corrects for the collimator blurring which is dependent on the distance between the collimator and the object. The version that is offered by Hermes Medical Solutions (Stockholm, Sverige) is called Resolution recovery (RR) and is applied within the iterative reconstruction algorithm ordered subset expectation maximisation (OSEM).

Aim: The aim of this study was to evaluate how spatial resolution, noise and contrast in the tomographic image are affected by RR. Furthermore to evaluate how resolution is affected by reconstruction parameters like the number of equivalent iterations.

Material and Methods: All acquisitions were performed on a Siemens Symbia T16 SPECT/CT-system with low energy high resolution (LEHR) collimators and the reconstructions were performed in Hermes. In order to study the spatial resolution a water filled Jaszczak phantom was used with an input of three ^{99m}Tc-filled line sources. In order to study image noise and contrast the same phantom was used but with six mounted plastic spheres in a background filled with ^{99m}Tc and water. The images were reconstructed both with and without RR. The number of equivalent iterations (subsets times iterations) was varied when reconstructing the phantom with the line sources. Spatial resolution was calculated in these images.

Results: Images reconstructed with RR gives an increased central spatial resolution of 20% and a decreased noise level (8% lower). The contrast is somehow better for the images with RR (41% for images corrected with RR compared to 38% for the non corrected images). The convergation for spatial resolution is delayed using reconstructions with RR compared with reconstructions without RR.

Conclusion: The results show that both spatial resolution and noise handling are improved by the use of RR. The result serves a good basis in further optimization studies in nuclear medicine examinations with respect to acquisition time and/or administered activity.

**Presenting author: annie.olsson@karolinska.se*

Monte Carlo-simuleringar av GE Discovery Alcyone CZT SPECT kamera

Mikael Peterson*, Michael Ljungberg

Medicinsk strålningsfysik, Lunds Universitet, Lund, Sverige

Introduktion: På senare tid så har gammakameror baserade på halvledarteknik med kadmium-zink-tellur (CZT) introducerats i kliniken. En avgörande skillnad ur simuleringssynpunkt jämfört med konventionell scintillationskamera är den direkta insamlingen av laddningsbärare som ger ett mer högupplöst energispektrum men med annorlunda energifördelning. Andra skillnader går att härleda från användandet av pinnhål som kollimator, bl.a. litet fokuserat FOV. Implementeringen av CZT-kameror innebär flera förbättringar, t.ex. bättre energiupplösning, kortare insamlingstid samt reducerad administrerad aktivitet, men kräver också nya metoder för t.ex. optimering av energifönster.

Metod: En analytisk modell av laddningstransporten i en CZT detektor för GE Discovery 530c/570c SPECT implementerades i Monte Carlo-programmet SIMIND och validerades med mätningar. Kamerasystemet består av 19 detektormoduler med ett pinnhål per detektormodul. Valideringen utfördes i 2 steg; (1) tre spektra uppmättes för tre isotoper (^{99m}Tc, ^{123}I och ^{201}Tl) och jämfördes med simulerade spektra; (2) känslighet och spatial upplösning kontrollerades med en ^{99m}Tc-punktkälla och ett tredimensionellt translationsbord.

Resultat: Simulerade energispektra överensstämmer väl med experimentellt uppmätta för fototoppen, men överskattar k-edge x-ray escape peak för kadmium och tellur samt underskattar bidraget vid låga energier. Jämförelserna för spatial upplösning visar god överensstämmelse och systemkänsligheten är 11.6% är högre för simuleringar jämfört med mätningar. Slutligen, för att demonstrerar potentialen för kliniska studier, genomfördes simulering av ett hjärtfantom med inferior perfusionsdefekt. Projektionsdata rekonstruerades och utvärderades sedan i Xeleris arbetsstation.
Slutsats: Vi har genomfört simuleringar av halvledardetektor med pinnhålskollimering. Data kan rekonstrueras på arbetsstation och användas för optimering och utvärdering av insamlingsprotokoll och metoder.

**Presenting author: mikael.peterson@med.lu.se*

SIMIND Monte Carlo based image reconstruction

M Ljungberg*

Department of Medical Radiation Physics, Lund University, Lund, Sweden.

Objectives: In an iterative reconstruction algorithm, a model of the image system is needed to be able to calculate SPECT projections. This part of the algorithm is called the forward projector. In most methods, some approximations are included in the projector. For example, the collimator resolution is modelled by a distance dependent Gaussian function, which not always include septal penetration. Scatter is often compensated by subtracting energy-window based scatter estimates prior to reconstruction or as part of the forward projector. However, these scatter estimates do not reflect the true scatter distribution in the main photopeak window. Backscatter events are often omitted.

Methods: The SIMIND Monte Carlo program has been widely used for 30 years and is a reliable code for simulating scintillation camera imaging and SPECT. This program is in fact a full forward camera projector. We have therefore modified the code to become a complete ML-EM/OS-EM reconstruction algorithm. The source distribution is initially uniform. After an ordinary SPECT simulation is completed, the measured projections are imported. A ML-EM algorithm then calculates an error image that updates the source map and a new simulation (iteration) is started. Ordered sub-sets have been implemented. SIMIND-reconstructed images have been evaluated quantitatively and qualitatively from phantom studies of a RSD anthropomorphic phantom with 177-Lu and 111-In activity in the liver and in different spheres will 111-In in an elliptical phantom.

Results: Our results show good activity recovery when comparing to know activities. Comparison with images from a different reconstruction program shows good agreement.

Conclusions: The SIMIND program has been modified to reconstruct SPECT images with a high accuracy. The drawback is the time required to reconstructing but the development of this feature of SIMIND was not aimed to replace fast clinically reconstruction program hut rather to be useful as a reference program.

**Presenting author: michael.ljungberg@med.lu.se*

Developing a Semi-Automatised Tool for Grading Brain Tumours with Susceptibility-Weighted MRI

Maria Duvaldt*[1], Tomas Jonsson[2]

[1]Department of Medical Physics, Karolinska University Hospital, Stockholm

Gliomas are a common type of brain tumour and for the treatment of a patient it is important to determine the tumour's grade of malignancy. This is done today by a biopsy that is classified on a malignancy scale from I to IV (set by WHO). Recent studies have shown that the local image variance (LIV) and the intratumoural susceptibility signal (ITSS) in susceptibility-weighted MR images correlate to the tumour grade. The aim of this project is to develop a software program that can separate gliomas into low grade (I-II) and high grade (III-IV). The result is a graphical user interface written in Python. The user chooses an image, draws a region of interest and starts the analysis. The analyses implemented in the program are LIV and ITSS, and the code can be extended to contain other types of analyses. To validate the image analysis, 16 patients with glioma grades confirmed by biopsy are included in the study. Their susceptibility-weighted MR images were analysed with respect to LIV and ITSS, and the outcome was tested versus the known grades of the patients. No significant difference could be seen between the high and the low grade group, in the case of LIV. This was probably due to hemorrhage and calcification, characteristic for some tumours and interpreted as blood vessels. Concerning ITSS a statistically significant difference could be seen between the high and the low grade group ($p < 0.02$). The sensitivity and specificity was 80% and 100% respectively. Among these 16 gliomas, 11 were astrocytic tumours and between low and high grade astrocytomas a statistically significant difference was shown. The degree of LIV was significantly different between the two groups ($p < 0.03$) and the sensitivity and specificity were 86% and 100% respectively. The degree of ITSS was significantly different between the two groups ($p < 0.04$) and the sensitivity and specificity were 86% and 100% respectively. The results indicate that SWI is useful for separating high and low grade astrocytomas with 1.5T imaging within this cohort. It also seems possible to distinguish between high and low grade gliomas with ITSS.

**Presenting author: maria.duvaldt@karolinska.se*

MonitorXA: Automatic daily monitoring of Key Performance Indicators (KPI's) for QA of X-ray angiographic and interventional (XA) equipment

J. Sjöberg*, A. Omar, R. Bujila, P. Nowik and G. Poludniowski

Dept. of Medical Physics, Karolinska University Hospital, Stockholm, Sweden

Purpose: Conventional quality control methods for testing system performance of XA equipment at Karolinska University Hospital typically generates data that is infrequently sampled in time and observer dependent due to the requirement of extensive manual interventions. These factors limit the potential use for trend analysis as well as potentially leading to a situation where deterioration in equipment performance is not identified in time. The purpose of this work was to implement routine semi-automated QC based on KPI's. A KPI is a quantifiable parameter that has a known dependency to many underlying parameters. Dense sampling of KPI's in time for XA equipment has the potential to alleviate the aforementioned limitations of conventional QC methods.

Methods: A software was developed using Matlab (Mathworks Inc., MA, USA) and deployed on a DICOM server. A protocol was designed on a Philips AlluraClarity XA system at the Neuroradiology department where 7 images per detector are acquired each morning by the clinical staff using a preset beam quality at different detector air kerma (DAK) levels (70 kV, 0.9 mmCu+1.0 mmAl, DAK range: ~65 nGy to 6.5 μGy) and a standard irradiation geometry. X-ray technicians were trained using an instructional video, hosted remotely. Images are automatically exported to the DICOM server and analyzed by the software. The signal transfer properties, the noise linearity with a fitted noise decomposition model, the noise stationarity, the signal uniformity, defective pixels analysis and variance images for artifact evaluation are all automatically generated. Quantifiable data is stored in a database, and reports are created with indications on established pass/fail criteria and emailed to selected recipients.

Results: The MonitorXA concept automates relevant QC tests recommended by IPEM which enables the sampling of performance metrics on a daily basis. The entire process takes ~6 minutes and in one instance a significant artifact and a defective pixel has been identified.

Conclusion: A semi-automated system for monitoring the performance of XA equipment, including data aggregation, analysis, management and reporting has been developed. The system facilitates efficient data collection, enabling useful trend analysis on large data sets. MonitorXA is a part of the XQuality project at Karolinska University Hospital.

**Presenting author: johan.sjoberg@karolinska.se*

Nationellt möte om sjukhusfysik, Falkenberg strandbad 11-13 november 2015

Caroline Adestam Minnhagen	Sahlgrenska Universitetssjukhuset
Emelie Adolfsson	Region Östergötland
Isabell Ahlén	SAM Nordic AB
Minna Ahlström	ScandiDos AB
Anders Ahnesjö	Uppsala Universitet/Akademiska
Gudrun Alm Carlsson	Linköpings universitet
Jonas Andersson	Västerbottens läns landsting
Karin Andersson	Universitetssjukhuset Örebro
Linnea Andersson	Region Östergötland
Peter Andersson	Göteborgs Universitet
Laura Antonovic	RaySearch Laboratories AB
Oscar Ardenfors	Karolinska Universitetssjukhuset
Jonas Arrefalk	Västerbottens läns landsting
Peder Arvidsson	Östersunds sjukhus
Bertil Axelsson	
Lovisa Bergh	Skånes Universitetssjukhus
Jonas Berglund	Nuklex AB
Johan Blom	Nuklex AB
David Boersma	Uppsala universitet
Alex Bogason	Mallinckrodt Radiopharmacutical
Martin Bolin	Karolinska Universitetssjukhuset
Gusfav Brolin	Region Kronoberg
Sara Bruce	Akademiska sjukhuset
Åsa Carlsson	Sahlgrenska Universitetssjukhuset
Roberto Casado	Radeq
Sofie Ceberg	Skånes Universitetssjukhus
Torsten Cederlund	Strålsäkerhetsmyndigheten
Johanna Dalmo	Sahlgrenska Universitetssjukhuset
Patrik Dalsjö	Mallinckrodt Radiopharmacutical
Malin Darpö	Danderyds sjukhus AB
Emma Djärv	Sahlgrenska Universitetssjukhuset
Ninni Drugge	Sahlgrenska Universitetssjukhuset
Maria Duvaldt	Karolinska Universitetsjukhuset
Lars E Olsson	Skånes Universitetssjukhus
Martin Echerwall	Siemens Healthcare AB
Anneli Edvardsson	Lunds universitet
Robert Eklund	Scanflex Medical AB
Sture Eklund	Västmanlands sjukhus
Katrin Elisabet Håkansson	Rigshospitalet Köpenhamn
Alexander Englund	Akademiska sjukhuset
Per Engström	Skånes Universitetssjukhus
Klas Eriksson	Danderyds sjukhus / KI
Simone Eriksson	Siemens Healthcare AB
Ulrika Estenberg	Karolinska Universitetssjukhuset
Markus Fahlström	Akademiska sjukhuset
Andreas Forsberg	Norrbottens Läns Landsting
RobertForsberg	Radeq
Anders Frank	Strålsäkerhetsmyndigheten
KarinFransson	Landstinget i Kalmar län
Anette Fransson Andreo	Karolinska Universitetssjukhuset
Daniel Förnvik	Skånes Universitetssjukhus
Giovanna Gagliardi	Karolinska Universitetssjukhuset
Narine Geghamyan	Aleris Röntgen
Ina Gillström	Västmanlands sjukhus
Christoffer Granberg	Norrlands universitetssjukhus
Ulf Granlund	Universitetssjukhuset Örebro
Jenny Granström	Elekta Instrument AB
Agnetha Gustafsson	Karolinska Universitetsjukhuset
Anders Gustafsson	Cureos AB
Christian Gustafsson	Skånes Universitetssjukhus
Julie Haglund	
Annica Hall	Västerås landsting/Skandion
Ylva Hammarström Larsson	Landstinget Dalarna
Markus Hulthen	Karolinska Universitetssjukhuset
Ole Høj	Hoy Scandinavian
Cecilia Ingebrigtsen	Universitetssjukhuset Örebro
Anderas Johansson	Mälarsjukhuset
Annelie Johansson	RaySearch Laboratories AB
Jan Johansson	Strålsäkerhetsmyndigheten
Cathrine Jonsson	Karolinska Universitetsjukhuset
Joakim Jonsson	Norrlands universitetssjukhus
Sofia Jonsson	Umeå Universitet
Tomas Jonsson	Karolinska Universitetsjukhuset
Mahmoud Joweini	Siemens Healthcare AB
Nils Kadesjö	Karolinska Universitetsjukhuset
Jehangir Kahn	Umeå Universitet
Johnny Kallin	NU-sjukvården
Henrik Karlsson	Landstinget i Kalmar län
Mattias Karlsson	Karolinska Universitetsjukhuset
Mehdi Khosravinia	Landstinget Blekinge
Johan Knutsson	Mälarsjukhuset
Linda Knutsson	Lunds universitet
Marcus Krantz	Sahlgrenska Universitetssjukhuset
Ingrid Kristensen	Skånes Universitetssjukhus
Love Kull	Sunderby sjukhus
Sonny La	Blekingesjukhuset
Maria Larsson	Södra Älvsborgs sjukhus
Kerstin Ledenius	Skaraborgs Sjukhus
Timo Leivo	Landstinget Västmanland
Lars Lilja	C-Rad AB
Elina Lillieskold	Landstinget Västernorrland
Emelie Lind	
Elias Lindback	Karolinska Universitetssjukhuset
Anders Lindberg	Sahlgrenska Universitetssjukhuset
Ulrika Lindencrona	Sahlgrenska Universitetssjukhuset
Ylva Lindgren	Södersjukhuset
Karolina Lindskog	Akademiska sjukhuset
Annelie Lindström	Centralsjukhuset i Karlstad
Daniel Ljungberg	Scanflex Medical AB
Michael Ljungberg	Lunds universitet
Anna Ljusberg	Region Östergötland
Cissi Lundmark	Södersjukhuset
Tobias Magnander	Sahlgrenska Universitetssjukhuset
Alexandr Malusek	Linköpings universitet
Joakim Medin	Region Skåne
David Mendes	Canberra AB
Deborah Merzan	Karolinska Universitetssjukhuset
David Minarik	Skånes Universitetssjukhus
Kerstin Muntzing	Sahlgrenska Universitetssjukhuset
Stefan Mårtensson	Gammadata AB
Søren Møller	Varian Medical Systems Scandinavia
Mattias Nickel	Landstinget i Kalmar län

Nationellt möte om sjukhusfysik, Falkenberg strandbad 11-13 november 2015

Carl-Magnus Nilsson	Varian Medical Systems Scandinavia
Joachim Nilsson	Karolinska Universitetsjukhuset
Ted Nilsson	Karolinska Universitetsjukhuset
Jonas Nilsson Althen	Region Östergötland
Fredrik Nordström	Skånes Universitetssjukhus
Eva Norrman	Universitetssjukhuset Örebro
Karin Nygård	Akademiska sjukhuset
Johan Nyström	Scanflex Medical AB
Richard Odh	Strålsäkerhetsmyndigheten
Anders Olsson	Tesika Teknik AB
Annie Olsson	Karolinska Universitetsjukhuset
Sara Olsson	Region Kronoberg
Mikael Peterson	Lunds universitet
Hannie Petersson	Lunds universitet
Sven Petersson	Karolinska Universitetssjukhuset
Tobias Pommer	Karolinska Universitetssjukhuset
Rrezarta Reci	Skånes Universitetssjukhus
Johan Renström	Centralsjukhuset i Karlstad
Michael Sandborg	Linköpings universitet
Karin Sandqvist	Praktikertjänst AB
Annika Sartz	Universitetssjukhuset Örebro
Marie-Louice Sarudis	Södra Älvsborgs sjukhus
Agneta Schmidt	YourRad AB
Gary Schmidt	YourRad AB
Tony Segerdahl	Danderyds sjukhus AB
Lea Sillfors-Elverby	NU-sjukvården
Johan Sjöberg	Karolinska Universitetssjukhuset
Katarina Sjögreen Gleisner	Lunds universitet
Bo Stenerlöw	Uppsala universitet
Anna-Carin Strandberg	Elekta Instrument AB
Maria Sundin	Chalmers
Henrik Sundström	Östersunds sjukhus
Ylva Surac	Sahlgrenska Universitetssjukhuset
Henrik Svensson	Region Kronoberg
Sara Svensson	Gävle sjukhus
Marcus Söderberg	Skånes Universitetssjukhus
Julia Söderström	Karolinska Universitetssjukhuset
Andre Søndergaard	VisionRT
Anja Taschner	IBA Dosimetry GmbH
Charlotte Thornberg	Skånes Universitetssjukhus
Stefan Thunberg	Strålsäkerhetsmyndigheten
Charlotta Tilk	Micropos Medical AB
Nina Tilly	Elekta / Uppsala Universitet
Pontus Timberg	Skånes Universitetssjukhus
Anders Tingberg	Skånes Universitetssjukhus
Erik Traneus	RaySearch Laboratories AB
Susan Varli	Danderyds sjukhus AB
Barbro Vikhoff-Baaz	Sahlgrenska Universitetssjukhuset
Ingemar Wiberg	ScandiDos AB
Elinore Wieslander	Skånes Universitetssjukhus
Jonna Wilén	Umeå universitet/NUS
Kristina Ydström	Skånes Universitetssjukhus
Ibisam Yusuf	Karolinska Universitetsjukhuset
Konstatin Zakaryan	Radeq
Karin Åberg	Akademiska sjukhuset
Per-Erik Åslund	Akademiska sjukhuset
Sofia Åström	Norrbottens Läns Landsting
Jakob Ödén	Stockholms universitet

Organisationskommitté
Caroline Adestam Minnhagen
Mattias Nickel
Disa Åstrand
Ylva Surac

Programkommitté
Anders Tingberg
Sofie Ceberg
Michael Ljungberg
Karin Åberg
Marie-Louise Aurumskjöld