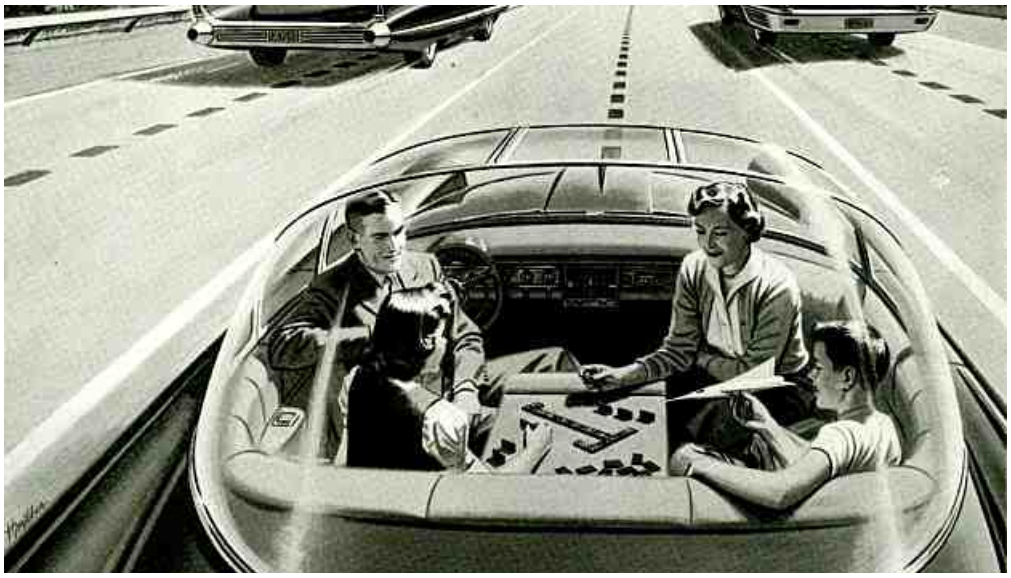
BULLETIN

August 2017



SGSMP
SSRPM
SSRFM

Schweizerische Gesellschaft für Strahlenbiologie und Medizinische Physik
Société Suisse de Radiobiologie et de Physique Médicale
Società Svizzera di Radiobiologia e di Fisica Medica
Swiss Society of Radiobiology and Medical Physics

No 89 www.ssrpm.ch

Editorial

Letter from the Editors

Dear SSRMP members and Bulletin readers. Do you notice anything new? Of course you do! The world isn't in black and white anymore! It has colours! And what colours! I would like to express my great and deep gratitude to Jean-Yves Ray for having dared to bring forward this innovation, for his tireless spirit of initiative, for the time and effort invested into making this possible (it has been a lot!) and finally for the excitement with which he involved the whole editorial team. I would like to thank the editorial team for fully supporting him in adventuring into this new solution. Finally, I would like to thank the SSRMP board for approving and supporting (including financially) the project.

So, what's new? Up until the last issue of the Bulletin, all the SSRMP Bulletin copies were printed at PSI, and then packed and sent out by Werner Roser and his children, who we would like to deeply thank for this wonderful voluntary service. But, it was time to free the Rosers from this workload, and to add some colour to our Bulletin! Starting with this issue, the printing company Mengis Medien AG (Visp) will print our Bulletin in colour and take care of packing and sending out the copies to all the SSRMP members. Moreover, the editorial team is now using an open source software (Scribus) for realizing this new (colourful) graphical layout.

So, time to put on your sunglasses and enjoy reading this bright new colorful issue. There are updates from the minutes of the recent AMP meeting, about the work in progress of the SSRMP Working Groups, and you will also find a detailed program of the SSRMP Education Day that will be held later this year. Among the Issues of Interest, the report from the European Congress of Radiobiology (ECR) 2017 is a particularly interesting contribution. It's presented here alongside four interesting original articles directly from the official Journal of the Congress. We couldn't of course miss a report from ESTRO and from the Educational Course about Nuclear Medicine. Also, we have feedback from the International Stereotactic Radiosurgery Society meeting – the first time that this meeting had been reported on in our Bulletin. Finally, the SpotLightOn section is starring protons centre stage, and the Personalia section focuses on the French-speaking part of the country. Enjoy the reading!

Francesca Belosi,
on behalf of the Editorial Team.

Contents

BULLETIN 89 - August 2017

Cover Image - top: image taken from Car and Driver (http://blog.caranddriver.com/future-past-self-driving-cars-have-actually-been-around-for-a-while/).
Cover Image - bottom: automatic generation of multiple plans with Plan Explorer by RayStation 6. Image taken from medicalphysicsweb (http://medicalphysicsweb.org/cws/article/newsfeed/68771).

PRESIDENT'S LETTER

Dear colleagues,

As physicists, we are familiar with an almost 100 years old theorem by E. Noether, which tells us that for each quantity with a conservation, there is a continuous symmetry associated to that. As an example: energy conservation is associated with symmetry in time and the momentum conservation is associated with symmetry in space. We are all making use of these effects in our daily clinical routine; although very often, we are not fully aware of that. But think about the convolution processes taking place for dose calculations in radiation therapy treatment planning systems: of course, the spatial invariance (or actually the variance due to the existence of inhomogeneities) places an important role and it would be more computation efficient if we could go into Fourier space to perform a multiplication instead of convolution. I am not quite sure whether Noether's theorem can be extended to other well-known symmetries in daily practice of a medical physicist. Possibly, we can guess (to be proven!) that a symmetric beam arrangement of a treatment plan in radiation therapy is producing some conservation such as the robustness with respect to uncertainties. In the same way, it could also be speculated (to be proven!) that a symmetric measurement setup in a medical imaging quality assurance procedure compiles in results, which are robust and solid.

There is no doubt: symmetries are attractive, at least for physicists! There seems to be a fundamental beauty in it and corresponding theorems - such as the one of Noether - create pretty positive resonance in a physicist's mind. Note that there was a famous movie called "A Beautiful Mind" some years ago about J.F. Nash. Although Nash was mathematician, the similarity to physicists is obviously given. In essence, symmetries are very welcome for physicists and one can even say that symmetries make physicists happy.

So, that's the beauty about symmetries! However, if symmetry is the beauty, the question is: where is the beast? Or in other words: if we just concentrate on the beauty (i.e. the symmetry), do we miss something (i.e. the beast)?

Definitely, in many daily tasks - and more generally for the full set of responsibilities - of a medical physicist, the aim is not to find the beauty but the beast. To give an example, we just have to bear in mind that the rationale for doing quality assurance in radiation therapy is to guarantee the safety of the patients. Remember the importance of this task: we are dealing with high doses of ionizing radiation. Thus, when performing quality assurance, we are challenging the treatment planning systems as well as the

PRESIDENT'S LETTER

treatment delivery machines in order to exclude the “beasts”, such as inappropriate dose calibrations or mechanical problems as for instance collisions or misalignments of collimators. In this term, the medical physicist is actively seeking for the “beasts” and quite habitually the physicist takes the role of a “ghostbuster” (another famous movie) looking for troubles and providing appropriate solutions.

From my personal experience, it is interesting to recognize that the “ghostbuster’s” success in finding the “beasts” is very often associated with asymmetries rather than symmetries. Actually, this is not fully surprising. Thinking differently and using some kind of an “asymmetric style” can help to detect weaknesses of a well-defined process. I don’t want to be misunderstood: of course, it is important to follow clear-structured guidelines and recommendations in order to perform high standards in quality assurance. Certainly, these documents provide very important benchmark and stress tests, which are to be considered and followed. However, sometimes, the behavior of “thinking outside the box” is also very important and opens the eyes for new aspects. This is not only true for the research and development of new techniques or methodologies in medical physics, but it is also suitable for standard practices. I am personally convinced that the basic talents of a physicist to think critically and analytically are very relevant and important in this context.

The current bulletin comes in a new style and is thus a perfect example demonstrating that SSRMP is an active society with a lot of things moving forward. I would like to thank explicitly the bulletin editorial team, headed by Jean-Yves Ray, for their big efforts and for realizing this transition to a more modern style of the bulletin. I am sure that the bulletin contains more beauty than beasts. And since physicists like the beauty, I am sure that you are going to love reading it.

Peter Manser,
SSRMP president

SCIENCE

Report of the AMP meeting held on 21st of June 2017

Twenty-seven colleagues attended the last AMP meeting in Bern.

SSRMP board report on current topics

P. Manser reported on current topics being dealt with by the SSRMP board. These topics included: exam style changes, the upcoming continuing education day, Winterschule Pichl, Dreiländertagung, the Bulletin, the 2017 salary survey, collaboration with SRO, SGR/SSR and BAG, and the efforts being made to improve communication with SSRMP members.

Recommendation N° 8

After fruitful discussions, the revision of Recommendation N° 8 on «Reference dosimetry of high-energy therapy photon beams with ionisation chambers» was accepted by the AMP with minor modifications. The next step is validation of the draft by the board, with final publication expected at the end of 2017. The working group participants, and in particular Stephanie Tanadini-Lang who chaired the working group, are deeply thanked for their work.

Working groups

After the review and restructuring of the working groups, four groups remain active. The chair persons (or representatives) of each group gave a summary of their activities.

Stereotactic radiosurgery (A. Mack)

The working group has met 13 times. The meetings are usually composed of two parts: first there is a general discussion about the issues currently faced by the different departments (e.g. special QA-procedures), and then the second part of the meeting is dedicated to education and expertise exchange – with each participating centre having an opportunity to present their dedicated SRS/SBRT system to the group, in combination with a visit to the centre.

With this background work done, the group is now focused on preparing a recommendation. The work has been shared out between the members, with different people working on separate chapters of the future guidelines. The goal is to complete a first draft by the end of 2017.

Reference dosimetry (S. Tanadini-Lang)

The working group just finalized the revision of Recommendation N° 8. Now they are working on the revision of Recommendation N° 9 (Low and medium energy X-Ray dosimetry) and Recommendation N° 10 (High energy electron beam therapy dosimetry).

Medical imaging physics (MIP) (G. Lutters)

The goal of this working group is to support clinical medical physicists working in medical imaging, with a particular emphasis on implementing the requirements of the radiation protection ordinance Art 74.

The MIP working group has set a two-year road map for itself. At the end of each two-year period, the members evaluate their progress and report on the achieved goals.

One of the aims of the group is to support and encourage communication between SSRMP medical physicists, technicians, physicians, manufacturers, and radiation protection officials (FOPH) involved in

medical imaging - especially concerning radiation protection ordinance Art 74 issues. The group meets two to four times a year.
Note that the following topics are outside the scope of this working group: radiation oncology therapy imaging and the duties of the radiation protection officer/license holder/medical equipment manufacturer concerning machine quality assurance.

IGRT (J.-F. Germond)

The IGRT working group is concerned with image guidance issues in the context of radiation therapy. It was the first group worldwide to publish in 2010 a recommendation on IGRT (as SSRMP recommendation No. 16) which is still applicable in the context of the recently released updated version of the Swiss radiation protection ordinance. At the request of the Swiss medical physics community, it was originally planned to prepare precise guidelines about how to implement the IGRT recommendation in routine clinical practice. However, the release of similar IGRT recommendations by other medical physics societies has prompted commercial firms to provide the necessary tools to satisfy the requirements. Radiation oncology centres can nowadays easily acquire these tools, including the necessary training, so that detailed specific Swiss procedures are superfluous.

On the other hand, the dissemination of IGRT has opened many new domains in its use as well as novel uses of medical imaging in radiation oncology. Some areas where extensions of the present recommendations concerning QA could be useful, include: 4D IGRT, dose delivered by IGRT, special techniques for guidance during irradiation, and guidance for adaptive therapy. In the category of novel imaging techniques, topics include: a QA recommendation for image fusion and auto-contouring as well as clinical workflow related challenges of IGRT, dosimetric consequences of IGRT and its impact on margins. Although these topics could be addressed in separate working groups, they all pertain to image guidance and consequently the IGRT working group is the ideal forum in which to discuss them.

New Working group

Our president P. Manser presented the proposal of a new working group dealing with the implementation of the new ordinance on ionising radiation. The proposition was accepted by the AMP and a first meeting, in the form of a brainstorming workshop, open to everyone, is scheduled in Bern on the 23rd of August at 14h (UniS A201).

Annual dosimetry intercomparison

The linear accelerator intercomparison has been completed and the results will be presented in the next issue of the Bulletin.

Continuing education day 2017

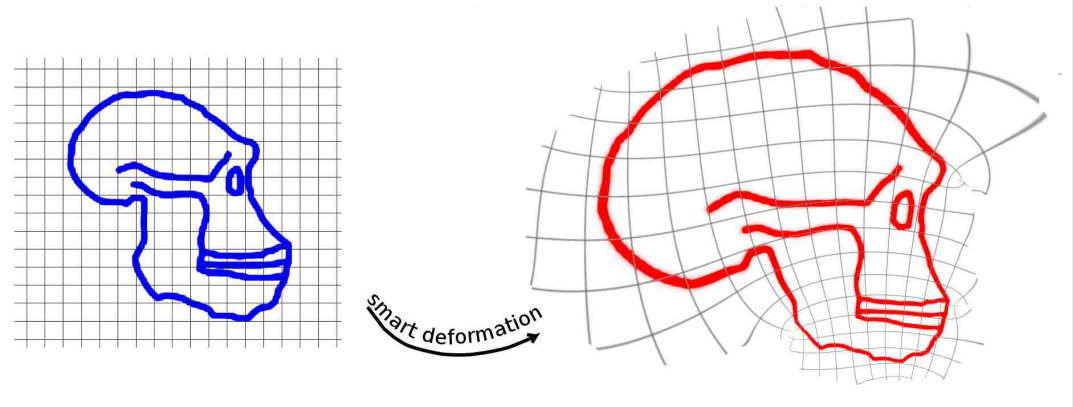
The SSRMP continuing education day will take place this year in Solothurn on the 27th of October. The announcement of the program can also be found in this edition of the Bulletin.

Raphaël Moeckli,
AMP chairman

SCIENCE

SSRMP Continuing Education Day 2017
27th of October 2017, Solothurn

Deformable image registration



Programme

09.00 – 09.30	Coffee	
09.30 – 09.45	Welcome, Introduction	
09.45 – 10.30	Role of image deformation in radiotherapy	M. Ozsahin (Lausanne)
10.30 – 11.15	Mathematical aspects of deformable image registration	S. Klein (Rotterdam)
11.15 – 11.30	Coffee break	
11.30 – 12.15	Quality assurance of DIR	C. Tanner (Zürich)
12.15 – 13.00	AAPM recommendation of TG132: practical aspects	J.-F. Germond (Lausanne)
13.00 – 14.15	Lunch	
14.15 – 15.00	Do we need image registration in adaptive radiotherapy ?	M. van Herk (Manchester)
15.00 – 15.45	Round table: where to go with DIR ?	All
15.45 – 15.55	Closing	
16.00 – 17.00	SSRMP annual general assembly	P. Manser

Registration

The day is traditionally free of charge, but the registration is mandatory. Please send an email to Silvia Kleiner (silvia.kleiner@insel.ch) until 30th of September.

Venue

Radio-Onkologie Solothurn / Bürgerspital Solothurn: Aula in main building

Bürgerspital Solothurn can be reached from the train station, bus terminal C, by bus no. 3 in direction “Lohn”, or by bus no. 2 in direction “Kriegstetten“, until bus stop “Spital”.

Alternatively, the Bürgerspital can be reached within a 10 minutes walk from the opposite side of the train station via “Wassergasse”.

The Aula of the Bürgerspital Solothurn is located in the main building (no. 3) at floor G.

Support

The continuing education day 2017 is supported by
Accuray, Elekta, Philips, Raysearch, Varian

EDUCATION

Feedback on the SSRMP Educational Course in Nuclear Medicine

Universitätsspital Zürich, 11th-12th May

Between 11 & 12 May, the Nuclear Medicine Educational Course took place in Zürich after a lapse of 3 years since the last edition. Over 12 medical physicists, both from imaging and radiation oncology, and MSc students attended the two-day course.
The first day of the course was concerned with hybrid imaging (SPECT/CT & PET/CT) topics such as:

1. Physics basics in Nuclear Medicine: radioactive decay, radiotracers, detectors employed, image acquisition and reconstruction;
2. radiation protection of staff and dose optimization to the patients;
3. image quality in clinical practice with focus on system resolution, sensitivity & image artifacts;
4. acceptance and stability control of imaging devices (PET and SPECT) ;
5. internal dosimetry in nuclear medicine.

During the second day, the participants were split into two groups and both of them had a practical session on radioprotection (how to handle contaminations & structural design and planning of a nuclear medicine department as well as radiation therapy treatment rooms) and internal radiation therapy dosimetry with Y-90 and Lu-177 using a dedicated software (OLINDA) with real-case (anonymized) patient data. To conclude this practical session, a simulated NEMA NU2 phantom preparation was performed to assess PET image quality. The workflow of the process was extensively discussed within each group: phantom preparation, PET measurements and data analysis.

At the end of this experience, questionnaires were distributed to the participants for assessing the performance of the course and whether or not it lived up to their expectations. The results were mostly satisfactory including also some constructive comments for further improving the course. Furthermore, the participants expressed the wish for adding more emphasis on the clinical personalized dosimetry, a topic with continuing increase of interest in Nuclear Medicine.

by Konstantinos Zeimpekis, MSc, DIC
Medical Imaging Physicist SGSMP & Radiation Protection Officer
Nuclear Medicine, UniversitätsSpital Zürich

Silvano Gnesin, PhD
SGSMP medical physicist
Institute of radiation physics, Lausanne University Hospital

Thiago Lima, PhD
SGSMP medical physicist
Kantonsspital Aarau

PROFESSIONAL AFFAIRS

SSRMP representation within the working group dedicated to the medical justification of the CPR/KSR

The justification of examinations involving the use of ionizing radiation in medicine comes in three levels. The first level concerns the basic justification deriving from the fact that the correct use of ionizing radiation brings more benefits than detriments to the society in general. The third level stipulates that an examination must be justified for every individual patient. This level concerns the general practitioner and the physician who will perform the examination. It ensures that the procedure takes into account the diagnostic and therapeutic objectives as well as the characteristics of the individual patient.

Between these two levels of justification is level 2, which has to guarantee that a given procedure is adequate to answer a defined clinical question for a given group of patients.

Up to now, the justification at level 2 depended only on the judgment of the general practitioners. The update of the Ordinance on radiation protection (StSV/ORaP) requires, in its Article 28, that a group of experts proposes strategies to be in conformity with the legal requirements.

The main tasks of this group will be to propose:

- Recommendations to the general practitioners when dealing with radiological examinations prescriptions. The idea is to use existing recommendations applied in Europe or in other countries where this type of recommendations already exist.
- Recommendations on new radiological techniques when they appear on the Swiss market.

The implication of medical physicists within this working group is aimed at proposing strategies to evaluate the image quality for already existing modalities, in order to help radiologists optimize their protocols. In addition, when dealing with new modalities, it is essential to make comparisons in terms of image quality and patient exposure with alternative techniques. This will be also performed by the medical physicists in close collaboration with the radiologists.

President of the Working Group and SSRMP delegate:
Francis R. Verdun
CHUV/UNIL
Institute of Radiation Physics
Rue du Grand-Pré 1
1007 Lausanne

Do you know your delegate?

Although the SSRMP president is the first representative of the society, the executive board may require the support of additional delegates.
The board formally appoints a delegate as representative to another society or an authority's body to act on behalf of the SSRMP.
This article describes the tasks of one of your delegate.

Feedback on the European Congress of Radiology 2017

Vienna, 1-5 March 2017

The European Congress of Radiology (ECR) is organized every year in Vienna by the European Society of Radiology. It is an international congress and every year attracts a great number of participants from Europe as well as overseas. More than 21,000 people participated this year. A huge commercial exhibition also takes place. ECR is of particular interest for medical physicists working in radiology as the scientific program includes dedicated sessions and courses prepared by the Physics subcommittee. Basically it is the conference where medical physicists can meet and discuss with radiologists and radiographers. Several scientific sessions were purely focused on medical physics; some intended for medical physicists, others concentrated more on the needs of radiologists or radiographers. There were refresher courses as well as interdisciplinary sessions in addition to many sessions on radiologic imaging of all varieties.

Creating art from fake radiological images.

The sessions focused on medical physics included the following topics:

- CT technology and reconstruction algorithms
- Innovations in radiology
- Radiation dose estimation, measurement and reduction
- Performance optimization in medical imaging
- Advances in medical imaging methodology
- Physics-based approaches to imaging, diffusion and motion

Our German colleagues were impressive with their numerous high-quality scientific presentations in modern fields such as dark-field and phase-contrast imaging which are gradually approaching clinical application.

The purpose of the refresher courses is primarily educational and they are intended for non-experts. However, the standard of lectures remains very high and specialists may learn from them. This year five refresher courses were given:

- Single-, dual-, multi-energy CT
- Motion management in medical imaging
- Dose reduction using iterative reconstruction in CT
- MR artifacts and devices
- Artifacts and pitfalls in tomography

There were several sessions of very high interest to the authors of this article and will therefore be described in more detail.

A number of presentations were given on the hot topic of dose management softwares in physics sessions as well as in other sessions intended for radiographers and radiologists. Presentations were focused on the software impact on everyday practice. The manufacturers have realized that the software gradually becomes a tool that can be used by people other than physicists and are developing features that may help the whole imaging community.
Another set of sessions were held under the EuroSafe Imaging Campaign, which had a strong presence at ECR 2017 to promote radiation protection and the ESR's quality and safety initiatives. The mission EuroSafe Imaging campaign is to support and strengthen medical radiation protection across Europe following a holistic, inclusive approach. Among the topics discussed in those sessions were also diagnostic reference levels. What a surprise! Personally, I (Elina) went to the meeting with the feeling that I was going to hear the same things once again. Fortunately, I was proved wrong. Fresh ideas, closer to the clinical practice were presented. It was promoted that diagnostic reference levels should be determined according to clinical indications and not anatomical regions as is the case today. In this way, their impact on clinical practice is expected to be greater. A long discussion followed also about the correct use of DRLs; ICRP will publish a new report in 2017 on the topic. You may find more information about the Eurosafe Imaging campaign on the website: http://www.eurosafeimaging.org/
Another very interesting and interdisciplinary session was held about appropriate image quality. The session included talks given by radiologists and medical physicists and focused on different possibilities of image quality quantification. One of the most important questions when talking about appropriate image quality is the decision criteria. Simple physical metrics such as signal-to-noise-ratio or modulation-transfer-function do not always appropriately simulate the true detection rate of lesions. On the other hand, studies using human observers to quantify subjective image quality are very time consuming and require resources that are not available. So the focus may lie in the construction of model observers that simulate the human observer and allow for the required quantification.
Of particular interest was the EFOMP workshop on "Radiation incidents and accidents in medical imaging and their management".

The workshop included the following presentations:

- Radiation incidents and accidents in CT
- Radiation incidents and accidents in interventional suites
- Accidental exposure during pregnancy
- Incidents and accidents in MRI
- Radiation incidents and accidents in nuclear medicine
- Management of incidents and accidents in imaging departments: the role and responsibilities of medical physicist

Particularly the last talk included many strong arguments strengthening the medical physicists position in the radiology team. From our perspective, the best comment about this EFOMP workshop was given by a Swiss radiographer: “Finally, I understood what a medical physicist can do!”. Ok, this might be a biased judgment, taken into account that we are medical physicists and quite new in the domain of radiology in Switzerland, but it made us glad.
An interesting presentation for the physicists working in radiation therapy was given about the radiobiology and the rectal complications for the patients accidentally irradiated in Epinal.
There was also a very interesting honorary lecture about the future of CT. Not so long ago CT was considered “without future” as MR was gaining ground in radiological practice. The present clinical situation with CT holding its ground shows us, that this prediction of CT slowly disappearing did not come true. The Josef Lissner honorary lecture given by Mathias Prokop with the title “The future of CT – From hardware to software” gave interesting insights into the development of CT hardware and software during the last decades. Prokop promoted CT as a “mature technology” in terms of hardware, which means that huge steps in technical development have occurred. The possibilities for CT evolution are therefore more likely to come from improvements on the software side. One of the first steps in this direction was taken by implementing iterative reconstruction algorithms. These will certainly continue to be developed further and new possibilities will open with improving computational power.

ECR Today, the congress daily newspaper, included the following four articles that summarize well the presentations. The articles are reprinted with no change and in agreement with the ESR. You may also find the original newspapers on the website:
http://www.myesr.org/publications/ecr-today-daily-congress-newspaper

- CT Refresher Course to provide early morning energy boost
- Appropriate image quality of diagnostic imaging procedures: Wishful thinking or concept for ensuring quality and safety?
- Patient safety: how to manage radiation incidents and accidents
- How low can iterative reconstruction really help us go?

Take-home messages from ECR:

- Clinical DRLs: The definition of DRLs shall be done based on clinical indications and not just on the title of the examination
- Clinical protocols are needed especially for new techniques such as dual-energy CT. Radiologists will need to collaborate more closely with medical physicists in order to understand the new technologies and develop these protocols.
- Working all together. A general wish for close collaboration could be noticed. More and more combined sessions are organized by radiologists, medical physicists and radiographers together.

Note that ECR is a green conference: you will not receive any notepaper, so you will have to bring one with you if you are a traditional person. Don't worry for the pen, they provide one in the congress bag along with the scientific and exhibition program! You will also receive free delicious apples and water.

A bit about Vienna? Fantastic view of Vienna from the bar 57, just across the Austria Center. Drinks and food are good, too!

Yvonne Käser, PhysMed Consulting GmbH
Elina Samara, Hôpital du Valais

Impressions from Vienna: Hofburg at night

ECR Today - CT Refresher Course to provide early morning energy boost

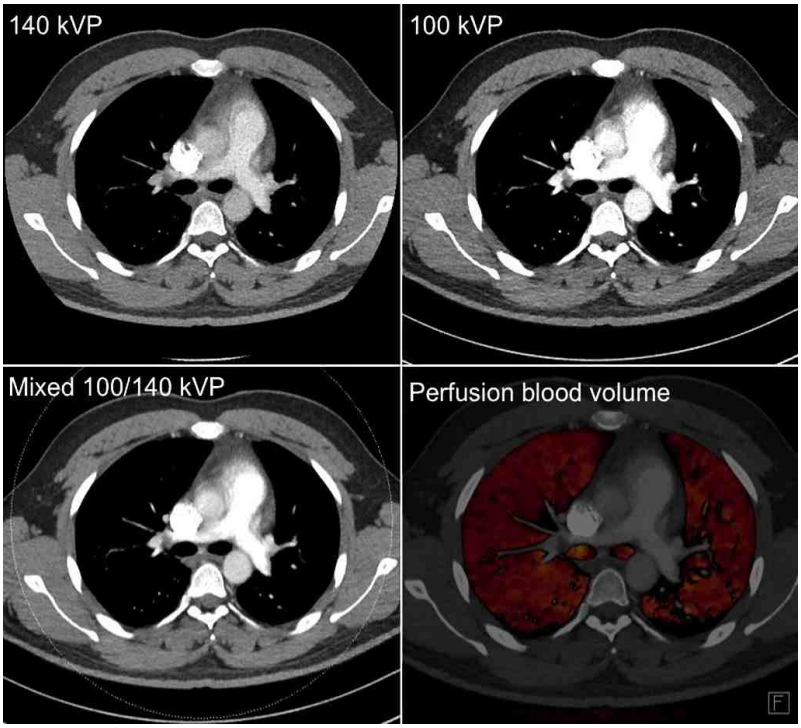
Dual-energy computed tomography (CT) was first proposed in the 1970s, but it is only now that it is beginning to find widespread clinical use, as a result of improvements in CT technology. The main benefit of dual-energy CT arises from the fact that x-ray attenuation is energy-dependent and the form of the energy dependence varies with atomic number. CT images obtained at two energies (i.e. two kV values of the x-ray beam) can therefore be used to decompose the images into different materials (e.g. bone and iodine) in order to better distinguish them[1]. Today's Refresher Course will provide attendees with essential information about the technology, methods and applications of dual and multi-energy CT.

A method for quantitative bone mineral analysis using dual-energy CT was developed by Genant and Boyd in 1977[2]. Using a conventional CT scanner, two scans were carried out, one after the other, at different kV settings. This technique was not very successful due to the high radiation dose, image registration and other problems. The next key development took place in the 1980s and made use of a single x-ray source, the kV of which could be switched rapidly between two values during the scanning procedure; this meant that two CT scans, at different tube potential values, could be obtained almost simultaneously[3]. The method suffered initially from the inability to switch the tube current quickly enough; later advances in the technology did, however, enable the technique to be used in clinical CT scanners. More efficient (and simpler, in some respects) is the approach of using dual x-ray sources, mounted on the same gantry but orthogonal to one another. The tube potential of the sources can be controlled independently, allowing truly simultaneous dual-energy CT to be accomplished[1]. The disadvantage here is that data recorded by one source-detector pair may be corrupted by scattered photons arising from the other x-ray source. The latest technology for dual-energy (or indeed multi-energy) CT makes use of so-called photon-counting detectors[1, 4]. These make use of a single x-ray source, but the detectors are able to discriminate the energies of photons, so allowing them to contribute to separate reconstructed images, effectively obtained at a range of kV values. Although energy-discriminating solid-state detectors have been used in nuclear medicine for some time, their employment in CT had to wait for improvements in technology, especially as regards the ability to cope with the very high exposure rates used in CT.

Dual-energy CT was clinically endorsed after the introduction of dual-source CT systems in 2006. Now, the latest CT technology allows simultaneous image acquisition at two or more energies, making the method applicable and useful in a variety of clinical applications.

Dual-energy CT offers superior lesion detection and characterisation. It is used for detection and characterisation of renal stones, renal masses and liver lesions, in oncologic imaging, in vascular imaging and in metallic implant imaging (artefact reduction). Moreover, there are several promising applications under investigation in other areas such as musculoskeletal and cardiac imaging. Each CT manufacturer uses different algorithms for material decomposition. Thus, virtual monoenergetic images can be created or blended images can be produced using a combination of low energy and high energy data (see Figure).

Patient radiation dose and associated risks are always areas for concern. Initial studies have shown that dual-energy CT delivers higher doses to patients than single-energy CT[5]. However, more recent publications have shown that dual-energy CT is associated with patient doses similar to those received during single-energy CT[6]. However, it should be stressed that limited information on this is available in the literature at present; differences in acquisition techniques have important implications on patient radiation doses and further studies are needed to fully investigate this topic.



Axial images demonstrating simultaneous dual-energy CT acquisitions including the 100kV$_p$ source image from tube A, 140 kV$_p$ image from tube B, the mixed 100/140kV$_p$ image and the perfusion blood volume (surrogate for pulmonary perfusion). The window level and width for all four images were the same. The lower kilovoltage (100 kV$_p$) image clearly demonstrates increased iodine conspicuity and may be of added value for better depiction of the peripheral embolus or in circumstances of poor contrast bolus tracking.
Case courtesy of Dr. Charlie Chia-Tsong Hsu, Radiopaedia.org, rID: 31363.

By John Damilakis, Professor of Medical Physics at the University of Crete, Greece, and Preesident of the European Federation of Organisations for Medical Physics (EFOMP);
and David Lurie, Professor of Biomedical Physics at the University of Aberdeen, UK

References

[1] McCullough CH et al. Dual- and multienergy CT: principles, technical approaches, and clinical applications. Radiology 2015, 276, 637-653.
[2] Genant H and Boyd D. Quantitative bone mineral analysis using dual-energy computed tomography. Invest. Radiol. 1977, 12, 545-551.
[3] Kalender WA et al. Evaluation of a prototype dual energy computed tomographic apparatus. I. Phantom studies. Med. Phys. 1986, 13, 334–339.
[4] Shikhaliev PM, Fritz SG and Chapman JW. Photon counting multienergy x-ray imaging: effect of the characteristic x rays on detector performance. Med. Phys. 2009, 36, 5107–5119.
[5] Ho LM et al. Dual-energy versus single-energy MDCT: measurement of radiation dose using adult abdominal imaging protocols. Acad. Radiol .2009, 16, 1400-1407.
[6] Henzler T et al. Dual-energy CT: Radiation dose aspects. AJR 2012, 199, S16-S25.

This article was originally published on March 1, 2017, in ECR Today, the daily newspaper of the European Congress of Radiology, the annual meeting of the European Society of Radiology.

ECR Today - Appropriate image quality of diagnostic imaging procedures: Wishful thinking or concept for ensuring quality and safety?

Ensuring and improving the quality and safety of diagnostic imaging procedures for the benefit of the patients is one of the challenges faced by radiology departments in daily routine, especially in view of the ever-increasing complexity of examinations.

While this is true independent of imaging modality, computed tomography (CT) deserves special attention inasmuch as its application is, on average, associated with the highest radiation exposure to the patients among imaging procedures that require the use of ionising radiation. Currently, CT is one focus of the EuroSafe Imaging campaign, the flagship radiation protection initiative of the European Society of Radiology launched in 2014, which has, among others, the objective of promoting appropriateness in radiological imaging.

With 'appropriateness' being defined as 'the quality or state of being just right for the requirements', achieving an image quality appropriate for a particular radiological examination implies that the quality of the resulting image data has been set to a level just good enough for answering the specific clinical question with high diagnostic accuracy and confidence, but without being excessively 'brilliant'. In view of 'appropriate' CT examinations, in turn this means their acquisition has been performed at the lowest radiation exposure achievable, i.e. resulting in the lowest potential harm to the patients.

Despite being subject to various limitations, several subjective and objective metrics for measuring image quality have been introduced and are currently in use, e.g. for comparing imaging hardware, for quality assurance (QA) and for the optimisation of imaging procedures. However, even when related to the radiation exposure associated with a particular examination, physical image quality measurements are only meaningful in clinical routine if these can be directly related to diagnostic quality of the image data acquired in patients. Therefore, defining 'appropriate image quality' in diagnostic imaging (e.g. CT) is a very challenging task, as robust, clinically meaningful and easy-to-use measurement methods for image quality are still missing to date.

Furthermore, the image quality of actual clinical examinations is influenced by several factors such as patient characteristics (e.g. size, weight, age, etc.) as well as the imaged body region. Consequently, image quality achieved in practice will vary even if examinations are acquired using the same set of parameters, i.e. using the same acquisition protocol resulting in equivalent nominal radiation exposure.

In addition, image quality will also depend on the technical status of the imaging hardware and software employed. For example, CT systems might feature iterative image reconstruction technology, the use of which can significantly alter image data appearance and can be exploited for reducing radiation exposure by adjusting acquisition parameters.

The level of image quality that is deemed 'appropriate' for answering a particular clinical question with high diagnostic accuracy and confidence needs to be specific to each clinical indication. The 'appropriateness' of the image quality of a procedure should therefore only depend on the diagnostic task, while being independent of factors such as patient characteristics or the imaging hardware and software used for the examination.

Since the radiation exposure of imaging procedures employing ionising radiation, e.g. of CT, is required to stay within diagnostic reference levels (DRL), these need to be accounted for by any future concept or metrics with regard to the appropriateness of image quality. This is especially true for clinical DRLs no longer defined by examined body region, but instead specific to particular clinical indications. Work on the definition of clinical DRLs for CT examinations is currently ongoing as part of the EuroSafe Imaging campaign.

While successfully defining criteria for the 'appropriateness' of image quality for each clinical question would ideally result in a technology-independent 'ground truth' for confident and reliable diagnosis, quantitative metrics for easily measuring the 'appropriateness' of image quality based on patient image data are lacking to date. Their development should be part of future research in medical radiation protection, since reproducibly achieving appropriate image quality in clinical routine should be the ultimate goal of every optimisation of imaging procedures. In order to render these efforts for ensuring quality and safety of imaging procedures sustainable, a review process in view of the appropriateness of image quality and, if applicable, the radiation exposure associated with the modality employed should be implemented in clinical routine.

By Wolfram Stiller, physicist at University Hospital Heidelberg, Germany,
dedicated to research in the field of x-ray computed tomography and member of the ESR Radiation Protection Subcommittee and the EuroSafe Imaging Steering Committee.

This article was originally published on March 2, 2017, in ECR Today, the daily newspaper of the European Congress of Radiology, the annual meeting of the European Society of Radiology.

ECR Today - Patient safety: how to manage radiation incidents and accidents

Accidents during imaging are rare, but nevertheless when they do happen the results can be devastating. Ongoing education and safety awareness, whether relating to radiation exposure or other incidents, remain vital.

Interventional radiologists must try to display not only the dose-area product (DAP) on the fluoroscopy screen but also the entrance skin dose (ESD), and they should change the radiation entrance field if the ESD exceeds 2 Gy, according to Prof. Dr. Dr. Reinhard Loose, emeritus professor of radiology at the University of Erlangen and former chair of the Department of Diagnostic & Interventional Radiology and Nuclear Medicine at Nuremberg Hospital.

“For high dose procedures, including both interventional radiology and CT, dose parameters should be stored electronically, preferably as a DICOM Radiation Dose Structured Report (RDSR),” he noted.

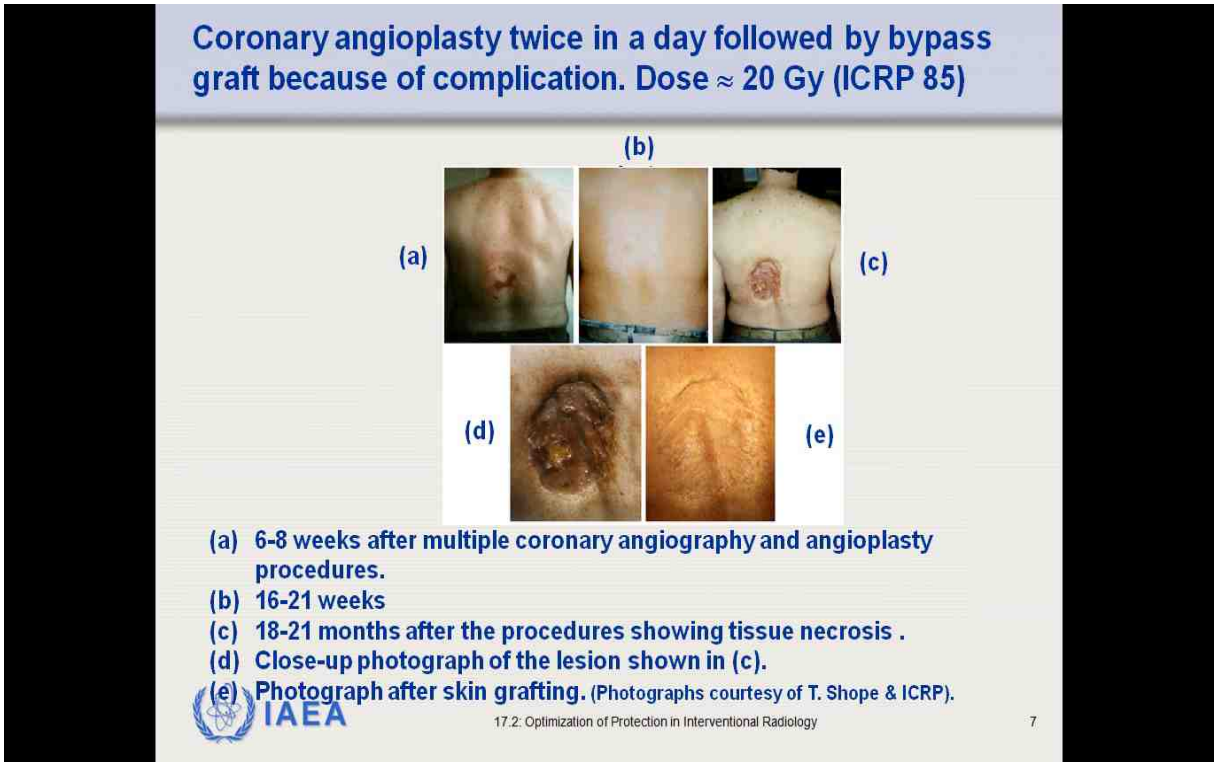
The doses of different modalities and in interventional procedures, between different operators, should then be compared. Furthermore, radiologists should ask referrers to check patients for injuries two to four weeks following high-dose examinations.

Skin and soft tissue injuries, such as erythema and necrosis, often affect the body area closest to the x-ray tube, usually the back. While the threshold for reactions is an ESD dose of about 2 Gy, severe reactions develop above 5 Gy.

Loose cited one incident in which the obesity of a cardiac valve replacement patient meant that the typical diagnostic reference levels of a prior diagnostic coronary angiogram were exceeded by a factor of three. Then, during the valve repair, the fluoroscopic image quality was so poor that the operator changed to cine images. Tens of thousands of images were generated and the patient received an ESD of more than 30 Gy. Several skin transplantations followed a few months later.

While very complex interventions, and therefore doses, are increasing, angiography detectors are becoming more dose-efficient and ESD tracking helps the radiologist to change the radiation entrance field as needed.

“While the threshold levels for national reporting of overexposure accidents under the European Directive 2013/59/Euratom (EU-BSS) are currently under discussion, all incidents should go to a local critical incident reporting system, and this includes near misses without radiation. Communication between the staff members involved, the referrer, and in some cases with the patient is essential” , he pointed out.



Coronary angioplasty was performed twice in a day, followed by bypass graft because of complications. Dose » 20 Gy (ICRP 85). (Provided by IAEA: Training Material on Radiation Protection in Diagnostic and Interventional Radiology; L17.2: Optimization of Protection in Interventional Radiology)

Pregnant patients

The sense of safeguarding future life prospects is heightened when pregnant patients present for imaging. But what should happen when pregnancies are discovered only after a medical imaging procedure has taken place?

Abortion due to x-ray examinations is not justified in the vast majority of cases, according to Prof. John Damilakis, PhD, director of the medical physics department of the University Hospital of Iraklion, Crete.

“Referring physicians and radiographers must investigate the reproductive status of all female patients of childbearing age prior to x-ray imaging, and a screening policy for pregnant patients must be defined prospectively,” he explained.

This translates into a need for clear guidelines on pre-imaging protocols for determining pregnancy status. Posters in waiting areas constituted one key strategy.

Risk assessment tools

Management of pregnant patients depends mainly on conceptus dose and stage of pregnancy, according to Damilakis. His department has recently developed a free web-based tool (COnceptus Dose Estimation, CODE http://embryodose.med.uoc.gr/index.php/en/) for estimating dose and risk.

The frequency of accidental exposure of pregnant patients is unknown, but in today’s presentation he will draw on various studies that point to a significant number of unidentified pregnancies in patients undergoing irradiating imaging tests, and incidental pregnancy diagnosed in emergency trauma.

As part of the project that led to the development of CODE, Greek obstetricians were asked how many

pregnant patients exposed accidentally to diagnostic x-rays visited them over 12 months to seek advice about the biological effects of radiation on the embryo. Around 63% of respondents stated that one to five pregnant patients who had been exposed accidentally to radiation asked for information, underlining the rate of accidental exposure of pregnant patients in the country, according to Damilakis.

During the first two weeks after conception, only high-dose radiation exposure can terminate pregnancy via miscarriage, but not diagnostic x-ray, he added. Furthermore, radiation risks are more significant during organogenesis and the early foetal period.

Damilakis fears that some referring physicians and radiologists who lack knowledge in this area recommend termination of pregnancy following any x-ray examination. Meanwhile, others avoid all x-ray examinations for pregnant patients, despite the fact that the radiation risk for the conceptus is negligible, and this practice results in underdiagnosis for these pregnant patients.

In the second part of this double session, EF2, Prof. David Lurie, PhD, head of an MRI research group and professor of biomedical physics at the University of Aberdeen, U.K., plans to advocate ongoing MRI safety education for all staff at every level, not just on initial appointment to a post.

“The number of MR scanners and scans conducted are steadily increasing. So it is very likely all radiology staff will have some involvement with MRI at some time during their career. Awareness of MR safety issues is paramount,” Lurie told ECR Today ahead of the congress.

Incidents caused by the so-called missile effect are extremely rare these days, mainly due to better management of controlled areas in MRI facilities, he noted.

More common are the effects of the static magnetic field on small, treatment-related objects such as endotracheal tube components and on non MR-safe implants including pacemakers, stents, and aneurysm clips.

“Any implanted device should be fully documented in a patient’s notes. But these notes may not always be available, particularly in an emergency situation, and the patient is not always able to provide accurate information,” Lurie said.

Action plans depend on the type of accident in question, but at the facility in Aberdeen, all incidents and near misses, including patient referrals with pacemakers, are registered onto an online incident reporting system run by the local health authority and are reviewed by radiology management, including the MR safety officer.

Lurie pointed to reports in the literature indicating that adverse events during MRI are increasing.

“This may be because hospitals are getting better at reporting such incidents, or it could be that pressure for higher throughput of patients is leading to less time being spent on preventative measures; even a simple thing such as instructing a patient on the correct use of foam earplugs takes time and effort,” he concluded.

By Frances Rylands-Monk, medical journalist based in St. Meen Le Grand, France.

This article was originally published on March 3, 2017, in ECR Today, the daily newspaper of the European Congress of Radiology, the annual meeting of the European Society of Radiology.

ECR Today - How can iterative reconstruction really help us go?

Recent years have seen dramatic improvements in CT technology, and this has brought with it a steady improvement in clinical utility, in turn resulting in an increased number of scans conducted worldwide.

Unfortunately, an unwanted consequence of the increased use of CT is an overall increase in radiation dose to the patient population. Therefore, major efforts have gone into promoting methods to reduce patient dose while maintaining image quality.

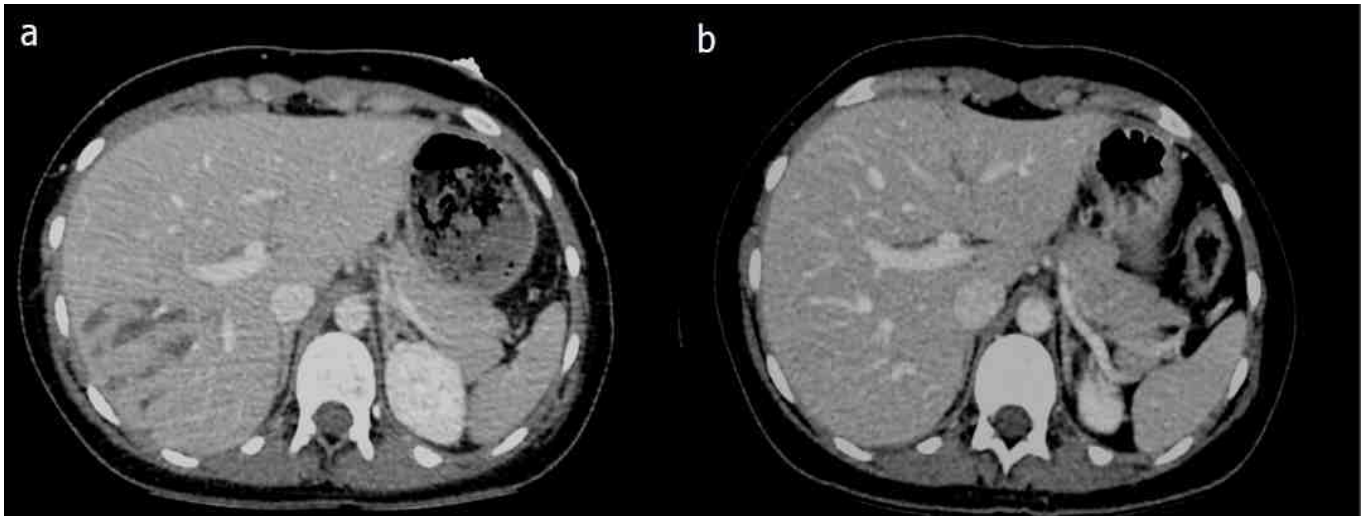
Probably the most dramatic effect on dose reduction has come from the use of Iterative Reconstruction (IR), which is now available on most latest-generation CT scanners. Today's Refresher Course on CT dose reduction using IR will provide attendees with vital information about the background, methods, pitfalls and practical use of IR; it is 'essential viewing' for all ECR attendees who have an interest in state-of-the-art CT and dose reduction.

For many years, Filtered Back Projection (FBP) was the primary method used for reconstructing CT images. FBP takes the raw CT data (1000–4000 projections) and projects it back into the image space, to determine an attenuation value for each voxel. Despite its robustness and generally acceptable performance, CT images reconstructed by FBP can suffer from image noise, poor low-contrast detectability and image artefacts, and these problems (especially noise) are amplified when the radiation dose is lowered.

There is a need for an improved reconstruction method to allow a reduction of radiation dose while improving the spatial and temporal resolution, without sacrificing image quality; IR goes a long way towards satisfying these goals. Instead of the 'brute-force' reconstruction used in FBP, which uses only the raw data, IR methods involve modelling the physical processes involved in the generation of projection data. The resulting simulated projections are compared with the raw data, and reconstruction proceeds in a cyclical manner until there is a good match (according to a pre-defined criterion) between the measured and simulated data[1]. In fact, IR was proposed as long ago as the 1970s and has already found extensive use in methods such as SPECT. However, the much larger data sets (higher spatial resolution) in CT have precluded the use of IR with CT until relatively recently, when it has become feasible due to improvements in computing hardware.

The power of IR algorithms is that they can model many of the physical parameters that FBP does not (and cannot) take account of, such as the x-ray spectrum and the blurring of the focal spot. A number of approaches and algorithms exist for IR, with their own strengths and weaknesses. The most basic IR algorithm goes through a series of iterations applied on a first-pass FBP raw dataset. Recently, more complex IR, termed fully-model based algorithms, have become available, which use both backward and forward projection datasets. By combining many more iterations, image noise can be reduced even further, potentially enabling 80–90% patient dose reduction compared to FBP1, [2]. The noise reduction afforded by IR can be exploited as improved image quality at constant dose, as a reduction of dose with no loss in image quality (see Figure), or as a combination of these.

Despite the real benefits of IR in CT, the method has to be used with care since it can introduce its own effects on images. Some studies have found over-smoothing in cases when higher strengths of IR were applied. This has been associated with aggressive noise reduction and is reported as a distinctive image texture of 'waxiness' or 'pixilation'. Hence, it is vital that the appropriate radiation dose level as well as the strength of the IR techniques is selected; CT dose reduction with IR techniques should be achieved in a gradual stepwise approach.



Abdominopelvic 2mm-slice CT images from a 26-year-old patient (follow-up of post-traumatic hepatic fracture). (A) Full-dose CT with FBP reconstruction (529 mGy•cm); (B) Half-dose CT with IR reconstruction (267 mGy•cm). Note the comparable image noise. From reference [2].

Finally, it is important to note that images reconstructed by IR techniques can have a different appearance compared to FBP, mainly due to a decrease in overall noise and different depiction of tissues. Therefore, radiologists need a period of adaptation to the new image appearance. Over time, as they become accustomed to the look of the images, the iterative strength level may be altered, in order to reduce the patient dose even further.

There is no doubt that iterative reconstruction has an enormous amount to offer in clinical CT and it has already been taken up by the major manufacturers, each of which offers their own variant of the technology. IR most certainly leads to substantial reductions in patient dose from CT, which can only be a good thing. Nevertheless, optimum use of IR requires further discussion among the community, and international guidance about the implementation of IR in clinical practice would be very beneficial.

By Vesna Gershan, Associate Professor of Physics of Medical Imaging Techniques at the Ss. Cyril and Methodius University in Skopje, Macedonia;
and David Lurie, Professor of Biomedical Physics at the University of Aberdeen, UK.

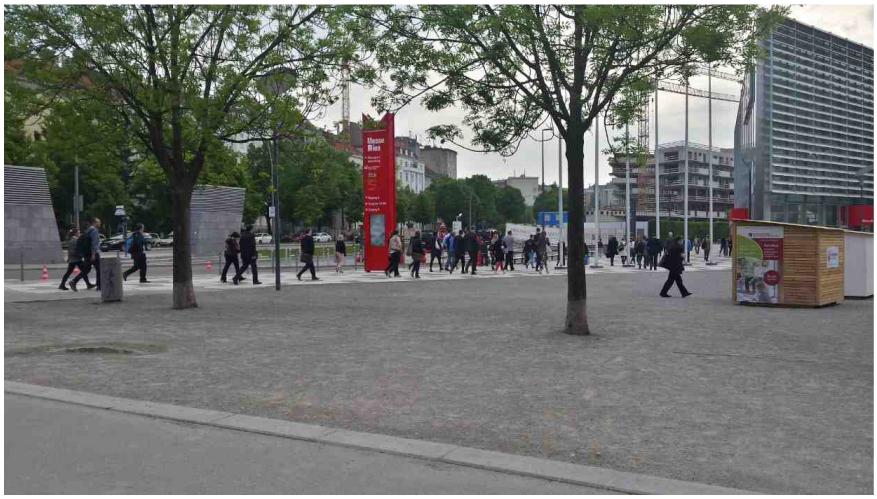
References

[1] Geyer et al., 'State of the Art: Iterative CT Reconstruction Techniques', Radiology, 276, 339-357 (2015).
[2] European Society of Radiology, Ask EuroSafe Imaging, Tips & Tricks, 'Iterative reconstructions in CT', http://www.eurosafeimaging.org/wp/wp-content/uploads/2016/06/CT-WG_TipsTricks3.pdf

This article was originally published on March 4, 2017, in ECR Today, the daily newspaper of the European Congress of Radiology, the annual meeting of the European Society of Radiology.

ESTRO 36, This House believes that ...

The 36th ESTRO edition took place in Wien, with its 5620 participants and company delegates, 598 oral communications and 422 posters (without counting the electronic posters).
Four (and half) demanding days, especially as the social opportunities to create connections and exchange impressions were as great and intense as the scientific activities.



Wiener Messe. People entering the conference venue

Picture taken during the ESTRO party

Despite my little experience with ESTRO congresses, I believe that this year edition was incredibily rich of original high level contributes. How am I supposed to summarize the contents of all these days of talks, announcements, symposia, lectures and debates?

Luckily the ESTRO website does provide an excellent and complete overview of all the presented abstracts:

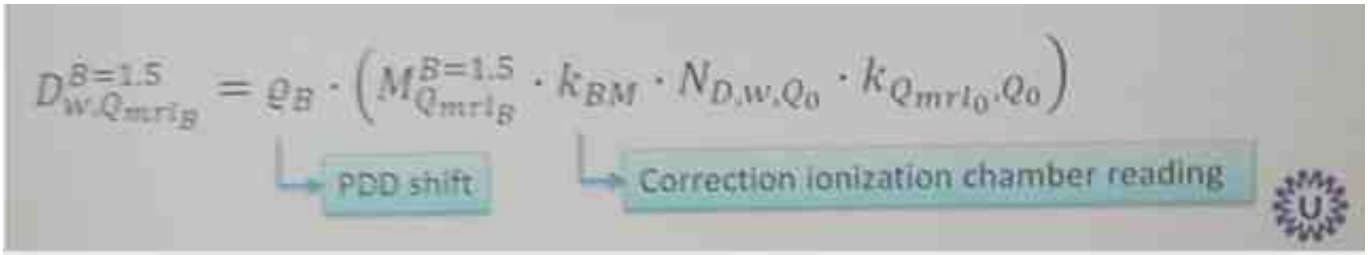
https://user-swndwmf.cld.bz/ESTRO-36-Programme-book-and-exhibition-guide1.

So, shall I delegate the contents of this report to what's provided in the ESTRO website and go for a run along the Limmat? Not before sharing with you some of the questions that this ESTRO edition raised in me.

Throughout the conference I had the feeling that this year it was not just about people and groups presenting their most recent works and results, and company releasing their new products. Even though I can't avoid mentioning the exploits of the 7MV MRI Linac by Elekta and the super fast double-layer MLC Halcyon machine by VARIAN. Drum's sound and light games drove the attention of everyone in the exhibition area and contributed to create an almost epic atmosphere.

But again, it was not all about novelties.

The congress was crossed by a constant questioning. Many steps forward have been and are being done in molecularly targeted radiotherapy; treatment planning is moving from purely physical dose calculation towards biological optimization thanks to the several studies on biomarkers; the first patients are being treated at the Universitair Medisch Centrum in Utrecht on a MRI Linac, delivering 8 Gy in one fraction (palliative treatments for bone metastasis); dosimetric equipment for commissioning this machine and for patients specific QA are in place and finally a new formalism for reference dosimetry has been "constructed";



Reference Dosimetry formalism. Picture taken from presentation of B. Van Asselen (Utrecht)

adaptive RT (ART) with on-line plans adaptation is the hot-topic almost everywhere and many centers presented their first results and implemented workflow (MD Anderson Cancer Center is taking advantage of deformable image registration, the Netherland Cancer Institut in Amsterdam also proposed various adaptive protocols, the RT department in Liege is using CBCT for ART in NSCLC patients ...); automated treatment planning demonstrated to be efficient and safely suitable for the "bread and butter" indications; the new in-room/gantry-integrated cyclotron solutions are going to make proton RT available on a hospital-base, therefore accessible to everyone.

In short, the future doesn't look so much as a future anymore.

And where's the questioning? Actually three intense debates took place during ESTRO.

1st Debate (Sunday)

What shall we offer to our patients? Protons guided photon therapy (MRI Linac) or photons guided proton therapy (CBCT guided PT)?

- MRI images surely offer a way better soft-tissue contrast and therefore an on-line localization of the target at the moment of irradiation. Is that true? Is there actually any imaging technique at all that can offer to the naked human eye the capability to visualize the CTV?
- Protons will always offer a huge reduction of the famous and feared low-dose bath and this seems to strenghten the immunological response to RT. Nevertheless, following and properly irradiating moving targets is still a big challange in PT.
- Finally, which of the 2 techniques is more suitable for which indications? Neither of the 2 contenders (B. Raaymakers and T. Lomax) could give any answer to that.

2nd Debate (Monday)

Which priority topic should the ESTRO invest on? QA management of dosimetry (C. Hurkmans – The Netherlands), standardizing and improving education of the young medical physicists in Europe (N. Jornet – Spain), development of image registration, dose accumulation and real time ART (U. Oelfke - UK), implementing decision making tools (A. Dekker – The Netherlands), biology modelling (M. Alber - Germany), or finally a proton RT available for everyone (T. Bortfeld -USA)?

Every speaker tried to win the audience's approval. Where do we believe the future of our fight against cancer will be? It is there that the community should invest its moeny and we should all commit our time and energy. But, who are we to make such a pre-selection? Who could have the right to say to N. Bohr: "look man, you'd better find another way to spend your time. The future of quantum physics relaies on waves mechanics, not on particles" ? Yet, Bohr and Schrodinger developed the theory of quantum mechanics just coming from 2 different sides. And, maybe as a sign that indeed the majority of the audience did not feel like having that right, the educational project won the prize.

3rd Debate (Tuesday)

Are all these advances in technology going to eliminate the need for human input within the next 20 years? With the possibility of automated planning and in the future of more and more sophisticated decision making tools, what would be the role of planners, clinicians and physicists? On the other side, can any of us, imaging to be a patient, wish for having to interface with only machines and screens without any contact with a human face? Let's maybe leave to automation the most elementary tasks within the RT workflow, so that we, persons, physicists, planners and doctors can concentrate more on complex cases, developments and research, and on making these automatic models more and more "educated".

These are all the question marks I'm bringing home from this 4 days congress. These, and … the "good intention" of contributing to all of these great attempts to make the RT world a little bit better, with the littleness of my every day clinical activity at my institute.

Francesca Belosi, Med Phys at PSI

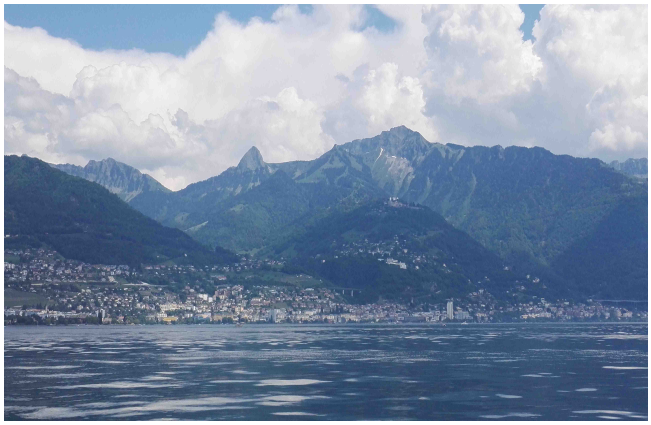
13th Meeting of the International Stereotactic Radiosurgery Society (ISRS)

Montreux, May 28 – June 2, 2017

As announced by the ISRS President, Antonio De Salles from Sao Paulo, in his welcome message, the International Stereotactic Radiosurgery Society (ISRS) celebrates 25 years of development in Radiosurgery worldwide. The society was created to foster learning and research on the topics of brain and body radiosurgery and promotes technical developments in stereotactic radiosurgery and stereotactic radiotherapy.

This anniversary is an opportunity for reminding the multidisciplinary approach of the society based on the scientific knowledge of three diverse specialties which are Neurosurgery, Radiation Oncology and Medical Physics.

The ISRS holds biennial meetings between Europe, Americas and Asia alternatively, with the last ones in Yokohama (2015) and Toronto (2013). This year, Montreux was honored to host the 13th ISRS meeting. The Auditorium Stravinski facing the Lake Geneva was an outstanding venue for sharing the most important



developments in Stereotactic Radiosurgery although some of us would have preferred walking outside or swimming in the lake! Chatting with some participants from worldwide, we could feel that Switzerland remains very attractive, relying on its beautiful landscape. Well, very expensive, indeed!

The meeting was organized over 5 days starting on Sunday May 28th with educational courses and the opening ceremony. From the following Monday until Thursday, the talks were distributed between a main session in the

Auditorium and one to three parallel sessions in smaller rooms. Each day started with so called breakfast seminars as three parallel refresher courses. We particularly appreciated the quality of the talks which composed those seminars. Unfortunately for us, commuting every morning from Sion, those were very early wake-ups!

We do not know the exact number of participants but our rough guess is something like 700 with a fair Swiss representation. Thus, the atmosphere was quiet and pleasant like in the old days of the ESTRO Biennial Physics. The commercial exhibition was pretty small with Elekta taking the central stage. Yes, we got the feeling that this meeting was the "Gamma knife congress".

The educational course on Sunday morning was very good. It provided a review of the basic principles of radiosurgery for guys like us who know some of the theory but have no experience at all in the field. Radiobiological concepts, like the biologically effective dose, and special cares in imaging QA such as MR image distortion, were discussed in that framework. Then, clinical reviews were presented on functional radiosurgery as well as brain and spinal metastases radiosurgery. The afternoon was dedicated to industry sessions with lectures by devices users followed by hands-on with main systems.

The following topics were the highlights of the sessions that we attended:

Physics

There were not so many physics sessions throughout the meeting. Most of them were concentrated on Monday. The majority of the talks were on topics related to dedicated treatment modalities as the Gamma Knife and the Cyberknife. For clinical physicists working with linacs (like us), there was not much to bring back home. Fortunately, a few morning refresher courses emphasized on the physics of radiosurgery process as a whole.

- As a good take-home point for the rest of the conference, a very animated panel discussion reminded all the audience of one of our famous "R's": repair is indeed a crucial point also for radiosurgery, especially since the time required for delivering the same dose with the different devices (Gamma and Cyberknife, FFF Linac, ...) can vary from a couple of minutes to one hour or more. The question being, of course, how should our clinicians adapt their prescriptions?
- We liked to hear that Gamma machines came to rotate as well (Infini, MASEP). Since the tomotherapy breakthrough already more than 20 years ago, all manufacturers must offer something which turns around the patient!
- An end-to-end dosimetry audit conducted in UK in 26 radiosurgery facilities with an anthropomorphic head phantom showed that good agreement with predicted dose distributions from TPS was achievable by all modalities. Nevertheless, the linac group showed largest variations related to more heterogeneous practices within the group, compared to smaller variations seen within CyberKnife, and more consistent practices seen in Gamma Knife groups. The variations in prescription practices, techniques and plan quality highlight the need for standardization in SRS practice. The never ending question about the isodose prescription (ranging from 45% to 100% for the same reported dose) was a particularly striking example.
- Virtual cones formed by two 45° collimator fields, which small rectangular sizes (5mmx2.1mm) are shaped by the MLC, seemed to offer a smart alternative to physical cones, since they would not, in theory, require any patient-specific QA once commissioned as library plans.
- We had very comprehensive lectures on radiosurgery as a whole process: how radiosurgery must be safe and effective despite difficult geometric and dosimetry gradient constraints which require extremely high

accuracy and precision; identify, quantify the uncertainties at every step of the complex SRS chain, which includes MR image distortion optimization, deformable registration QA, image guidance performances, intrafractional motion, as some examples; at last but not least, perform end-to-end tests. We went out with valuable advices.

- Recommendations: several speakers reminded that IAEA TRS-483 and AAPM TG-155, both dealing with small field and non-equilibrium condition dosimetry, will be published within the next months. No doubt that they will be featured in a future issue of this bulletin!

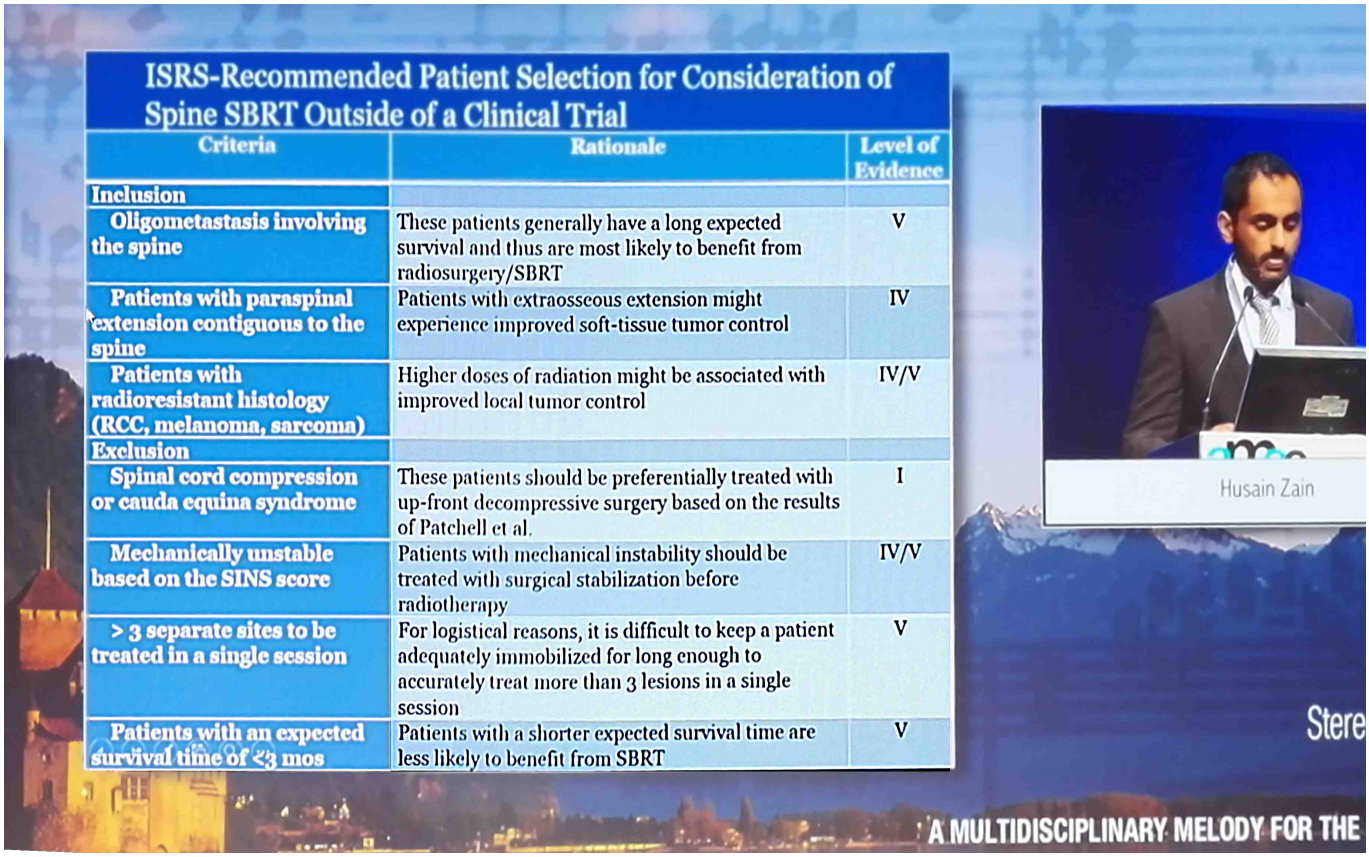
As imaging technique, we learnt about MR diffusion tensor imaging (DTI) tractography. This amazing MR technique uses anisotropic diffusion in axones to estimate the white matter organization of the brain such as neural tracts. Integration of stereotactic tractography into SRS represents a promising tool for preventing complications by reduction in radiation doses to critical "connected" cortical areas by the white matter tracts. MR was virtually the only imaging modality that was discussed in the clinical talks, emphasizing the need for our community to carefully assess the image quality (deformation, artifacts, registration, ...) through dedicated QA. As an example, Novotny (CZE) presented an extensive characterization of three Siemens MR systems with fiducials, phantom and patient data, showing that ~1 mm deformation should be expected. Combined with the accuracy of the IGRT on the treatment machine, this uncertainty already "eats up" a not negligible part of the tight SRT margins!

Brain metastases

We were very much interested in the treatment of brain metastases where stereotactic radiosurgery became very popular in the last years, especially in the context of aging population. Everyone seems to agree, based on high level evidence, that patients with one to four brain metastases will greatly benefit from radiosurgery with lower adverse effects than with a whole brain radiotherapy. It remains a very active field of research to produce the evidence that the same results may be expected when more metastases are to be treated simultaneously. Many talks concentrated on that topic trying to identify significant prognostic factors for treatment strategy making. Patient good performance status, cumulative volume (or volume of the largest) and number of metastases, among others, were proposed. Similarly to whole brain treatments, protecting the hippocampi might improve neurocognition performance preservation: a clinical trial is actually about to begin at Duke.

Spinal metastases

Spinal radiosurgery is an increasingly used treatment method for metastases in the spine. By delivering ablative doses of radiation, SRS provides excellent tumor control (up to 94% local control) and pain relief (up to 96%). Clinical outcome data are available. However, this information has primarily been generated from retrospective and nonrandomized prospective series. Various presenters exposed their current protocols, and insisted on the need for a consistent contouring of the spinal cord in (both in the sup-inf and radial directions) in order to ensure patient safety for this critical organ.



Lung, Liver and Pancreas

While most talks focused on the brain stereotactic irradiation, a few noteworthy contributions reminded the medical physics community of what is expected from us for these challenging targets. With 4-D CT and now 4-D MR imaging becoming the norm, we should always keep an eye on the reconstruction and fusion processes in order to hit the clinical target within the tight margins. The accuracy of the positioning chain from CT (or MR) simulation to treatment, the intricacies of breath-hold + contrast CT-sim protocol at Duke for liver SBRT, or the technical challenges of having an MR and a Linac in the same bunker gave an insight of what kind of questions are still to be answered.

Functional radiosurgery

Treatment of neurologic functional disorder is obviously a very important and interesting topic but we did not feel very concerned about it. However, we are curious about how the radiation oncology community will get more and more interest in some of the relaReted benign diseases.

by Cyril Castella and Jean-Yves Ray,
Hopital du Valais, Sion

EFOMP teaching course announcement

Institut de radiophysique
Rue du Grand-Pré 1
CH-1007 Lausanne

Use of mathematical model observers in the framework of CT patient dose optimization in Europe

Aims

This module aims to help the future MPE acquire the knowledge, skills and competences necessary to exercise a leadership role within the profession in his own country and in Europe in the field of CT imaging. The content of the module will focus on the use of mathematical model observers when willing to assess objectively image quality in CT. The standard methods will be first briefly reviewed (mainly during the on-line phase of the course). During the face to face part of the course the concept of model observers will be presented together with some background theory in psychophysics allowing the MPE to understand the strengths and weaknesses of the model observer approach. Practical examples will be given to show how an MPE could propose a patient dose optimization scheme in CT. This course should also help MPE to fully interpret the characteristics of CT units provided by manufacturers in situations where an Institution is willing to purchase a CT unit. Patients' dose aspects will not be addressed during the face-to-face phase of the course.

Module Code: MPE08

Module Level: EQF level 8

Online start: 15 January 2018

Face-to-face period: 12-16 March 2018

Location: Lausanne, Switzerland

Registration fee: CHF 570.- (€ 520.-)

Organized by: Prof. Francis R. Verdun & Prof. François Bochud

For more information: **http://eutempe-net.eu/**

PSI: the knowns and the unknowns

What is legendary (and all of you for sure know) :

• that the proton therapy center of PSI is the pioneer of proton pencil beam scanning (PBS), recognised worldwide

• that indeed it hosts the very first PBS machine, the 'old-good' Gantry1

• that since 2013 a way faster PBS machine, 'the sexy-smart' Gantry2, is in clinical operation, utilizing fast, double parallel upstream scanning, with a continuous energy selection across a range of 70-230 MeV; the scanning speed that this machine can reach potentially allows treating moving targets by means of re-scanning

• that every single piece of this proton therapy centre is in house developed, i.e. softwares, machines, control systems and even the TPS (PSIPlan)

• ... and that.. surprise surprise! the 3rd Gantry of this centre is going to be the very first commercial treatment machine ever installed at PSI ! (ProBeam by Varian)

What many of you might know :

• that, due to many technical limitations, the only indications that could be treated with Gantry2 were initially only intracranial lesions with a size below the sweeper magnet scanning range (20x12cm) and no extracranial ones, as the dedicated treatment couch was still missing

• that in Gantry2 due to the very long patient's specific verification workflow and limited availability of the CT (in-room CT, therefore not available simultaneously to patients irradiation) we had to reduce the treatment activity to the morning only

• that indeed there are some delays with the actual clinical activity of Gantry3

What maybe remained a bit behind the shadows:

• that we are a very dynamic, in continuos expansion group, with 6 PhDs and Post-Docs (+ 2 starting soon !), 7 among physicists, technicians and engineers dedicated to imaging and dosimetry, 8 physicists dedicated to development, 13 medical physicists (3 Junior in training and one as a shared position with USZ + 2 new collegues starting soon !), 8 among physicists, engineers and technicians dedicated to machine maintenance and operation, 13 MTRs, 6 medical doctors (one in training as shared position with USZ and one in training as shared position with Inselspital) and 6 physicists

dedicated to medical software implementation and maintenance

• that Gantry2 has made many steps forward in the last year thanks to the huge effort and dedication of many of my collegues, all aiming to exploit at maximum the potentials and capabilities of this fast scanning machine, in order to improve the quality of treatments offered to our patients and to widen the targeted patients population.

In practise, since June 2016 a long couch was commissioned and the so called 'patched fields' technique was introduced, allowing the irradiation of targets extending more than the 20x12cm sweeper magnet scanning area. Indeed, as Gantry2 employs a parallel scanning approach (i.e. the beam optics of the final 90 degree bending magnet are so designed that all scanned pencil beams within a field exit the nozzle exactly parallel to each other), extended treatment fields can be automatically delivered by moving the

couch between the patches, without the need to create and optimize wedged dose distributions in the overlapping areas

• that the legendary volumetric rescanning approach for moving targets can be put in practise and it's fully integrated in our clinical workflow (together with a 4-D dose optimization)

• that a new planning-delivery technique was commissioned, named 'Automatic Beam Pool'. It refers to the possibility of setting the pre-absorber (a sort of range shifter plate that is normally set in place in order to reach very superficial depths, i.e. <3.5cm), on a spot-base, rather than on a field base. Which means that the pre-absorber will be placed in the nozzle during the delivery of the most superficial spots (which will then have an enlarged spot size due to the Multiple Coulomb Scattering within this material), but it will be taken out as soon as not needed anymore, preserving a very narrow shape for the deeper pencil beams (it can be considered the equivalent of a mixed electrons-photons irradiation)

• that our patient's specific verification workflow is becoming more and more efficient and that an out-room CT can now be used for planning images allowing to enlarge the patients capacity on Gantry2

• that despite the delay in Gantry3 becoming operational (well.. it has to be said ..PSI is not exactly the plug and play kind of centre ...), we have almost completed the acceptance tests and collected all needed beam data to start commissioning and playing around with the Eclipse TPS

• that the arrival of Gantry3 opened PSI to the commercial world, bringing along the integration of ARIA as OIS, and Velocity as PACS and tool for contouring and image registration (as some of our doctors stated : 'back to civilization !').

What still remains a challenge (and therefore among the unknowns):

• treating children and adults with Cranio Spinal Irradiation in Gantry2 (many challenges need to be overcome on the dose optimization side but also in finding an appropriate fixation device that fits our long couch). All related obstacles are being tackled and the goal is to start treating these indications in autumn

• going forward with the commissioning of Gantry3 ..and .. eventually treating the 1st patient before Christmas of this year !

Francesca Belosi, Med Phys at PSI

Welcome!

Kees Spruijt

Since several years I had the idea to live abroad for a period of time to experience a new culture, learn a new language and live in a country not as flat as the Netherlands. Then, an email from the Clinique the Grangettes popped up in my mailbox. They were searching for a medical physicist. It was March 2016…
Before continuing, I would like to give you a short overview of my training and experience in the Netherlands. For me, it has always been fascinating to apply physics to the medical world, however, despite liking to work in a hospital, I did not really know in what kind of department I wanted to work. Luckily, one of my internships during the master in Medical Natural Sciences gave the answer: I wanted to work in a radiotherapy department. It is just great and fulfilling to work as a team with people in different disciplines (doctors, technicians, RTT's and medical physics engineers), and make together the difference for a patient.
After finishing my masters in 2009, I started the four year medical physicist training at the VU University medical center (Amsterdam). I took the opportunity to explore all parts of radiotherapy. Mostly at the VU, however, as part of the training I also worked for the NKI/AVL (Dutch cancer institute) and the MCA (small hospital in Alkmaar). In 2013, I was proud to obtain my degree of medical physicist.
Subsequently, I started my first job in a hospital (ZRTI) that was just opening a satellite location. It was very challenging since a lot of new equipment, workflows and trainings needed to be prepared to be able to treat the first patient. The positive result did not remain unnoticed and so I soon became the head of physics.
Then it became 2016, and I still wanted to work abroad. So when receiving that email from the Clinique the Grangettes, I applied for the job and as you might expect, I even got it!
In the meanwhile, I have already been working in Geneva since more than a year. Also here I have done, seen and experienced a lot. Besides working hard, I have enjoyed (and will enjoy) the mountains very much.
I had the pleasure to already meet some of you during the SASRO, local meetings, collaborations and some occasional matches of table tennis. Looking forward to meet all of you in the upcoming years!

Kind regards, Kees Spruijt

“People on the move”

Maud Jaccard

After a fruitful 3-year experience in the radiotherapy group of Institut de Radiophysique at CHUV (Lausanne), I am about to begin a new chapter of my professional life by joining the medical physicists team of the radio-oncology service at HUG (Geneva). Therefore, I am qualifying at the moment as “on the move”! Although actually now I will be more static, since I have never left Geneva and I have been commuting by train for the last few years.
In 2014 I started working at CHUV where I trained in medical physics, and I obtained my SSRPM certification last year. My time at CHUV was a very rich experience. I met wonderful people and I had the chance to work with many different advanced radiotherapy techniques and to be involved in an exciting research project about high dose-rate radiotherapy.
Before that, I studied theoretical physics at the University of Geneva and completed my PhD in cosmology and modified gravity, trying to elucidate the nature of dark energy. During this period, I discovered (almost by chance!) the field of medical physics and I decided to leave the puzzle of the acceleration of the universe expansion, and turn to the linear acceleration of electrons in a waveguide. I have never regretted this choice, as I find the job of medical physicist so stimulating and diverse, and I enjoy its interdisciplinarity.
I would like to use this opportunity to send my greetings to my former colleagues who I will miss, and to my new ones who I am looking forward to start working with!

Maud Jaccard
maud.jaccard@gmail.com
Currently in transition between Centre Hospitalier Universitaire Vaudois (CHUV, Lausanne) and Hôpitaux Universitaires de Genève (HUG, Genève).

Editorial staff and Information

Impressum

Editors

Francesca Belosi
Proton Therapy Center
Paul Scherrer Institut
5232 Villigen
056 310 37 45
francesca.belosi@psi.ch

Nathan Corradini
Clinica Luganese
Centro di Radioterapia
6900 Lugano
091 960 81 28
nathan.corradini@clinicaluganese.ch

Shelley Bulling
Centre d'Oncologie des Eaux-Vives
26 rue Maunoir
1207 Genève
022 319 77 30
sbulling@eaux-vives.com

Jean-Yves Ray
Service de radio-oncologie
Hôpital de Sion
Av. Grand-Champsec 80
1951 Sion
027 603 45 12
jean-yves.ray@hopitalvs.ch

Web Editor

Jean-Yves Ray
Service de radio-oncologie
Hôpital de Sion
Av. Grand-Champsec 80
1951 Sion
027 603 45 12
jean-yves.ray@hopitalvs.ch

SSRMP Secretary

Roman Menz
Radiologische Physik
Universitätsspital Basel
Petersgraben 4
4031 Basel
roman.menz@usb.ch

Publisher

Schweizerische Gesellschaft
für Strahlenbiologie
und Medizinische Physik
(SGSMP/SSRPM/SSRFM)

Printing Press

Mengis Druck und Verlag AG
Pomonastrasse 12
CH-3930 Visp
www.mengisgruppe.ch

Call for Authors

Also, you are invited to participate in the construction of our bulletins. Of desirability are all contributions that could be of interest to members of our society, such as

- Reports of conferences, working group meetings, seminars, etc.
- Reports on the work of various committees and commissions
- Succinct results of surveys, comparative measurements etc.
- Short portraits of individual institutions (E.g. apparatus equipment, priorities of work, etc.)
- Reports on national and international recommendations
- Short Press Releases
- Photos
- Cartoons & caricatures
- Announcement of publications (E.g. books, magazines)
- Announcement of all kinds of events (E.g. conferences, seminars, etc.)
- Short articles worth reading from newspapers or magazines (if possible in the original)
- Member updates (E.g. appointments, change of jobs, etc.)

The easiest way to send your document is as a MS Word document via email to one of the editor addresses above.

Deadline for submissions to Bulletin No. 90 (03/2017): 11.2017

SSRMP Board

Board members

Dr. sc. nat.	**Peter Manser** President peter.manser@insel.ch	Abteilung für Medizinische Strahlenphysik Inselspital - Universität Bern 3010 Bern	031 632 37 71 031 632 24 29 031 632 21 11
PD MER Dr.	**Raphaël Moeckli** Vice President Chair Science Committee raphael.moeckli@chuv.ch	Inst. Univ. de Radiophysique (IRA) Rue du Grand-Pré 1 1007 Lausanne	021 314 46 18 021 314 80 68
Dr. phil. II.	**Roman Menz** Secretary roman.menz@usb.ch	Radiologische Physik Universitätsspital Basel Petersgraben 4 4031 Basel	061 328 73 14
MSc.	**Regina Seiler** Treasurer regina.seiler@luks.ch	Radio-Onkologie Luzerner Kantonsspital Spitalstrasse 6000 Luzern 16	041 205 58 07 041 205 58 11
Dr. rer. nat.	**Frédéric Corminboeuf** Chair Education Committee f.corminboeuf@lasource.ch	Centre de Radio-Oncologie Clinique la Source Av. Vinet 30 1004 Lausanne	021 642 70 00
MSc.	**Jean-Yves Ray** Chair Professional Affairs jean-yves.ray@hopitalvs.ch	Service de radio-oncologie Hôpital de Sion Av. Grand-Champsec 80 1951 Sion	027 603 45 12 027 603 45 00
MSc.	**Yvonne Käser** yvonne.kaeser@physmed.ch	PhysMed Consulting GmbH Kleindorfstrasse 12a 8707 Uetikon a. S.	079 453 99 02
Dr. med.	**Markus Notter** markus.notter@lindenhofgruppe.ch	Radioonkologie Lindenhofspital Bremgartenstrasse 117 3001 Bern	031 300 95 11 031 300 88 11 031 300 86 99
Dr.	**Stefano Presilla** stefano.presilla@eoc.ch	Ente Ospedale Cantonale Servizio di Fisica Medica Viale Officina 3 6501 Bellinzona	091 811 91 84

Conference Calendar

CALENDAR 2017

August 23
Bern

SSRMP Workshop RPO2MPP
http://ssrpm.ch/event/ssrmp-workshop-2017/

September 10
Dresden, DE

Dreiländertagung SGSMP-DGMP-ÖGMP 2017
September 10 - September 13
http://www.dgbmt-dgmp.de/

September 18
Trieste, IT

Joint ICTP-IAEA Workshop on Monte Carlo Radiation Transport and Associated Data Needs for Medical Applications
September 18 - September 29
http://indico.ictp.it/event/7992/9

September 21
Bern

OFSP-BAG 2nd National Radiation Protection Day in Medicine
Theme: Diagnostic Radiology
http://ssrpm.ch/event/ofsp-bag-workshop-2017/

September 24
San Diego, USA

ASTRO Annual Meeting
September 24 - September 27
https://www.astro.org/2017-ASTRO-Annual-Meeting.aspx

October 15
Napoli, IT

International Conference on Monte Carlo Techniques for Medical Applications (MCMA2017)
October 15 - October 18
https://agenda.infn.it/conferenceDisplay.py?confId=12594

October 21
Wien, AT

30th Annual Congress of the European Association of Nuclear Medicine
October 21 - October 25
http://eanm17.eanm.org/

October 27
Solothurn

SSRMP Continuous Education Day: Deformable Registration
http://ssrpm.ch/event/ssrmp-continuous-education-day-2017

December 1
Bern

AMP Meeting
http://ssrpm.ch/event/amp-meeting-december-2017/

And please, if you participate in any conference or meeting, think of writing a few lines or sending a picture for the Bulletin.

THANK YOU!