IOP Institute of Physics
Medical Physics Group

NEWSLETTER
Summer 2011

Editorial

Welcome to another edition of the Medical Physics Group newsletter. In this edition we have reports from ISMRM – the world's biggest MRI gathering, ESTRO – Europe's biggest radiation oncology conference, and the UK biennial medical ultrasound meeting. There is also feedback from a European workshop on the Medical Physics Expert (MPE), an advisory role which many of our members provide to hospitals and other healthcare environments.

We have two new features; firstly highlighting journals of note in the field, starting with the well renowned *Physics in Medicine and Biology*, and secondly we would like to re-introduce an essay competition – essays on topics of interest to MPG members are invited for which winners will receive a £50 prize and the essay will appear in the next edition of this newsletter.

MPG continues to co-organise scientific meetings; as usual we have organised a scientific session, 'Modelling and Simulation in Medicine' for the annual IPEM scientific meeting, which this year is part of a wider gathering of colleagues from Ireland and across Europe. There are also plans to hold a meeting on applications of physics to healthcare, bringing together a number of groups within the IoP Applied Physics and Technology Division (APTD).

Our membership remains one of the largest in the Institute, at around 750 members, so please contact us with any comments and suggestions for articles and activities in the future.

Colin Baker
Clatterbridge Centre for Oncology

Journal spotlight

A new feature where we highlight journals of potential interest to medical physicists, starting with one published by the Institute of Physics...

Background: PMB is widely considered to be the most prestigious international journal for medical physics research. Founded over 50 years ago, it has built up a broad readership with high quality and rapid publications from around the world. In 2009 the impact factor was the highest among medical physics journals, and rose a further 10% in 2010.

High interest articles are open access and featured on *MedicalPhysicsWeb.org* for the widest audience.

By the numbers (2010)	
Impact factor	3.056
Average publication time - receipt to first decision - receipt to (online) publication	 48 days 148 days
Acceptance rate	40%
Proportion of articles from UK authors	10%
Articles published per year	540
Articles downloaded per year	670 000
First issue	July 1956

Scope: The application of theoretical and practical physics to medicine, physiology and biology, including:

- all areas of radiotherapy physics
- radiation dosimetry (ionizing and non-ionizing radiation)
- biomedical imaging (e.g. x-ray, MR, ultrasound, optical, nuclear medicine)
- image reconstruction and kinetic modelling
- image analysis and computer-aided detection
- other radiation medicine applications
- therapies (including non-ionizing radiation)
- biomedical optics
- radiation protection
- radiobiology

Recent highlights:
The top 5 most cited articles from the last two years (as of 31/05/11):

Polymer gel dosimetry

C Baldock *et al* 2010 *Phys. Med. Biol.* **55** R1

Topical review article describing the fundamental science and clinical applications of polymer gels to radiation dosimetry. These chemicals can be used as true three-dimensional dosimeters for a wide range of radiation types and qualities, especially steep dose gradients, though practicalities of manufacturing and handling may have limited initial uptake.

The Virtual Family—development of surface-based anatomical models of two adults and two children for dosimetric simulations

Andreas Christ *et al* 2010 *Phys. Med. Biol.* **55** N23

Development of a family of detailed whole body human models based on MRI scans and segmented using triangular surfaces meshes for greater accuracy and flexibility. They are provided free for research into evaluation of exposure to electromagnetic radiation, which is a topic of considerable current public and scientific interest.

A novel, SiPM-array-based, monolithic scintillator detector for PET

Dennis R Schaart *et al* 2009 *Phys. Med. Biol.* **54** 3501

Development of a new detector for PET scanning using silicon photomultipliers coupled to the scintillation crystal. These showed high spatial and temporal resolution, excellent depth of interaction determination for improved image resolution and MRI compatibility for potential use in hybrid PET/MRI systems.

GPU-based ultra-fast dose calculation using a finite size pencil beam model

Xuejun Gu *et al* 2009 *Phys. Med. Biol.* **54** 6287

Development of a radiotherapy dose calculation algorithm utilizing graphic processors to reduce computation time by 200–400 times. Rapid (re) calculation of treatment plans allows adaptive treatment based on variation in patient anatomy to be delivered after imaging in the same session.

Integrating a 1.5 T MRI scanner with a 6 MV accelerator: proof of concept

B W Raaymakers *et al* 2009 *Phys. Med. Biol.* **54** N229

Combined modalities have been suggested in diagnostic imaging, and x-ray imaging has recently been added to radiotherapy treatment units, but the addition of MRI would give greater soft tissue contrast and real-time imaging without additional radiation dose. This work describes such a combination with the aim of no degradation in functionality of both systems, which is not without challenges due to the interaction between electromagnetic fields.
(see ESTRO review for more on this work)

Old classic: If any members would like to describe a paper which has made a particular impact in their field, please let us know and we will include a retrospective in the next newsletter.

David Eaton
Royal Free Hospital, London

Contents

Committee

Upcoming meetings

Modelling and Simulation in Medicine at the European Medical Physics and Engineering Conference

Trinity College Dublin, Ireland
Friday 2nd September 2011
www.empec.ie

A multidisciplinary session organised by the Medical Physics Group at the annual medical physics meeting for the UK, Ireland and wider Europe.

0900–1030

Modelling and Simulation in Medicine I (invited speakers)

Modelling in human patient simulators
Professor Mark A Tooley (Bath)

Predicting clinical outcome following radiotherapy: modelling tumour control probability and complication risks
Dr Colin Baker (Clatterbridge)

Modelling and simulation of radiation transport in image guided radiotherapy
Dr Emiliano Spezi (Cardiff)

1030–1100

Coffee

1100–1230

Modelling and Simulation in Medicine II (proffered papers)

Performance of a dynamically adapted MDCT beam-shaping filtration in dependence of projection angle
L Veloza, H Kauczor, W Stiller

Developments of a Monte Carlo model to simulate digital mammography
T Sakellaris, A Pascoal, M Koutalonis, G Spyrou

An extendable multi-leaf collimator for electron beam Therapy
T O'Shea, M Foley, B Faddegon

Implementation of a human head and neck phantom for cone beam CT imaging simulation
G Zhang, R Jacobs, H Bosmans

PMMC – a high-performance Monte Carlo code for proton beam dose calculation
D Jacqmin

Diode detector modelling for Monte Carlo small field MV photon dosimetry
G Cranmer-Sargison, S Weston, N Sidhu, D Thwaites

Cancer Care: New Detector and Sensor Technologies and their Potential Impact

STFC Rutherford Appleton Laboratory, Harwell, Oxford
5 and 6 October 2011

The Futures Programme of the Science and Technology Facilities Council (STFC) and the British Institute of Radiology (BIR) are holding a joint workshop on cancer care research. The purpose of this workshop is to bring together the cancer care community and the research community funded by STFC in areas where there is significant potential for STFC to contribute, and begin the formation of collaborative research partnerships. During the workshop the STFC will describe its plans for launching a new Futures Network funding initiative to enable researchers from the different communities to engage and develop collaborative projects. The workshop will be held over two days at the Rutherford Appleton Laboratory, with a working dinner held during the evening of the first day.

Contact Dr Sharmila Banerjee (sharmila.banerjee@stfc.ac.uk) by 1st September for further information.

The Physics of Diagnostic Nuclear Medicine

Institute of Physics, London
Wednesday 19th October 2011 7pm
www.iop.org/events/scientific/conferences/y/11/nuclear-med/index.html

Organised by the IOP Nuclear Industry Group

Physics is central to diagnostic nuclear medicine through radionuclide production, radiopharmaceutical development, design of imaging devices and analysis methods used to interpret patient images and yield diagnoses. The roles physics plays in this medical discipline will be reviewed. Dr **Brian J McParland,** the Head of Medical Physics at GE Healthcare, Medical Diagnostics (formerly Amersham plc) will talk about the role that physics plays in diagnostic nuclear medicine.

Physics Applications in Healthcare

Institute of Physics, London

Organised by the IoP Applied Physics and Technology Division (APTD), date to be confirmed, likely early 2012.

Meeting reports

The Physics & Technology of Medical Ultrasound

Bar Convent, York

16–17th March 2011

Organised by the Institute of Physics and Engineering in Medicine (IPEM)

The purpose of the biennial meeting was to provide a forum for discussion, divulgence and dissemination of ideas from across the wide range themes within medical ultrasonics. The meeting took place over 2 days in Bar Convent, York. There were over 60 delegates and a rich programme covering all areas of interest.

Quality assurance, safety and measurement

After a brief welcome and introduction by **Haidong Liang** (scientific organiser), the meeting kicked off with a presentation by **Christian Langton** (Queensland University of Technology) entitled *'A new perspective on ultrasound assessment of cancellous bone'*. His presentation was followed by two presentations on acoustic measurement. **Victor Humphrey** gave a description of a new measurement technique for focussed high amplitude fields. **Rene van der Mijle** presented work on the use of ultrasound particle image velocimetry (PIV) with microbubble contrast agents to measure blood velocity profiles.

Just before coffee, all attendees were invited to speak for 1 minute to introduce themselves and explain their areas of interest. This proved to be very beneficial and promoted interaction during the coffee break.

The topic for the second session was quality assurance. **Jie Tong** described a simplified way of using the Newcastle OTTO with plain water. They developed a transform to correct for the misregistration that occurs due to incorrect speed of sound. **Barry Ward** described a way to assess spatial resolution by analysing speckle size using spatial frequency spectra. The method was able to distinguish between 'good' and 'bad' transducers and was able to detect small degrees of crystal dropout. **Vincent Pelling** spoke about his experiences in ultrasound QA including the limitations of subjective phantom based testing. He used the QA4US software (Thijssen, Weijers and De Korte 2007) software to demonstrate how calculated parameters can be related to changes in ultrasonographic factors. **Christian Langton** wrapped up the session with a description of ongoing work to investigate the feasibility of reading radiotherapy dosimetry gels using ultrasound transmission CT instead of the more established methods of optical CT or MRI.

Ultrasound safety was the topic for discussion after lunch. The afternoon began with an insightful talk from **Francis Duck** about the pitfalls of using the tools and terminology from ionising radiation protection to address ultrasound safety. He advocated a return to the underlying science when developing safety advice for users to reflect the fact that there is no evidence base for the use of dose-integration or ALARA for ultrasound. **Christian Baker** then described a novel, portable, beam plotting system designed for the routine measurement of medical ultrasound fields in a hospital setting. The system uses a hydrophone and pyroelectric sensor and has been trialled at a number of hospitals with encouraging results. **Philip Coulthard** described the use of a random void phantom for the assessment of defective transducer elements and showed how the phantom can be used to demonstrate the effect of probe defects to users in a clinically meaningful way. Finally, **Azibananye Mengot** spoke about ultrasonic thermography and his work in the development and characterisation of thermal test objects.

The final session on the first day consisted of five talks on acoustic properties and measurement. **Scott Inglis** described a comparative study of the imaging properties of mechanical and electronic endoscopic ultrasound systems, using the Edinburgh pipe phantom. He found both advantages and disadvantages to the newer electronic technology. **Carmel Moran** also presented work based on the use of the Edinburgh pipe phantom. In her first presentation she demonstrated the ability of the Resolution Integral to characterise subtle changes in performance of transducers. In her second talk, the Resolution Integral was used to assess the performance of pre-clinical ultrasound scanners at frequencies up to 55 MHz, using a modified Edinburgh pipe phantom with smaller diameter pipes. **Khalid Sindi** presented data on speed of sound (SOS) measurements in samples of ivory which demonstrated a variation in SOS according to the direction of the tubules in individual samples. Finally, **Sian Curtis** described the clinical evaluation of FLASH ultrasound™ (Innervision technologies, Calgary, CA). This new unconventional scanner employs synthetic aperture processing, with or without virtual point source and also performs attribute analysis such as speed of sound, phase and attenuation mapping. The technology has shown promise in the detection of carotid artery disease and breast cancer.

Innovation and application

The morning of the second day was dedicated to techniques and innovations. **Peter Wells** gave a review of new ultrasonic imaging technologies and highlighted the differences in perspective from users, industrialists and researchers when assessing new technology. **Chun Tsui** spoke about coherent ultrasonic Doppler tomography using a synthetic aperture technique and demonstrated enhanced spatial resolution (0.19 wavelengths). **Patrick Hunt** presented work on speckle tracking to detect peripheral nerve motion, ultimately this approach may be able to quantify the elastic properties of peripheral nerves at joints and non-joint locations. **Xin Yang** presented work on the quantification of Achilles tendon neovascularity and how this can be related to level of pain experienced in Achilles tendinopathy. Finally, **Tony Whttingham** spoke about a 'synthetic spectrum' approach in ultrasound imaging and demonstrated an improvement in signal to noise ratio compared to traditional broadband pulse transmission.

After coffee, the session continued with presentations from **Jie Zhang** on the manipulation of microparticles using phase-controlled ultrasound standing waves (electronic sonotweezers). **Helen Mulvana** and **Jonathan Casey** spoke about their complimentary work in the field of microbubble development and characterisation for drug/gene delivery. The session concluded with a talk from **Christian Langton** on his experiences of developing a robotically controlled ultrasound imaging system to dynamically monitor intra-fraction tumour motion and dosimetric consequences during external beam radiotherapy.

The day concluded with a session on quality assurance. **Michael Lynn** gave an encouraging talk entitled *'DIY phantoms for today's QA challenges'* where he advocated a practical and cost-effective approach to QA in a wide variety of ultrasound devices including bladders scanners, physiotherapy ultrasound and prostate brachytherapy. **Chao Sun** spoke about his investigation of the acoustic speed and attenuation properties of the IEC agar-based TMM in the high frequency range 14-46 MHz. He found that the acoustic speed was consistent with earlier studies and that the attenuation coefficient appears to vary linearly with frequency. **Sean Cournane** presented work based on the development of a set PVA-cryogel phantoms to mimic healthy and diseased liver. The Young's modulus of each phantom was measured using cyclic compression testing and using the reading obtained from transient elastography ultrasound. The results showed differences of up to 50%. **Tony Evans** spoke about his experiences of the equipment selection process for AAA screening. His talk gave valuable insight into the general challenges and pitfalls associated with equipment evaluation and procurement and the need for evidence-based advice on selection of equipment. He concluded that there is still a need for explicit and well defined image quality measures to be introduced for user evaluations. The final presentation of the meeting was by **Jacinta Brown** who described the development of anechoic target phantoms and lesion signal-to-noise ratio analysis for more challenging performance testing of breast ultrasound scanners. It was found that slice thickness was an importance factor and that the technique is suitable for comparing different scanners, imaging modes and system settings.

The meeting was supported by Imaging Equipment Ltd. and Mount International Ultrasound Services Ltd.

Aoife O Brien
Medical Physics and Bioengineering Dept.,
University College Hospital Galway, Ireland

19th Annual Meeting and Exhibition of ISMRM

Montreal, Canada, 7th – 13th May 2011

I recently attended the 19th annual meeting of the International Society for Magnetic Resonance in Medicine (ISMRM) in Montreal, Canada with expectation to communicate and exchange ideas with other professionals in my research field. My research focuses on foetal imaging, which is a small, untapped area of MRI research. ISMRM is one of the very few meetings where I can meet, interact and collaborate with other groups that share my research interest. Besides that, the educational talks conducted throughout the week gave me an opportunity to learn about and update myself on basic Magnetic Resonance (MR) techniques and the latest research and applications developed in other MR fields. These ideas will be useful in conducting and modifying my own research.

This year, ISMRM brought together 6000 international attendees—clinicians, scientists and technologists from institutions all around the world. The Educational Weekend was conducted on the first two days of the conference. It was dedicated to introducing the attendees to the latest techniques used in MRI. There were also talks given by experts on the theory of MR Physics, MR System Engineering, and Body MRI. These sessions were very informative and gave attendees opportunities to clarify any doubts on the subject matter. The educational weekend was especially useful for me at this time as I prepare to write my thesis.

Staff and students from the Sir Peter Mansfield Magnetic Resonance Centre at the closing ceremony

The weekdays of the conference were dedicated to paper presentations—talks, traditional posters and electronic posters. This year, there were more than 6000 paper submissions with an acceptance rate of 75%, and 10% being accepted as talks. These sessions gave me a great opportunity to expand my knowledge by learning different methodologies and approaches to solving MR problems. Parallel to these, there were also sessions for debates focussing on current issues in MRI: examples included *'A Hard Look at MR: Is It Simple Enough & Fast Enough to Fill the Gap?'* and *'Challenges in Fetal and Neonatal Imaging'*.

I presented a talk and two electronic posters on foetal imaging. This boosted my confidence and gave me an excellent opportunity to expose my work to researchers in my field. I also picked up a few tricks to improve my research through some brilliant discussions with experts in my field. It was great to network with experts from other institutions and give advice on how to solve problems in their research which I have encountered before.

The natural beauty of Montreal

Besides the educational sessions, ISMRM hosted several social events to enable students to meet established researchers. The closing ceremony was the highlight of these events with performances from Cirque du Soleil and bands playing a range of different music. This provided a relaxing atmosphere in which to meet other conference delegates in a more informal setting. It was a great way to close the conference.

The urban beauty of Montreal

To summarise, the ISMRM conference served as a meeting place for leadership, a place to learn, a place to network and do business as well as a forum to address the multitude of issues affecting magnetic resonance imaging today.

Devasuda Anblagan
(recipient of travel award from MPG)
Sir Peter Mansfield Magnetic Resonance Centre,
University of Nottingham

I arrived in Montreal, Canada on Friday 6th May 2011 in time to attend the educational weekend of the ISMRM 19th Annual Meeting and Exhibition. The educational programme consisted of two days of sessions covering a wide range of topics in MR presented by world leaders in the field. As the main focus of my Ph.D. research is on the development and application of methods for measuring functional connectivity between disparate brain regions, I was especially interested in the educational session entitled *'Advanced fMRI Techniques and Functional Connectivity Assessment'* chaired by **P. Bandettini and K. Miller**. Throughout the session the origin and definition of functional connectivity were discussed as well as different methods used to study it. Other educational courses which I found particularly instructive included MR Physics of Physicists and Functional and Anatomic Data Analysis, which covered background information into MR theory and analysis strategies.

The Mansfield Plenary lecture given at the opening of the conference entitled *'Challenges in fMRI'* was given by **Seiji Ogawa**. Seminal work from Ogawa et al. (1990), which related brain activation (via physiological changes including blood flow, blood volume and oxygen consumption) to a decrease in deoxyhaemoglobin concentrations formed the basis of the BOLD (blood oxygenation level dependant) contrast which is extensively used for measuring functional changes within MRI (fMRI). Since the development of this contrast the popularity of studying and using fMRI for applications including functional connectivity measurements, has soared with now well in excess of 1000 articles related to BOLD fMRI in the National Library of Medicine database.
It was an exciting opportunity to attend a talk from someone who has proved to be so influential within this field.

Throughout the conference functional connectivity, especially that measured whilst subjects are at rest, was a prominent theme with plenary talks dedicated to the topic as well as a couple of sessions. I presented two abstracts at the conference displaying our work on functional connectivity. One as a traditional poster entitled *'The electrophysiological basis of negative BOLD in default mode network'* and the other as an electronic poster entitled *'Investigating the neural basis of fcMRI'*. The chance to present our work at such a prestigious conference enhanced my communication skills and prompted discussion of our work with fellow researchers, with both posters receiving positive feedback. Since presenting results and ideas to others is a crucial element to scientific work the conference will aid in my career progression.

Cirque de Soleil acrobats at the closing ceremony

The conference has provided me with the opportunity to gain an updated perspective on work carried out in MRI from across the world. The sessions on functional connectivity were especially useful for allowing me to gain a deeper understanding of what is meant by the term connectivity. This up to date knowledge can then be applied to our work back in Nottingham.

Joanna Hale
(recipient of travel award from MPG)
Sir Peter Mansfield Magnetic Resonance Centre,
University of Nottingham

ESTRO Anniversary Congress

www.estroevents.org/ESTROevents/Pages/eiof11home.aspx

The thirtieth anniversary of the European Society for Therapeutic Radiation Oncology (ESTRO) was celebrated by 4000 medical physicists, radiation oncologists and therapeutic radiographers from all over Europe. Three meetings ran in parallel, showcasing the best research and clinical developments in radiation oncology, physics, technology and brachytherapy. The cavernous ExCel centre in East London hosted about 400 oral presentations, 1100 posters and a comprehensive commercial exhibition, which included full size linear accelerators and all the latest technology. To scratch the surface of this event, here is an extract from the society press release and some excellent articles by Tami Freeman from MedicalPhysicsWeb.org, the online resource for news and features run within the IOP publishing stable.

David Eaton
Royal Free Hospital, London

This congress is timely, as some 3 million people in Europe are diagnosed with cancer each year and due to an ageing world population and the adoption of less healthy lifestyles, the global burden of cancer is likely to triple by 2030. Cancer is still the number one cause of death in Europe, and with surgery, radiation oncology is one of the two main contributors to cancer cure. During the Congress, specialists discussed the latest clinical trials and improvements in biology, imaging, physics and technology which will allow radiation therapy to be more efficient and better tolerated.

Some of the future developments include the integration of molecular and genetic predictors of tumour and normal tissue response, the combination of radiation therapy with new and more efficient molecular targeted drugs, a more extensive use of particle therapies to better spare normal tissues, a complete integration of four-dimensional image-guided treatments, and the development of adaptive radiation therapy to the most active part of the tumour as defined by functional imaging.

Speaking at the inaugural opening, Professor Jean Bourhis, President of ESTRO, stressed that "all these technical and biological gains will undoubtedly enable an increasing proportion of patients to be free of tumour with fewer side effects after radiation therapy. **Radiation oncology will remain at the forefront of the fight against cancer.**"

ESTRO

MRI-linac: a progress update

http://medicalphysicsweb.org/cws/article/opinion/45971

Bas Raaymakers and Jan Lagendijk

Image guidance is becoming an integral part of radiation therapy, offering the potential to incorporate patient-based information into the treatment process. Such data enable patient repositioning or even replanning immediately prior to irradiation. Ultimately, image-guided radiotherapy (IGRT) could offer real-time imaging during treatment, enabling treatment of moving targets with motion compensation during beam delivery.

MRI could provide the ultimate means to perform such real-time guidance – offering soft-tissue-based, online position verification and monitoring during radiation treatment. A team at the University Medical Center Utrecht in the Netherlands is developing just such an IGRT system by integrating an MRI scanner with a linear accelerator. The system comprises a modified 1.5 T Achieva MRI scanner (Philips Healthcare, the Netherlands) with a 6 MV accelerator (Elekta, UK) rotating around it on a ring gantry.

The Utrecht researchers have already demonstrated simultaneous operation of the MR scanner and linac, using a prototype system with a static accelerator (see: MR-guided radiotherapy: proof of concept). With installation of a gantry-based prototype now imminent, Tami Freeman spoke to project leaders **Jan Lagendijk**, professor of radiation oncology physics, and **Bas Raaymakers**, associate professor of radiation oncology, to find out how the project is progressing.

TF: What is the main driver for implementing image guidance during radiotherapy?

JL/BR: Enormous progress is being made in the dose painting capabilities of radiotherapy systems. As a consequence, the question of "where to paint" is becoming more and more important. Shaping the dose according to our radiobiology knowledge is frustrated by positioning uncertainties. Also, as a result of these uncertainties, certain tumours can't be treated well: think of kidneys, liver, pancreas, oesophagus, rectum, etc.

What are the benefits of using MRI for such guidance?

MRI is excellent for soft tissue visualization and can provide cine imaging at a rate sufficient to track all motion – even breathing-related movements – in real time. By integrating high-quality MRI with modern accelerator technology, tissue can be tracked online and beams can be guided to their (moving and deforming) targets with (sub)millimetre precision.

This enables boosting of the dose to the gross tumour volume (GTV) and providing intermediate doses to the clinical target volume, avoiding visible non-involved structures. Almost all radiotherapy applications will benefit from reduced NTCP [normal tissue complication probability] and higher GTV doses. Such MRI-guided treatments can also provide a breakthrough for difficult locations, such as the abovementioned pancreas, kidneys, liver, oesophagus and rectum.

What are the key challenges in achieving simultaneous MRI and irradiation?

The interactions between the two systems were the main challenge. We needed to bring the systems together while maintaining their individual performance levels.

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How did the Utrecht team achieve this?

Those interactions are dealt with using active magnetic shielding and smart RF design. We also stayed with a diagnostic-quality closed-bore system, which implied that we had to modify the gradient coils and cryostat to allow passage of the beam. At present, a major challenge is the online Monte Carlo-based treatment planning. Secondary electrons interact with the magnetic field, and this interaction, including the electron return effect (ERE), has to be taken into account in the treatment-planning software. A second challenge is fast online image registration and tracking. A lot of progress is needed in that field.

The US company ViewRay makes a low-field system with three 60Co sources for irradiation. This system may be the first commercial one. The company has really helped to open thinking on MRI-guided radiotherapy. Their advertisement campaign, including the brilliant "seeing helps" cards, really helps in getting the rest of the industry going.

Could the MR images recorded during treatment be used for real-time repositioning?

Remember that the space inside an MRI is limited, which implies that table movements are also restricted. We have chosen a solution that we call "virtual couch shift", which means that every position adjustment is done within the treatment-planning environment. In practice, this implies that the whole system is prepared for online treatment planning. This enables us to account for not only translations, but also rotations and deformations.

Could the MRI-linac system enable new types of radiation treatments?

We are sure of that. At this moment, we are building in Utrecht the Centre for Image Guided Oncological Interventions. This new centre will have three treatment rooms dedicated entirely to new treatments. We are opening research lines on kidney, liver, pancreas, oesophageal and rectal cancer. Within this new centre, we will also investigate competitive technologies such as MRI-guided brachytherapy and MRI-guided high-intensity focused ultrasound.

What stage is the development of the Utrecht MRI-linac at?

The prototype gantry will be installed this summer, and the full system will be tested this autumn. If everything works as expected, then we will start working on the next steps to complete the system. We have begun preliminary testing, which involves a lot of MR imaging and treatment planning studies on all types of tumours. This helps us to understand the capabilities and limitations of the system and prepares us for the real thing.

What do you see as the first clinical application?

Our first clinical application will be very simple: the palliative treatment of spinal bone metastases. This will allow us to test the geometrical accuracy of the system on real patients. The vertebra is easily visualized on the integrated megavoltage imaging system and allows for accurate comparison of field co-ordinates with MRI co-ordinates.

When do you predict that first patient treatments using the MRI-linac may begin?

This is a hard question. The prototype that we will install this summer is still non-clinical; patient safety is not guaranteed, the system has no covers, etc. The first clinical system will hopefully be somewhere around the end of 2012, but this will depend on many other factors. We may decide to make the present prototype clinical if the clinical system takes too long.

Tami Freeman
Editor, medicalphysicsweb

Other highlights in brief

Enhanced guidance for animal irradiation

Small-animal studies are invaluable within radiotherapy research, enabling tests of novel irradiation strategies that cannot be studied in human subjects, as well as detailed investigations into biological processes, disease progression and therapy response. Studies on laboratory animals, for example, revealed the significance of the tumour environment as a target, demonstrating that even when direct irradiation to the tumour is blocked, it can still be destroyed by treating its periphery.

To read the full article go to http://medicalphysicsweb.org/cws/article/research/46009

Proton therapy: is randomization needed?

"We do not need randomized clinical trials to demonstrate that proton therapy is superior to X-ray therapy." This statement was the starting point for a contentious debate at the recent ESTRO anniversary congress in London, UK.

To read the full article go to http://medicalphysicsweb.org/cws/article/research/46037

Novel dosimetry for modern radiotherapy

As radiotherapy techniques evolve and treatment delivery becomes increasingly complex, there's a real need to develop quality assurance (QA) methods with which to verify these advanced dose distributions. At last week's ESTRO anniversary congress in London, UK, a dedicated session on "novel dosimetry methods" examined some of the options.

To read the full article go to http://medicalphysicsweb.org/cws/article/research/46070

Developments in managing motion

Image guidance plays a vital role in modern radiotherapy, helping to reduce the impact of both inter-fraction and intra-fraction motion. At the ESTRO anniversary congress, held earlier this month in London, UK, a conference session entitled "Strategy and developments in IGRT" examined some recent developments in this field.

To read the full article go to http://medicalphysicsweb.org/cws/article/research/46105

Tami Freeman
Editor, medicalphysicsweb

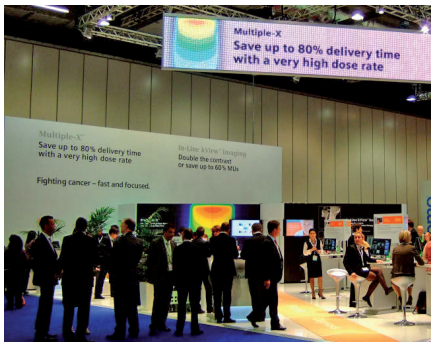
ESTRO update: product showcase

http://medicalphysicsweb.org/cws/article/research/45970

At the congress trade show, around 90 companies exhibited their newest developments in radiotherapy equipment and technologies. Here is a selection of some of the product releases that caught our eye.

Multiple-X speeds stereotactic radiotherapy

Multiple-X for Siemens Healthcare's Artiste linear accelerator is designed to significantly speed up stereotactic radiotherapy. Currently, patients undergoing stereotactic radiotherapy spend up to 60 minutes on the treatment table, with irradiation delivered at a dose rate of between 50 and 500 MU per minute. The Multiple-X feature enables Artiste to deliver up to 2000 MU per minute, a high dose rate that can shorten treatment time by up to 80%.



Radiotherapy calls for different energy intensities according to the tumour type and position. Multiple-X provides four types of flattening-filter-free beams: 7, 11, 15 and 17 MV. These can be combined with one flat energy. Siemens says that this enables use with further applications such as including intensity-modulated radiation therapy and 3D-conformal radiotherapy.

Nucletron highlights five innovations

Nucletron of the Netherlands showcased five products, including VCMC (vaginal CT/MR multi channel applicator) – the first Precise Dose Delivery Solution for treating gynaecologic cancers. VCMR features multiple channels that are curved in the tip of the applicator and can be loaded selectively, providing accurate precision and dose direction. Nucletron's Prostate Solution, meanwhile, covers both low-dose-rate and high-dose-rate brachytherapy in one software configuration, combining dynamic treatment planning and delivery with advanced robotic accuracy.

According to Nucletron, the latest version of its brachytherapy treatment planning platform, Oncentra Brachy 4.0, combines up to 50% reduction in planning times with exemplary treatment planning accuracy. The company also highlighted two external-beam treatment planning systems: Oncentra External Beam 4.0 and Velocity.

Remote planning for TomoTherapy

TomoTherapy announced a new feature for its radiotherapy treatment system: the Remote Planning solution, which enables dosimetrists, physicists and physicians to develop and approve treatment plans from almost anywhere in the world, via any web-connected computer.

Remote Planning gives users full treatment-planning capabilities from virtually any remote location. Importantly, it does this without impacting use of the TomoTherapy Planning Stations installed within the cancer centre. The feature can be accessed from remote locations via encrypted SSL connection, enterprise Citrix connection, VPN or other secure network access connections.

Orfit showcases mask developments

Orfit Industries of Belgium presented the latest additions to its range of thermoplastic masks for high-precision patient immobilization. This included a growing range of Hybrid Masks – reinforced masks that provide unparalleled horizontal stability and fixation force. The AIO-SOLUTION, meanwhile, is an all-in-one option comprising a head-and-neck immobilization system, lung board, breast board, abdominal system and belly and pelvic board in one product.

Orfit was also displaying the Efficast thermoplastic largest mask that it has ever made – a 350% scale mask measuring 1.2m in height, on show to demonstrate the company's craftsmanship. Other products on show included a paediatric frameless mask for head, neck and shoulders, and the Individual Head Support vacuum bag.

OSL introduces image analysis software

UK radiotherapy provider Oncology Systems Limited (OSL) introduced OnQ rts, an automated workflow software system for advanced multimodality image fusion and auto contouring, with analysis of results. The software's unique features include integrated contour analysis for clinician training and system QA, and offline batching of tasks for multiple patients.

OSL also highlighted its ImSimQA software and the Pioneer relocatable radiotherapy treatment suite. Launched in April, Pioneer houses a TomoTherapy treatment system and is designed to be installed and operational in as little as five weeks.

Tami Freeman
Editor, medicalphysicsweb

European guidelines on the Medical Physics Expert

http://portal.ucm.es/web/medical-physics-expert-project/inicio

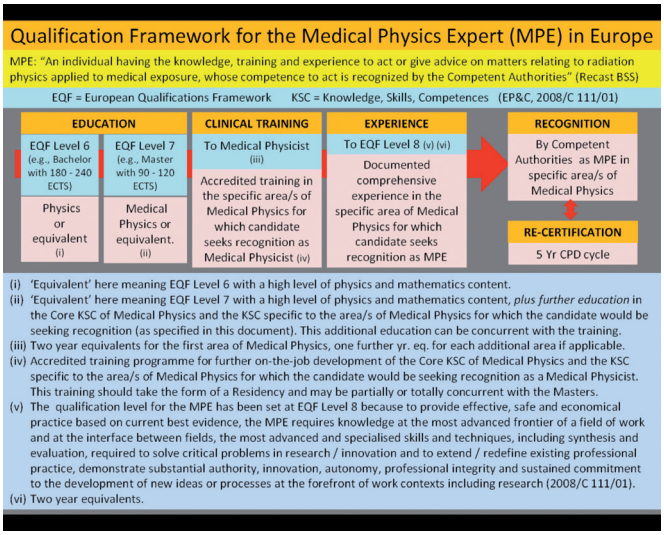
The European Commission awarded a contract in 2009 to develop guidelines on the Medical Physics Expert (MPE). The main aim of the contract was to support the harmonization of the MPE education in the European Member States, aiming at easier mutual recognition and improved mobility of the MPE throughout Europe.

A Consortium of 6 organisations was awarded the contract, including the Institute of Physics and Engineering in Medicine (IPEM) and the North East Strategic Health Authority: North East, Yorkshire and the Humber Quality Assurance Reference Centre.

The primary objective was for the consortium to reach an agreement on the roles and responsibilities of the MPE and the qualifications and clinical training required to support these roles. To help ensure Member States reach adequate levels of MPEs, the indicative MPE staffing levels to support the MPE roles also formed part of the contract.

A workshop was held in Seville in May 2011 to allow all member states an opportunity to explore the current position statement of the consortium on the MPE.

The qualification framework is now largely resolved. The entry requirement to train as an MPE is a degree in physics or equivalent. 'Equivalent' here means EQF Level 6 with a high level of physics and mathematics content.

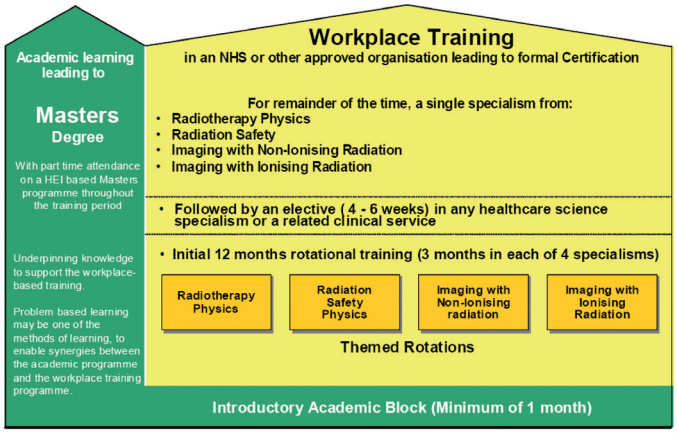


The education training required for an MPE is set at a Masters degree in Medical Physics or equivalent. 'Equivalent' here means EQF Level 7 with a high level of physics and mathematics content, plus further education in the Core knowledge / skills / competences (KSC) of Medical Physics and the KSC specific to the area(s) of Medical Physics for which the candidate would be seeking recognition. This additional education can be concurrent with the training.

A clinical training component for the trainee MPE has been set at 2 years for one area of discipline. After successful completion of this training the individual is a qualified Medical Physicist (MP). The MP will require further experience to become an MPE which is set at EQF level 8. This level was agreed since to provide effective, safe and economical practice based on current best evidence, the MPE requires knowledge at the most advanced frontier of a field of work and at the interface between fields, the most advanced and specialised skills and techniques, including synthesis and evaluation, required to solve critical problems in research / innovation and to extend / redefine existing professional practice, demonstrate substantial authority, innovation, autonomy, professional integrity and sustained commitment to the development of new ideas or processes at the forefront of work contexts including research.

The time it is likely to take for a MP to reach the required level to achieve MPE recognition is 2 full years documented experience for each area of discipline. In practice, it may take longer to provide such documented evidence. Recognition of MPE status will probably be through some form of peer review but the details are yet to be represented.

Modernising Scientific Careers Training Framework



The qualification framework developed by the consortium for an MP is broadly similar to that associated with the Modernising Scientific Careers training programme. The outlines of both these programmes are shown in the figures.

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This newsletter is also available on the web and in larger print sizes

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