BULLETIN

August 2018

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 92 www.ssrpm.ch

Editorial

Letter from the Editors

Dear SSRMP members,

Bringing together this Bulletin has been a bit more challenging than usual. Summer vacations, combined with general tiredness after a long winter - during which many of us had to deal with deep changes in their respective departments - meant that finalizing this issue has felt a lot like rowing upstream.
My "summer pearl" of wisdom, from my own experience, is that it can be very restorative to dare to challenge ourselves with something completely different to dose distributions, MC calculations, weekly/yearly QA and the next abstract deadline from time to time (i.e. planting potatoes? Ah ah!).
We are medical physicists, yes. But are we just only medical physicists? Re-discovering new possibilities, capabilities and passions, experiencing another kind of life, might re-new the spirit, the motivation and our medical physicist's soul!

This Bulletin is a lighter (Summer-adapted!) read, but it is not empty. There is an interesting description of the project that won the SSRMP research grant award in 2017. The project involves the design and testing of a deformable liver phantom, hopefully a step towards the much-pursued goal of real-time adaptive RT.
There are conference reports from the Swiss Congress of Radiology, the 57th edition of the Scientific Meeting of the French Medical Physics Society (very interesting to hear also the topics of discussion of our neighbours!), and one from the 6th MR in RT congress held in Utrecht. Many people are "with hands in the dough" (a very Italian expression!) to investigate and implement accurate and appropriate standards for routine QA procedures, absolute dosimetry and beam characterization for treatment planning systems when magnetic fields are added to the mix for radiotherapy treatments.

The PhD platform introduces the project of Silvan Müller from Inselspital, Bern who is working on the creative idea of electron-photon mixed RT treatments, to be able to exploit at the same time the advantages of these two different radiation types, leaving behind their respective downsides.
Also, I have to advertise with special enthusiasm, the SpotLightOn article about the Klinik für Radio-Onkologie of Kantonspital Winterthur. If we had a Bulletin Hall of Fame, then this article would definitely be part of it. Thanks to Enrico and his colleagues for the thorough description of the department and the data.

Finally, returning to the abstract deadlines of the opening paragraph - don't miss in the SSRMP News section, the announcement for the next SSRMP Annual Meeting and the abstract submission deadline!

Enjoy the last days and rays of this fantastic Summer!

Francesca Belosi,
On behalf of the Editorial Team.

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PRESIDENT'S LETTER

Dear colleagues,

Cancer is a disease which affects the entire world: 20 mio. new cases per year are expected in 2025 and due to insufficient access to medical care in low and middle-income countries, about 6 mio. cancer deaths yearly are estimated. Having said this, there comes the question, whether we as individuals or as a society are in charge to take actions and to help solving these problems. Do we already act appropriately? Are we prepared and do we have the resources? How are upcoming technologies - like digitization and automation - changing the corresponding challenges?

Surely, we don't have the final answers right now, but for me it is clear that it will become a major part for our future involvement and it sounds logical that we have to think not only locally but globally. I am well aware that this statement is somewhat inconsistent to the current trends and developments, which generally take place at this moment. To vote for global approaches is kind of old-fashioned at this stage but it's my sincere belief that there is no other way than global thinking, which brings mankind forward. What else than global involvement is filling the gaps, is building bridges and is providing technology and care to individuals on a big scale?

Our society, SSRMP, is the national society of Switzerland for medical physics and radiobiology and encompasses expertise in both fields, the cancer diagnostics as well as cancer treatment. SSRMP members are respected for their important role in daily practice within the clinical setting. They are in charge when dealing with the problem to optimize, calculate and deliver the right dose at the right time at the right position. Furthermore, medical physicists and radiobiologists working in Switzerland are well-known for their educational contributions and scientific achievements. Regularly and with a steady increase by number, Swiss research groups publish their investigations in high-ranked journals and present them on international and national conferences. Collaboration and cooperation are well-established in our society and researchers from all over the world are interested in working with us.

All these achievements are a result of hard work of individuals. For more than 50 years, SSRMP as a society could help providing platforms such as the annual meetings or the AMP meetings for discussions and the exchange of new ideas. The next SSRMP annual meeting has just been announced recently and will take place in Lausanne from 22.-23.11.2018.

PRESIDENT'S LETTER

Raphal Moëckli and his team are organizing this event and I would like to encourage all of you to participate actively on this meeting. At the same time, we are going to have our next general assembly, where - among other topics - the election of the new board has to happen. For me, it will be the last general assembly as president and as board member of SSRMP. After 10 years of board activities, I think it's time to step down. Frédéric Corminboeuf is also stepping down from the board such that also the position of the chair of the education committee is vacant. Over the last months, the board took over its responsibility for providing solutions for these vacancies. Thus, the board was in contact with different people and discussed with them about their interests to become board members. Currently, it seems that we have found smart and clever persons, who are interested in staying or becoming board members. Nevertheless, being a candidate for the board is open for all members of SSRMP and if you are interested in such a position, please get in contact with a current board member.

The current bulletin is also the last one, for which I write a president's letter. This gives me the opportunity to thank the editorial team, especially Francesca Belosi, for their amazing work in setting up these bulletins. I know that it's not easy to find authors and to remind the president (and probably others, but yes mainly the president) to come up with their texts and contributions. In addition, I like to thank all the readers of the SSRMP bulletin for their interests and their comments, which I regularly received over the last years. Always fascinating to see how people react on what was written. I am sure that you will like the current issue and I wish you inspiring reading.

Peter Manser,
SSRMP president

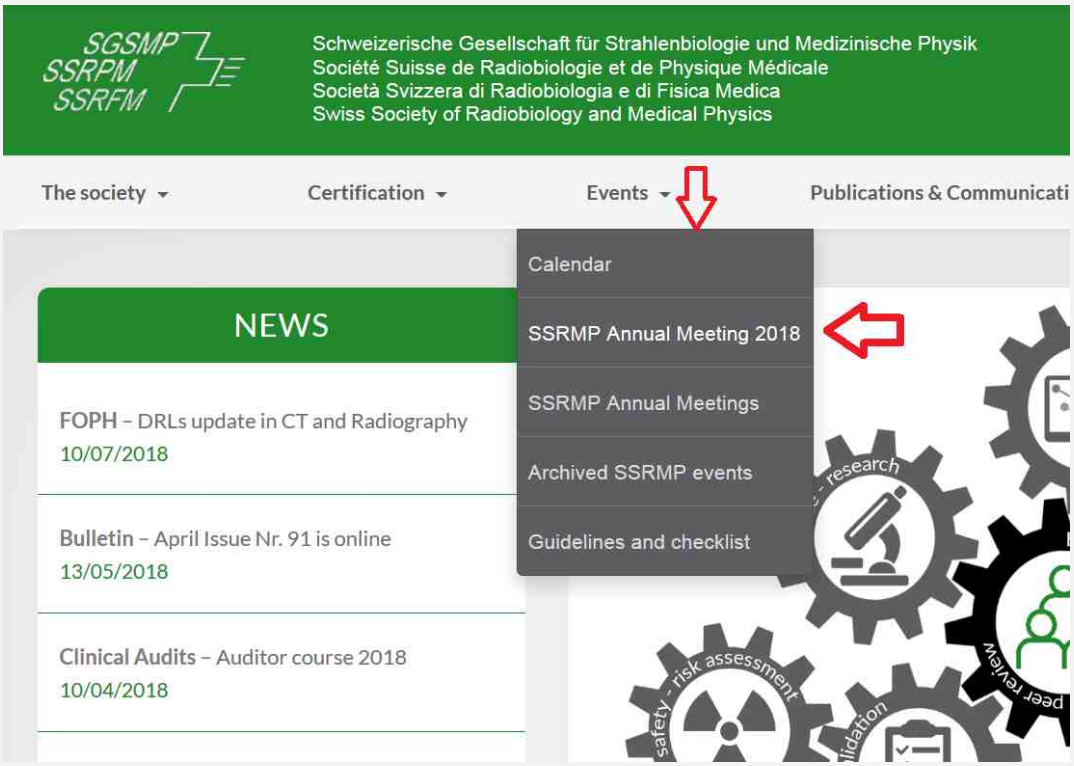
PROFESSIONAL AFFAIRS

Website updates

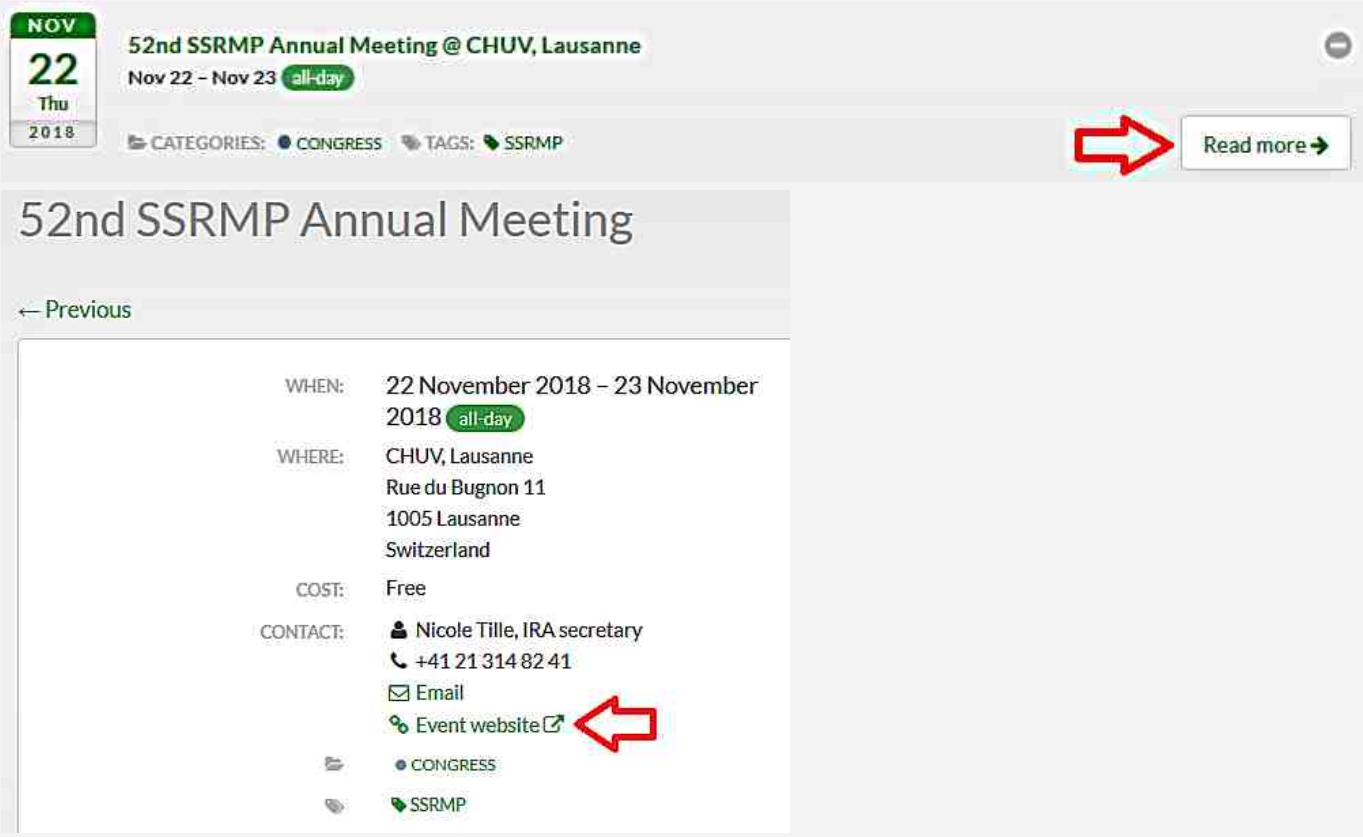
As part of the SSRMP communication platform, the website of the society **http://ssrpm.ch/** is continuously updated by the editor team with helpful information for their members. Additionally, modest developments are realized step by step within the extent of the available resources. We draw your attention here on the very recent new features.

SSRMP annual meetings

In order to take weight off the organizers of the SSRMP annual meetings, dedicated web pages have been created to host this year annual meeting and those of the coming years.
The pages of the current year's conference are easily accessed from the top menu **Events** (**http://ssrpm.ch/conference-2018/home/**).



PROFESSIONAL AFFAIRS



The past conferences pages, as well as the current's year ones, remain available from the event calendar details. Go backwards in the calendar dates or go to **SSRMP Annual Meetings** from the top menu **Events**. **Read more** displays the event details and in particular the link to the event web pages.

Event online registration

The second feature, which had been made earlier available, is the participants' online registration. Simply fill in the required fields of the registration web form and press the SEND button. None of your data is stored on the website but all the needed registration data are automatically sent by email to the conference organizer. This process makes each participant's registration experience as well as the registration management for the organizers far easier.

We hope that these new features will improve your experience of the society's website. Please let us know your comments and ideas how to make SSRMP communication platforms attractive and useful. We always look for motivated volunteers with web tool skills to participate to its on-going developments.

On behalf of the editor team
Jean-Yves Ray, Chair of the committee for professional affairs

Read again about the major website features in Bulletin 86 (December 2016)
http://sgsmp.ch/ - http://ssrpm.ch/ - http://ssrfm.ch/ - http://ssrmp.ch/

SCIENCE

SSRMP Annual Scientific Meeting Announcement
22nd - 23rd November 2018

Congress president: Raphaël Moeckli

Scientific committee:
Chair: Raphaël Moeckli
Members: Claude Bailat, François Bochud, Jérôme Damet, Peter Manser, Véronique Vallet, Francis Verdun

Secretary: Nicole Tille - 021 314 82 41

Venue:
Centre Hospitalier Universitaire Vaudois (CHUV)
Auditoire Charlotte Olivier (BH08-511)
Rue du Bugnon 46,
1011 Lausanne

Abstract submission: **13.08-15.09, 2018**
Please use the template at
http://ssrpm.ch/conference-2018/abstracts/

Online registration:
http://ssrpm.ch/conference-2018/registration/
Registration fee is free (**but registration is mandatory!**)

Social Event: Thursday evening. Book along with the conference registration

SSRMP General Assembly: **Thursday 22nd**

Call For New SSRMP Board Members

At this year's general assembly, a new SSRMP board will be elected. It is already known that some of our current board members will step down, and so this call for new SSRMP board members is of special importance. The elections and the board positions are open to every SSRMP member. In order to prepare the elections, it would be appreciated if anyone willing to become a board member would please indicate their interest before **September 20**, **2018**. Thus, if you are willing to be a candidate, please send an email to Peter Manser (peter.manser@insel.ch) or to any of our current board members.

SCIENCE

Award Research grant 2017

ELPHA: Dynamically deformable liver phantom for real-time adaptive radiotherapy treatments

Authors: Stefanie Ehrbar[1], Alexander Jöhl[1,2], Michael Kühni[2], Mirko Meboldt[2], Ece Ozkan Elsen[3], Christine Tanner[3], Orcun Goksel[3], Stephan Klöck[1], Jan Unkelbach[1], Matthias Guckenberger[1], Stephanie Tanadini-Lang[1]

1 Department of Radiation Oncology, University Hospital Zurich and University of Zurich, Switzerland
2 Product Development Group Zurich, Department of Mechanical and Process Engineering, ETH Zurich, Switzerland
3 Computer-assisted Applications in Medicine, Department of Information Technology and Electrical Engineering, ETH Zurich, Switzerland

Acknowledgements

This work has been conducted within the scope of the research grant of the Swiss Society of Radiobiology and Medical Physics. It was further supported by the grant CR32I3_153491 and P2_150620 of the Swiss National Science Foundation, and is a part of the dissertation of Stefanie Ehrbar. Over the last 14 months, several prototypes of the phantom were created and leading to the prototype described here. The full manuscript is submitted for publication elsewhere and a summary of this manuscript is shown here. This work has been performed in a collaboration of the University Hospital Zurich with the Product Development Group Zurich and the group for Computer-assisted Applications in Medicine, both from ETH Zurich. We further would like to thank Helene Isler and Sairos Safai for their advisory support, as well as Esben Worm and Per Poulsen for sharing their motion data.

Introduction

Tumors in the thoracic and abdominal region are prone to motion due to respiration, muscle contraction and peristalsis. Tumor motion increases the challenge to achieve a therapeutic radiation dose in the tumor, while minimizing the dose to the surrounding tissue. With motion-adaptive treatments such as gating or active motion tracking, the effects of tumor motion can be mitigated. These techniques require information about the tumor position in real time. The internal anatomy can be imaged directly with x-ray fluoroscopy. More often, fluoroscopic or electromagnetic tracking of implanted fiducial markers is used, or the tumor position is inferred from external motion surrogates. Ultrasound imaging being a low-cost, real-time, and non-ionizing method, has the benefit of no additional imaging radiation to the patient and no need for marker implantation, while maintaining good soft tissue contrast in abdominal organs.
Motion-adaptive treatments are highly complex. All involved systems, i.e. the radiation generation and beam shaping, the motion quantification, the information processing and the motion adaptation, have to work simultaneously and synergistically. To test, verify and improve the accuracy of such complex workflows, phantoms are required to mimic the human body for controlled experiments.

SCIENCE

There exists already a variety of commercial and experimental motion phantoms for verification of lung cancer treatments. However, there is a lack of abdominal phantoms, which mimic respiratory motion and deformation. Therefore, we designed, developed and manufactured a deformable liver phantom for verification of real-time adaptive treatments. This phantom is compatible with multiple motion quantification and imaging modalities.

Desired phantom specifications

A phantom for treatment verification in the real-time adaptive radiotherapy setting has to fulfill several requirements. First, the phantom should be able to perform reproducible, dynamic, respiration-like motion and deformation. Second, it should have anthropomorphic structures included, made from a material that shows soft tissue contrast of the liver in different imaging modalities. Third, a time-resolved dosimetry system should be included to investigate dose deliveries in the real-time adaptive setting. We designed the dynamically dEformable Liver PHAntom (ELPHA) to meet these specifications.

Phantom construction

Soft silicones (Ecoflex and Dragonskin, SmoothOn Inc., Pennsylvania USA) were chosen for the torso of the phantom, since this material with densities around 45 HU is highly durable, deformable, low-cost and easy to handle. Casting molds were created from wood and foils based on a patient MRI. A simplified vessel structure was added to the phantom. Radiographic image contrast was achieved by mixtures of the two silicones, and ultrasonic contrast by adding cellulose (Sigmacell Cellulose, SIGMA-ALDRICH Co., Missouri USA) as scatter material. Two electro-magnetic (EM) transponders (Varian Medical Systems, Palo Alto USA) were added to one vessel of interest (arrows in Figure 1).

The silicone torso was fitted between a static plate at the inferior end and a dynamic plate at the superior end of the torso. This allowed to control the motion in the main respiratory motion direction. The dynamic plate can be driven with sub-millimeter precision by a ball screw drive (Mädler AG, Feuerthalen, Switzerland) connected to a 150-Watt DC motor, which is controlled by an EPOS2 controller (both Maxon motor AG, Sachseln, Switzerland). With an interface based on Matlab (The MathWorks Inc., Massachusetts USA), individual motion trajectories can be applied to the controller. Figure 2 shows the torso within the mechanical setup and on the treatment table with an ultrasonic probe attached.

For dosimetry, a film insert and plastic scintillation dosimeters (PSD) were integrated into the phantom. The PSD are an in-home construction, transforming dose to a visible light signal. Small tips of scintillating waveguides were coupled to clear waveguides (BCF-20 and BCF-98, Saint-Gobain Crystals, France) to guide the light to a CCD camera for read-out (SVS 340 MUCP, SVS-Vistek GmbH, Seefeld, Germany). The integrated light output was sampled with a frequency of 1 Hz, giving a time-resolved dose.

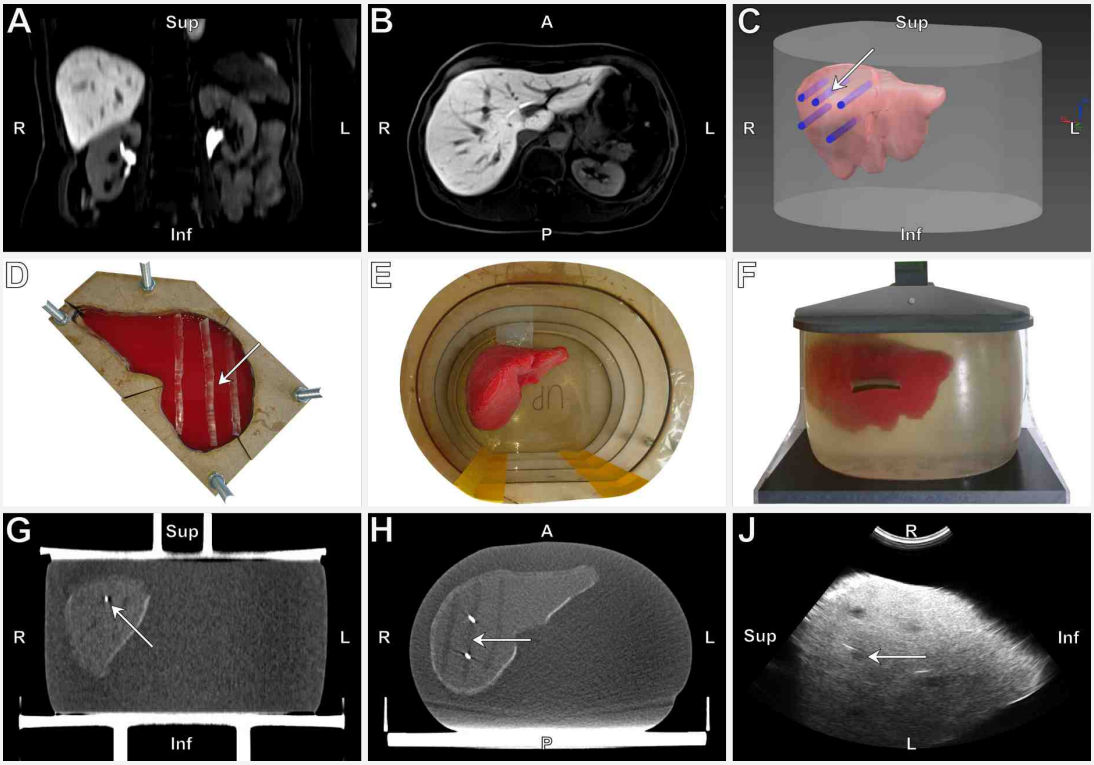
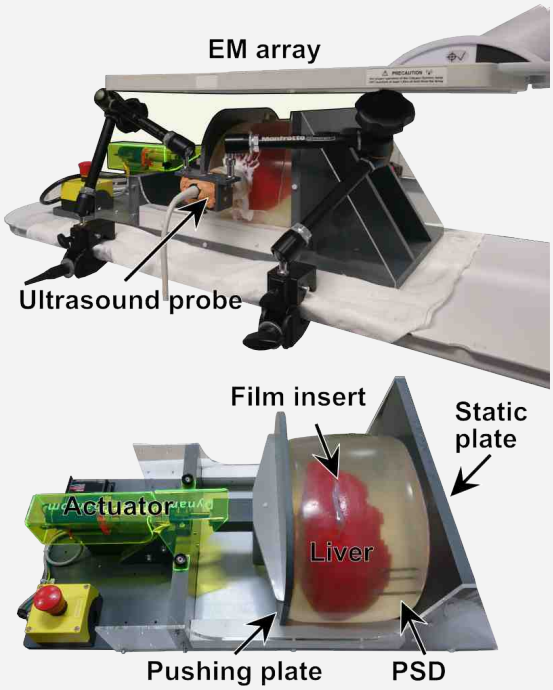


Figure 1: *Modelling and casting of the liver phantom: Magnetic resonance images (A, B) used to create the model (C) of the liver, vessel arrangement and torso outline. Wooden mold for the liver cast with embedded vasculature (D). Cylindrical mold for the torso with embedded liver (E). The fully casted phantom (F). CT image of the phantom in coronal (G) and transversal view (H). Coronal ultrasound image from the right side (J). Arrows indicate the vessel of interest with two EM transponders implanted (bright spots in CT image). L: left. R: right, A: anterior, P: posterior, Sup: superior, Inf: inferior.*

Figure 2: *ELPHA. Bottom: The silicone torso within the mechanical setup. Motor and spindle (actuator) are mounted below the cover on the left. Artificial liver tissue is opaque and includes a coronal film insert and plastic scintillation dosimeters (PSD).*
Top: The phantom is setup on the treatment table with the detection array on top for EM tracking and the ultrasound probe on the right side of the liver.



Comparison of ultrasound and EM transponders for motion detection

Real-time adaptive treatments require a motion quantification system. With ELPHA, multiple systems can be investigated and compared. Time-resolved ultrasound imaging of ELPHA's liver and vessel structures were performed in 2D with a convex-array transducer (SonixTablet, Analogic Corporation, Peabody, MA, USA). The position of the vessel was tracked in the ultrasound images with a template matching algorithm in LR and SI direction and compared to the motion traces acquired with the EM transponders.
Tumor motion with sine and chirp patterns with amplitudes of 10 and 20 mm, and a patient specific motion trace were tested. The root-mean square error between the motion detected with ultrasound and EM transponders was found to be larger for larger motion amplitudes, but below 1 mm for all traces. The ultrasound and the EM position signal are shown in Figure 3 for the patient specific curve. Figure 3 also shows how the internal motion amplitude is lower than the externally applied motion at the pushing plate and that motion in left-right and anterior-posterior direction is induced by the deformation.

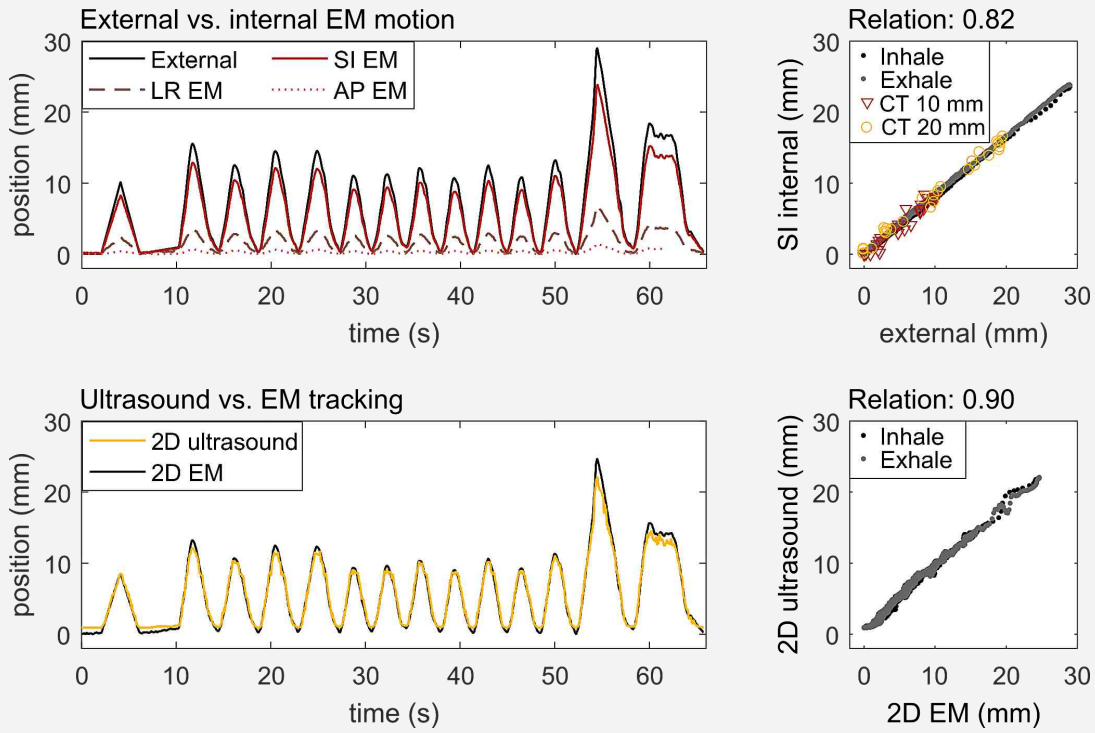


Figure 3: *Top left: Externally applied motion trace in black and internal motion recorded with electromagnetic (EM) transponders in red. Top right: Relation between external motion and internal motion in SI-direction separated for inhalation (black) and exhalation (grey). Internal and external motion measured in 4DCT scans with 10 mm (triangles) and 20 mm (circles) motion. Bottom left: Comparison of the in-plane (2D) internal motion detected by ultrasound (yellow) and EM transponders (black). Bottom right: Relation between ultrasound and EM transponder position separated for inhalation (black) and exhalation (grey).*

Couch tracking experiment

A volumetric-modulated arc therapy (VMAT) treatment plan with two arcs was setup with a fraction dose of 500 cGy, such that two PSD were placed in the high dose region and one in the dose fall-off. Time-resolved light output was measured with the phantom (i) in static position, (ii) with motion but without compensation (untracked), and (iii) with motion and couch tracking for motion compensation (tracked). The EM transponders were used for position feedback for couch tracking. Motion patterns from three since curves (Sine10, Sine20 and Sine30) were investigated. The time-resolved measured dose was compared to the time-resolved dose from the treatment plan (optimized and calculated in Eclipse treatment planning system (Varian Medical Systems) by calculating the RMSE for the radiation dose.

The time-resolved dose, which was measured with PSD 1 in the high dose region, is shown in Figure 4 in the static, untracked and tracked situation. The untracked dose rate shows a highly oscillating pattern induced by the motion. With increasing motion amplitude, the RMSE between calculated and measured dose increased. This increase was largest for PSD 3 placed in the dose fall off. With couch tracking, the RMSE could be reduced substantially.

The same experiment was carried out with film measurements and the dose-area histogram (DAH) of the target region on the film (circle with diameter of 20 mm) was evaluated. The measured DAH profiles are shown in Figure 4. The dose coverage was largely reduced with increasing motion to a Dmean of 300 cGy at 30 mm untracked motion (24 mm internal motion). With couch tracking, the coverage was mostly restored with mean dose above 480 cGy.

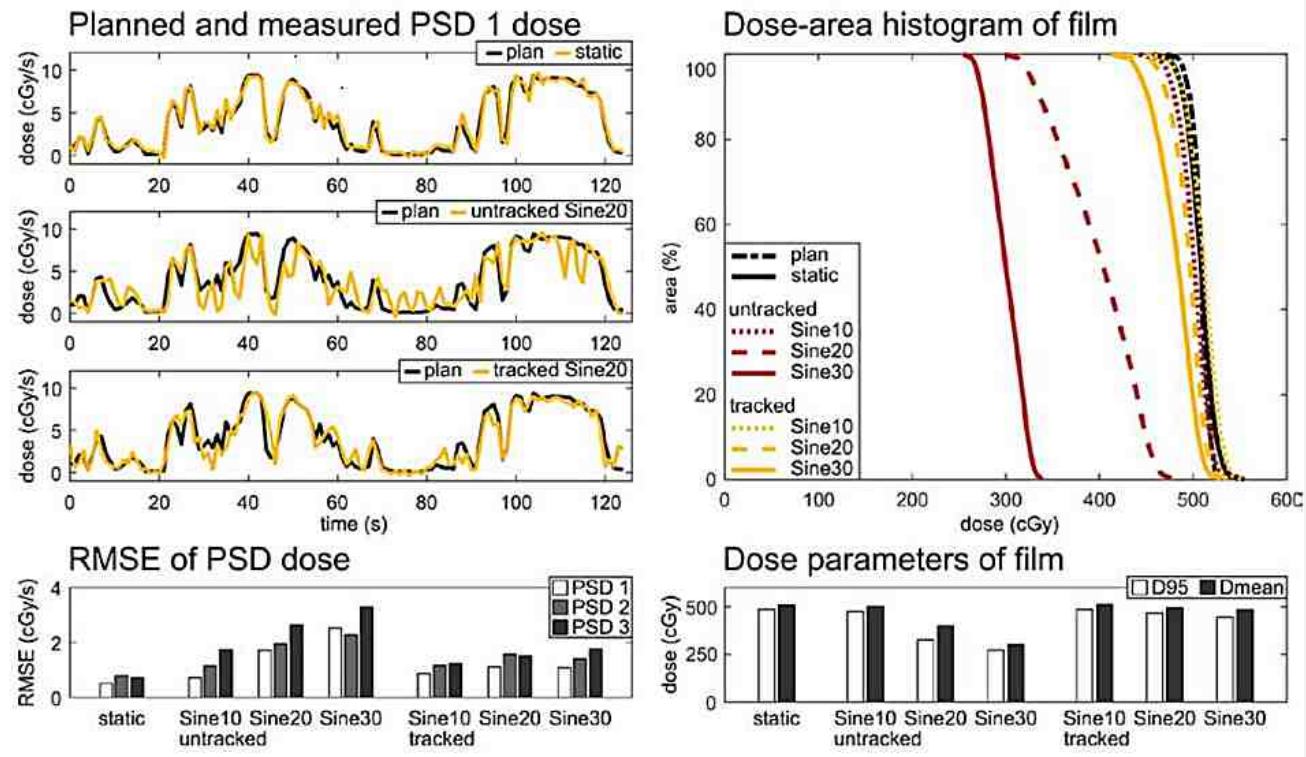


Figure 4: *Dosimetry of ELPHA. Left top/middle: Time-resolved dose measurement with plastic scintillation detectors (PSD) comparing the planned dose output (black) to the measured dose in the phantom in static, untracked and tracked situations for PSD 1. Left bottom: Root-mean-square error (RMSE) of the planned and measured dose for the three PSDs. Right top: Dose-area histogram (DAH) of film measurements within ELPHA in static, untracked and tracked situations. Right bottom: Dose to 95% of the volume and mean dose corresponding to the DAH.*

Conclusion

A dynamically deformable liver phantom was developed and successfully tested in two tasks of real-time adaptive radiotherapy. Verification of ultrasound imaging for motion quantification could be performed by comparison to integrated electromagnetic transponders, and the performance of treatment-couch tracking for motion compensation could be measured with time-resolved dosimeters. The phantom showed high motion reproducibility and durability throughout all experiments. In the future, the phantom can be used or adapted to many other imaging or dosimetry tasks.

Report from Swiss Congress of Radiology

Lausanne 10th - 12th May 2018

The 2018 version of the Swiss Congress of Radiology (SCR) was held in Lausanne between May 10th and 12th at the SwissTech Convention Center. The Swiss Congress of Radiology is the biggest radiological scientific and educational meeting held in Switzerland with an average attendance of over 1,200 professional and industry delegates. The SCR is organized by the Scientific Committee of the Swiss Society of Radiology (SGR-SSR), in joint collaboration with the Swiss Society of Nuclear Medicine (SGNM-SSMN) and the Swiss Association of Radiographers (SVMTRA-ASTRM).

The medical physics participation in this conference was seen extensively across different topics from radiation protection, patient dose and protocol optimization, image quality and new technology. These contributions were seen in the new diagnostic reference levels for conventional CT and CT in hybrid devices, description of new image quality parametrization in fluoroscopy, evaluation of patient doses and other talks.

Throughout the conference it was possible to see new areas of expertise that are becoming more common and which medical physicists will soon encounter in the clinic. These go from the introduction of state-of-the-art machine learning techniques and solutions in Radiology (presentations from Siemens, IBM and research institutes (EPFL)) to the arrival of game changer devices in nuclear medicine – the era of digital devices – for example the lunch symposium presented by our colleagues from CHUV on their expectations (between physicians, physicist and radiographers) on the new digital PET from Siemens.

Overall the SSRMP was well represented at the meeting with talks and oral presentations across all tracks. A highlight contribution among the physicists was a poster prize (magma cum laude) to Dr. Natalia Saltybaeva from Unispital Zürich on "*Overranging dose reduction by dynamic collimators: Evidence from clinical practice*". In this work, she evaluated the efficacy of dynamic collimators in daily clinical routine where she found that these types of collimator can be highly efficient for radiation dose reduction especially in high pitch scan modes.

Thiago Lima
Kantonsspital Aarau

57eme Journées Scientifiques Société Française de Physique Médicale

Toulouse, France 13th - 15th Juin 2018

Bord de la Garonne

Cette année les journées scientifiques de la Société Française de Physique Médicale SFPM se déroulaient à Toulouse, 4eme ville de France (habitants), ville Rose, ancienne capitale du royaume Visigoth, capitale de la nouvelle région Occitanie, berceau de l'aéronautique européenne.
Le programme des journées scientifiques était riche avec des sessions parallèles qui couvraient les trois grands domaines de la physique médicale à savoir la radiothérapie, la radiologie et la médecine nucléaire. Le choix des sessions pouvait s'avérer cornélien.

Chaque symposium était inauguré par une session perfectionnement ou de l'état de l'art suivi de nombreuses présentations soit R&D soit aspects cliniques directement en lien avec le thème du symposium.

Citons à titre d'exemple le symposium dédié à la **stéréotaxie** avec une session perfectionnement sur les marges du PTV (M. Hoogeman). La session **métrologie** débutait avec une introduction au Technical Reports Series n° 483, *Dosimetry of small static fields used in external beam radiotherapy* (P. Andreo). La session **planification** rappelait les modalités du concours de dosimétrie 2017 (J. Rolland), et était suivi par la session **radiothérapie adaptative et machine learning** avec également un état de l'art de la RT adaptative (R. Garcia). L'ensemble des TPS Monte Carlo commerciaux étaient passés en revue durant la session **modèle de calcul** avec une *Review of Monte Carlo systems applied to conventionnel external beam radiotherapy* (L. Brualla); vue d'ensemble également de différentes techniques de gating ou tracking avec la session sur le **mouvement respiratoire**, *Motion gating and tracking techniques overview and recent developments* (G. Mageras). Mais aussi d'autres sessions non des moindres avec CQ en IRM (L. Barantin), imagerie theragnostique (E. Hindie), détecteurs numériques en TEMP (L.Verger), et en TEP (De Brasse), place de la physique médicale en imagerie préclinique (J.M. Vrigneaud), RX interventionnelle (M. Eresue Bony) et nouvelles technologies. A noter que les HUG (Genève) intervenaient sur deux sessions à la fois stéréotaxie et planification. Un espace entièrement numérique était dédié aux différentes sessions poster.

Parallèlement au programme scientifique, les organisateurs/organisatrices rivalisent d'imagination d'année en année pour une soirée de Gala d'exception dans un lieu remarquable: le musée de l'aéronautique Aeroscopia était entièrement réservé aux congressistes avec apéritif et diner servis au choix sous la turbine d'un Airbus A300 ou sous le fuselage du concorde. Il faut souligner que la logistique est prévue dans les moindres détails avec la mise en place de navettes toutes les heures jusqu'au bout de la nuit pour un retour des participants vers leurs hôtels.

Musée Aeroscopia

Le centre des congrès situé dans le centre ville offrait la possibilité après une journée de conférences soutenues et intenses, de s'oxygéner l'esprit et de découvrir le patrimoine architectural, botanique, et culturel de la cité (Basilique Saint-Sernin, la place du Capitol, muséum, jardin japonais, la cité de l'espace etc.), de longer les bords de Garonne ou bien ceux du canal du midi comme l'évoque la chanson (chanson de Claude Nougaro) ...
En bref ce séjour en pays de cocagne fut assurément placé sous le signe du savoir industriel, scientifique et, culturel.

Brique rose et Jardin japonais

Le prochain RDV se tiendra à Angers du 5 au 7 juin 2019.

Geoffroy Guibert, pour SSRPM en direct de Toulouse
A vous l'antenne :)

6th MR in RT congress and Satellite symposium on standards and procedures for dosimetry and QA in MRgRT

Utrecht, Netherlands June 30th – July 3rd 2018

The 6th MR in RT conference was held in Utrecht in the Nicolai church from the 1st to the 3rd of July 2018. The Sunday morning session could not start until 11 o'clock so that we could sleep in on our first day, since a Mass was held before in the church. The weather was excellent and all coffee and lunch breaks could be held in the garden in front of the church. With 330 participants, the conference was fully booked and nearly all seats were occupied during the sessions. The official start of the conference took place on Saturday evening at the Radiotherapy department of the University Medical Center Utrecht (UMCU). A 15 minute tour through the department was organized, where we could have a look at the prototype MRI linac, the Elekta Unity system and the 1.5 T MRI brachytherapy suite.

Prior to the official start of the 6th MR in RT conference, on the 30th of June, the Satellite symposium on standards and procedures for dosimetry and QA in MR guided radiotherapy (MRgRT) took place at the UMCU. This symposium was organized by the leaders of the project "Metrology for MR guided radiotherapy", which is founded by the European Metrology Program for Innovation and Research (EMPIR). An European consortium, including the Swiss metrology institute METAS, is working on this project. The project partners and speakers from Australia, Canada and the USA presented in four sessions their ongoing developments and newest results. The audience was dominated by physicists, coming from 17 different countries. The various challenges for the dosimetry and quality assurance which arise from the presence of a magnetic field were discussed on this day. The focus was on the following topics:

- Measurement of absorbed dose to water
- Treatment planning systems and beam characterization
- Monte Carlo simulations
- Quality assurance

The first session was about the reference dosimetry for the MRgRT devices. The only primary standard in Europe for the calibration of the detectors in the magnetic field is a water calorimeter developed by the Dutch metrology institute VSL for operation in MRI incorporated treatment machines. The magnetic field correction factors (kB) of six waterproof ionization chambers (3 PTW 30013 and 3 IBA FC65-G) were presented, which were determined in this calorimeter. Indirect methods for the determination of kB were

discussed in this session as well. Several speakers presented their magnetic field correction factors for different detector types (ionization chambers, Alanine, Fricke). The session ended with a discussion on the Code of Practice (CoP) for reference dosimetry, where the audience was asked to share their opinions/wishes.
In the second session, the relative dosimetry for MRgRT treatment planning systems was discussed. Beam characterization measurements such as lateral and depth dose profiles were shown.
The challenges of the Monte Carlo (MC) simulations and dose calculations in magnetic fields were discussed in the third session. Also, a short general introduction was given so that non-professionals in MC could follow the further discussions. Then the difficulties and possible solutions of the MC simulations in the magnetic field were shown. The verification and benchmarking of the MC simulation was a topic as well as the MC implementations for clinical purpose.
The last session was about the QA and workflow procedures for MRgRT. The influence of the magnetic field on the MRI images and the MRI QA were discussed. Results for measurements with 3D gel and 2D film dosimetry in the magnetic field were shown and the dose response, energy dependence, reproducibility and inhomogeneity of these methods were discussed. Three available detectors for patient specific QA (Octavius 4D MR & 1500MR, ArcCheck MR and Delta4 MR) and anthropomorphic phantoms were presented and discussed.

The day ended with the official start of the 6th MR in RT conference. During the following two and a half days of the conference, over 50 oral presentations were held and over 80 posters were presented. The main topics of the conference were:

- Clinical experience from MR guided radiotherapy
- Online MR guided radiotherapy
- Deep learning in image processing for radiology / radiotherapy
- Dosimetry and quality assurance in the presence of a magnetic field
- MR imaging on MR linacs

All abstracts for the oral and poster presentations can be found on the 6th MR in RT website: **https://www.mrinrt2018.com/abstracts/**.

The last point on the conference schedule was the proposals and voting where the next meetings should take place. We voted that the next meeting will be held in Toronto (PMH) and the year after in Heidelberg (DKFZ).

Maria Trachsel, METAS

PhD platform: Silvan Müller

Treatment techniques for mixed beam radiotherapy with simultaneously optimized photon and electron beams

Electron beams are well suited to treat superficial targets, while sparing distally located organs at risk (OARs) due to their dose fall-off. However, electron beams are limited to treat targets within 5 cm from the patient surface owing to the limited range for the available energies. Moreover, OARs located laterally to the target relative to the beam direction can not be spared adequately due to the large penumbra of the electron beams. In contrast to electron beams, photon beams have a very small penumbra and targets can be treated at all locations in the patient because of the exponential dose fall-off. However, this exponential fall-off also leads to a large dose contribution delivered to normal tissue. A mixed beam approach could merge the advantages of photons and electrons, while keeping their downsides at a minimum. A high potential for treating targets with at least a superficial part is hypothesized.
The aim of this PhD thesis is to develop treatment techniques for mixed beam radiotherapy (MBRT) with simultaneously optimized photon and electron contributions that can be efficiently delivered using a conventional treatment unit. The work is carried out at the Inselspital in Bern and consists of the following three parts:

Part 1: Nowadays, electron treatments are still performed using standard or molded patient-specific cut-outs placed in the electron applicator. Replacing these collimation devices with the photon multileaf collimator (pMLC) for electron treatments would substantially improve clinical workflow. Moreover, intensity modulation would be enabled for advanced MBRT techniques. In this study, a Monte Carlo (MC) beam model for pMLC collimated electron beams was validated for source-to-surface distances of 70 - 100 cm. Moreover, it was shown that cut-out based single field plans could be replaced by single field plans of similar treatment quality using pMLC collimation.

Part 2: In this part, an inverse treatment planning process was developed to generate treatment plans for MBRT. The photon and electron apertures of the plans were simultaneously optimized with a direct aperture optimization and are deliverable with the pMLC in segmented manner. MBRT plans generated for a chest wall and a head & neck case dosimetrically outperformed IMRT and VMAT plans.

Part 3: The aim of this part was to develop and validate a treatment technique for dynamic mixed beam radiotherapy (DYMBER) utilizing increased degrees of freedom including different particle types (photons and electrons), intensity and energy modulation and dynamic gantry, table and collimator rotations. DYMBER plans for brain and H&N cases substantially improved OARs sparing compared to VMAT. Film measurements of DYMBER plans agreed very well with corresponding calculated dose distributions.

Overall, this PhD thesis demonstrates a substantial dosimetric gain if dose distributions of photon and electron beams are favorably complemented to each other. Thus, clinical cases of many treatment sites such as breast, head & neck and brain could benefit from mixed photon and electron beams.

Interview with the Doctor

What brought you to choose this topic for your PhD?

I did my physics Master's thesis already at the Inselspital in Bern, where I implemented a first optimization algorithm applicable to MBRT. The promising dosimetric results convinced me to go deeper into this topic. Besides, I very much enjoyed working in a research group closely connected to clinics.

What did you enjoy the most about the project?

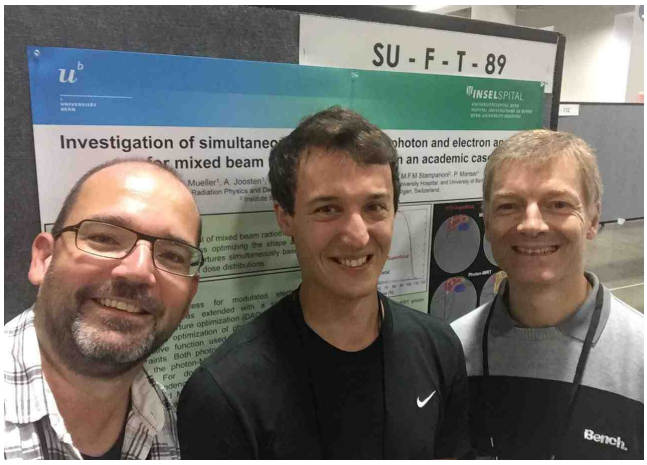
Definitely to explore the possibilities of MBRT with simultaneously optimized photon and electron contributions. For every clinical case, it was unknown how well MBRT would perform compared to treatment techniques like IMRT or VMAT. How big is the benefit of adding electrons? What part of the target will be covered by which particle type? How to implement a general treatment planning framework that handles both particle types simultaneously? Finding answers to these questions was very exciting!

Which part of the project was the most challenging?

Validating calculated DYMBER dose distributions with film in an anthropomorphic phantom in absolute dose units was challenging. If one wants to deliver treatment plans of a novel treatment technique, many aspects come into play: does the dose calculation consider all important impacts such as MLC scatter or couch absorption? How safe is the collision avoidance?

What impact do you think that your results will bring to the med phys society/world etc.?

I think people in radio-oncology will recognize the large dosimetric value of electrons for advanced treatment techniques and I believe our results increase the motivation of treatment unit vendors to support advanced MBRT techniques in future.



Silvan Müller (middle) and his advisors Dr. Peter Manser (left) and Prof. Dr. Michael Fix (right) at the AAPM annual meeting & exhibition 2016 in Washington DC

Would you do it again?

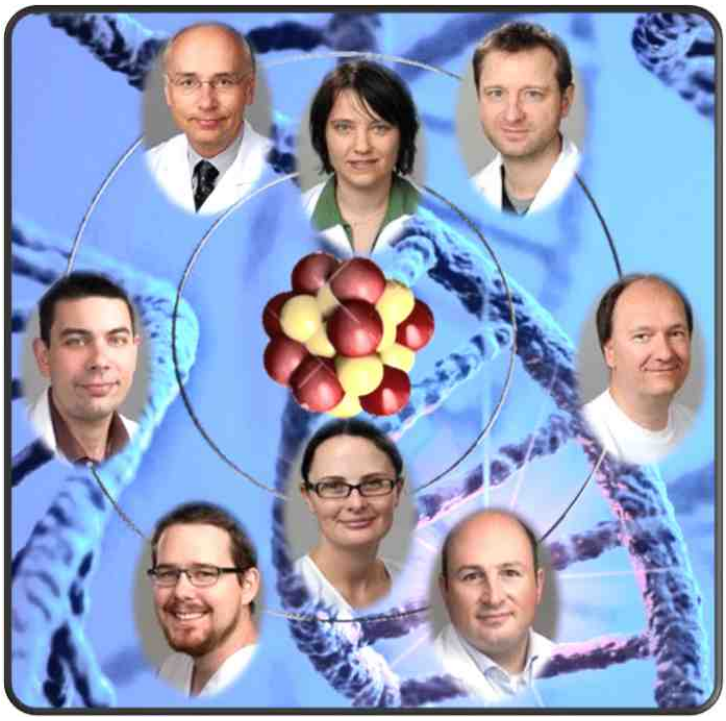
Yes, definitely! I learned a lot and thanks to my PhD thesis, I discovered my passion for medical physics, especially investigating and developing novel treatment techniques.

What are your plans for the future?

I believe DYMBER could bring treatment plan quality for conventional treatment units to the next level. Accordingly, I am very encouraged to continue developing this treatment technique such that its capabilities can be available for clinical application.

Silvan Müller,
Inselspital Bern

Klinik für Radio-Onkologie of Kantonspital Winterthur



The Physics Team from up-left to down-right: Bruno Schnekenburger, Cezarina Negreanu, Helmut Härle, Alessandro Clivio, Olaf Sommer, Linda Oliver, Alex Ringger, Enrico Barletta.

The tradition of radiotherapy in Winterthur goes back more than a century. Indeed in 1908 the cantonal hospital Winterthur buys an X-ray therapy device by "Reiniger, Gebbert & Schall", and in 1912 an "Idealapparat" for X-ray diagnostics and radiotherapy with a column stand, also by "Reiniger, Gebbert & Schall". In the same year, 522 X-ray images are acquired and radiotherapy treatments are delivered to 37 patients.

Since then, the radiotherapy in KSW develops constantly following the scientific and technical advances in the field until the first Cobalt-60 treatment unit is installed. The first medical physicist is hired 1981. In 1982 a Philips 15 MeV linear accelerator (Linac) for Photons and Electrons treatments replaces the Cobalt-60 device.

1999 is the year of the fundamental renovation of the clinic with replacement of accelerator, simulator and planning system and acquisition of a network (Lantis). A new Siemens "Primus" accelerator is installed and initially operates in parallel with the old Philips accelerator that will be later dismissed after 18 years of service.

In 2003 the radio-oncology is separated at the KSW as a specialty from radiology and becomes an independent clinic, led by a chief physician. In the same year, due to a lack of capacity, a second identical accelerator Primus is put into operation together with a new HDR afterloading device, comprehensive of an iridium source and the appropriate planning system.

In the following years the Clinic for Radio oncology, headed by Dr. Urs Meier, stays tuned with state of the arts in the medical physics field and patient treatment. All the relevant improvements are quickly introduced in the clinical routine, as for example the Intensity Modulated Radiotherapy (IMRT) (2005). Volumetric modulated arc therapy (VMAT), Flatness-Filter-free (FFF) treatments, advanced Image Guided

Radiation Therapy (IGRT) and respirator-controlled irradiations are introduced in 2010 whit the installation of the newly designed, digital controlled accelerator “TRUEbeam” by Varian.
Finally, at the beginning of 2017, the new clinic for radio oncology is inaugurated at the KSW: a modern building that guarantees a more efficient working environment for the staff and a more pleasant and easy environment for the patients.
Nowadays we are proud to be a “state of the art” radio-oncology clinic. Our technical equipment includes:

- Two Varian TrueBeam linear accelerators, one of them equipped with a six degree of freedom (6DoF) couch for stereotactic irradiations
- A Varian Gammamed Plus afterload unit for HDR Brachytherapy treatments
- A Canon Aquilion LB computer tomograph with a 90 cm bore diameter and a 70 cm field of view that allows us to perform good quality Planning CTs also on massive or with reduced mobility patients. The system works also as Virtual Simulator thanks to a Lap DORADO 4 Laser equipment
- A Varian RGSC new generation gating system is coupled with the CT and the linacs, allowing us to carry out 4D-CT scans and respiratory controlled patients irradiations

- A Wolf T 200 orthovoltage treatment device is used to treat surface tumoral lesions and benign diseases that can profit of low energy photons irradiations
- The Varian Eclipse treatment planning system (TPS) and the Aria 15.2 radio oncology clinical information system (ROCIS) complete our technical infrastructure.

Parallel to the attention paid to our technical equipment also the professional skills of the people employed in our clinic are continuously developed with an articulated continuous education program that includes weekly seminars for the whole clinic, weekly journal club meetings for the different working groups, also in collaboration with other hospitals and clinics, and the participation to national and international workshops and conferences. In particular all Physicians and Physicists visit at list an international school or workshop every year on different relevant topics, in order to bring back to the clinic and possibly introduce in our workflow the latest advancements in radio oncology and medical Physics.

ZRR

Since 2014 is active in Rüti the "Zentrum für Radiotherapie Rüti Zürich-Ost-Linth" (ZRR) with the aim of strengthening this area in terms of medical support for cancer patients. Up to the establishment of this center, the patients needed to travel to Winterthur, Zürich or S. Gallen in order to profit of radio-therapeutic treatments. The center started his activity at the beginning of October 2014 with the first patient being treated on the 2nd of October 2014.

Some Statistics for 2017 (KSW and ZRR)	
Ambulant Patients	977
Stationaries Patients	145
Total number of Patients	1122
Computer calculated Plans	1312
IMRT/VMAT Plans	876
Stereotactic treated Patients	56
Brachytherapy Sessions	126

The ZRR is operated as an AG from the partners - Spital Uster, GZO (Spital Wetzikon), ZeTuP AG (Tumorzentrum Rapperswil-Jona), the Spital Linth and the Kantonsspital Winterthur.
The center is equipped with a Varian TrueBeam accelerator, Eclipse Planning Systems, a Varian RPM gating system and a Philips Brilliance Big Bore CT with a LAP Dorado 4 system designed as virtual simulation unit, sharing the Aria 15.2 ROCIS and its servers with Winterthur. That because, right from the projecting stage, the center was designed to operate in synergy with the Kantonsspital Winterthur. Although the ZRR operated independently in every daily activity the idea was to provide a safe and reliable solution. Given that any vital equipment could have a serious breakdown it would be possible to treat the patients without any time delay and replanning on the treatment machines at the Kantonsspital Winterthur. In this respect the machines on both sites are matched.
In order to improve the collaboration between the two clinics, a videoconference communication system has been installed and it is daily used to discuss patients' treatment plans in our daily "patients meeting" or to share weekly teaching lessons. It is also used to get in touch with other clinics and hospitals for Tumorboard and continuous education programs.
More, the medical and physics teams share often their activities between the two centers and that helps to keep the same working and quality standards at both locations. On this topic our motto is: We have two treatment locations, but we are one team with one standard!

ZRR- Zentrum für Radiotherapie Rüti Zürich-Ost-Linth AG

The Klinik für Radio-Onkologie forms an integral part of the "Tumor Center Winterthur", with its currently seven organ centers, that was founded from KSW in order to optimize interdisciplinary cooperation. Thus, the patients benefit from an optimal therapy adapted to the individual situation. Since May 2018 the "Tumor Center Winterthur" is ISO 9001:2015 Quality management certified.

Enrico Barletta
medical physicist, Winterthur

"Welcome!"

Marie Fargier-Voiron

After 11 years of studies, PhD, and training far away from my home region, I had the great opportunity to come back and exercise my profession in an ideal environment. Far away… not so far maybe… Five years in Grenoble enabled me to discover new ski spots and to obtain along the way an engineering degree in microsystems for electronics and biotechnology.

After a Master in medical physics, I left the Alps for 6 years in Lyon. I had the great opportunity to do a PhD within the framework of a collaboration between Elekta, the laboratory CREATIS, and the Leon Berard Cancer Center. For 4 years, we worked hard to record every motion of the prostate with ultrasound during radiotherapy sessions. What an idea just at the dawn of the new era of MR-linac! Nevertheless, this experience was so rewarding, reflecting the interest of the medical physicist job for me: to act at the interface between researchers, manufacturers and medical staff.

Finally, I obtained the French diploma of medical physics after some study periods in Paris and two years of training in the radiotherapy department of the "Hospices Civiles de Lyon".
In November 2017, I obtained my SSRPM certification.
Six months ago, my family and I had the chance to leave the city and settle in the foothills of the Jura - thus, improving our level in skating and biking!

Now, I work with two great colleagues and a wonderful team at the Clinique de Genolier, with different exciting projects for the near future!
I am looking forward to meet all of you during the different events of the Swiss medical physics community.

Marie Fargier-Voiron
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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. 93 (12/2018): 11.2018

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Conference Calendar

CALENDAR 2018

August 30
Zürich

SASRO Annual Meeting
August 30 - September 1
www.sasro.ch

September 17
Trieste, IT

Joint ICTP-IAEA Advanced School on Quality Assurance and Dose Management in Hybrid Imaging (SPECT/CT and PET/CT)
September 17 - September 28
http://indico.ictp.it/event/8336/overview

September 19
Nürnberg, DE

49th Annual Meeting of the DGMP and 21st Annual Meeting of the ISMRM-DS
September 19 - September 22
http://www.dgmp-kongress.de

September 21
Bern

3rd National Day on radiation protection in medicine. Theme: operating rooms
www.bag.admin.ch/strahlenschutztag

September 27
Aarau

SSRMP Education Course on Medical Physics in Nuclear Medicine
September 27 - September 28
http://ssrpm.ch/event/ssrmp-education-course-2018/

October 21
San Antonio, USA

2018 ASTRO Annual Meeting
October 21 - October 24
https://www.astro.org

October 26
Malaga, Spain

2nd ESTRO Physics Workshop – Science in Development
October 26 - October 27
https://www.estro.org/congresses-meetings/items/2nd-estro-physics-workshop-science-in-development

November 22
Lausanne

52nd SSRMP Annual Meeting
http://ssrpm.ch/conference-2018/home/

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!