EFOMP
EUROPEAN FEDERATION OF ORGANISATIONS FOR MEDICAL PHYSICS

Quarterly Newsletter

European Medical Physics News

ISSUE 02/2022 | SUMMER

This photo was captured by Esa Tienhaara from Divicon Oy during one of the meeting's coffee breaks.

The Finnish Medical Physics Days, Which Were Held on 13–14 May 2022 at Hotel Nuuksio in Espoo, Finland

European Medical Physics News is published by the EFOMP Communications and Publications Committee and distributed free-of-charge in electronic form.

Please register at the EFOMP website to receive notice of EMP News editions

EFOMP announcements mailing list

Send material for publication to any of the editors. The editors reserve the right to edit the text when appropriate.

Advertisements for relevant products and services are welcome, price list available on *EFOMP website.*

For more news and information about upcoming events and courses please follow us on social networks or visit our website:

https://www.efomp.org/
/company/efomp/
@EFOMP_org
/efompweb
/EFOMP.org/
pubcommittee@efomp.org

EFOMP
EUROPEAN FEDERATION OF ORGANISATIONS FOR MEDICAL PHYSICS

Contents

Front page: A group photograph of EFOMP officers with the Finnish medical physics society that was taken during the Finnish Medical Physics Days, which were held on 13–14 May 2022 at Hotel Nuuksio in Espoo, Finland, where the spring officers' meeting was also held.
This Photo was captured by Esa Tienhaara from Divicon Oy during one of the meeting's coffee breaks.

EDITORIAL

Welcome to the Summer 2022 issue of European Medical Physics News, the quarterly newsletter of EFOMP.

I would like to take this opportunity to welcome you to the Summer issue of European Medical Physics News, the quarterly newsletter of EFOMP! The arrival of summer brings with it many welcome changes, the most notable of which is the return of verdant foliage to the trees and the blossoming of flowers. Unfortunately, events in Eastern Europe continue to dominate our thoughts, as the continent's instability and economic challenges persist, and are at their worst since World War II, and we express our deepest sympathies and support to our Ukrainian colleagues as they face the deplorable invasion of their country.

Despite these events, this newsletter contains a set of fantastic news that illustrates the European Medical Physics Society's continued commitment to health care service provision and advancement. The theme of this issue of the newsletter is the 4th European Congress of Medical Physics will take place in St Patricks Campus at Dublin City University, Dublin, Ireland from 17 - 20 August 2022. More than ten refresher courses and numerous scientific sessions together with a decent social program are being held during the congress this year; please see the program for further details. There are multiple articles covering the refresher courses for this meeting contained in this issue. The scientific committee has added a number of new components to the conference, including a DIY-Fair, a specific area and seminars for early career professionals, and three fascinating schools, among others. This release includes an article written by Naomi Mc Elroy that provides additional information for those who are interested in exploring the beautiful countryside of Ireland outside of Dublin – just in case you decided to combine your business trip with a vacation.

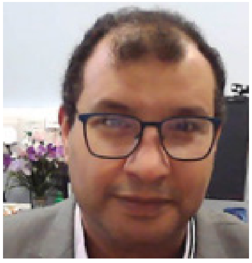
This issue's front cover features a group photograph of EFOMP Officers with the Finnish medical physics society taken during the Finnish Medical Physics Days, which were held at Hotel Nuuksio in Espoo, Finland, on 13-14 May 2022, where the spring officer's meeting was hosted as well. The venue is situated within Finland's Nuuksio National Park, surrounded by picturesque lakes and verdant forests. Officers of EFOMP had the privilege of attending face-to-face meetings with our Finnish colleagues. Conversations over coffee, casual drinks, a bit of dancing, and the shared journey to the airport all facilitate the exchange of scientific information and contact information, thereby enhancing medical physics in Europe. A huge thank you goes out to Sampsa Turunen, the chair of the Finnish Association, and Tommi Noponen, the EFOMP delegate, for hosting that high-profile event and providing such wonderful hospitality throughout this time – who also wrote a brief article about the meeting in this release.

This issue of the newsletter includes several recurring features, such as a topical message from EFOMP President Paddy Gilligan and an overview of recent activities conducted by EFOMP Secretary General Efi Koutsouveli. Additionally, this issue of the newsletter contains a list of upcoming events.A summary of recent Physica Medica papers by the journal's Editor-in-Chief Iuliana Toma-Dasu is also included in this release, as are a summary of Evelina Jaselske's PhD thesis on polymer dose gels for medical application, Reetta Siekkinen's MSc thesis summary on Myocardial Perfusion Imaging (MPI) with Positron Emission Tomography (PET), and Hacking medical physics, Part 3, on Visual programming with Hero by Patrik Brynolfsson, Joakim Jonsson and Tufve Nyholm.

In addition, our popular Medical Physicist's Free Time section includes an article written by David Lurie about his interest in sketching and painting, the fourth article by Prof. Jim Malone in his "Art to Challenge and Inspire" series, this time on a thought-provoking painting entitled "A Convent Garden", by Willian Leech (1881 - 1968), and Levthe-lion, our amiable cartoon character, is back for another episode, this time on his radiotherapy treatment and learning about the outcome!

Three articles about the professional medical physics life are included in this newsletter collection: Jaroslav Ptáek's descripted the department of medical physics and radiation protection in University Hospital Olomouc, Czech Republic; Leticia Irazola's discussed the requirements for becoming a recognised medical physicist in Spain; and insights into the role of the medical physics professional in the life cycle management of medical devices by Stephan Klöck.

We have included 12 articles from commercial companies, including conference sponsors and EFOMP Company Members, to round out this ECMP-focused issue. I am confident that you will enjoy reading about the products and activities of the companies. As always, this issue of European Medical Physics News contains a wide range of articles, which I hope that you will find it interesting!



Mohamed Metwaly, PhD, is a Lead consultant clinical scientist and registered medical physics expert (MPE) in the RPA2000 record – UK. He is the head of Dosimetry and Imaging quality assurance service –radiotherapy physics - the United Lincolnshire Hospitals NHS Trust. He is the editor-in-chief of the Institute of Physics and Engineering in Medicine [IPEM] Report Series and the IPEM Rep to EFOMP. Since 2018, he has been an MPE reviewer at the Health Research Authority (HRA) who reviews and approves ionisation radiation exposure for research and clinical trials. He joined the UK Accreditation Service (UKAS) technical evaluation team for BS70000 in 2018. Since 2022, he has been a Care Quality Commission (CQC) Specialist Advisor – radiotherapy.

Communications and Publications Committee

To contact the Committee, send an email to pubcommittee@efomp.org.

Mohamed Metwaly
UK
IPEM
Chairperson
EMP News editor

David Lurie
UK
IPEM
Past-Chairperson
EMP News editor

Jurgita Laurikaitienė
Lithuania
LMFBIA
Internet Manager
EMP News editor

Ivan Gencel
Serbia
SAMP
Secretary
EMP News editor

Paddy Gilligan
Ireland
IAMP
EFOMP President
EMP News editor

Markus Buchgeister
Germany
DGMP
EMP News editor

Katrīna Čaikovska
Latvia
LMEPS
EMP News editor

Carmel J. Caruana
Malta
MAMP
EMP News editor

Leticia Irazola
Spain
SEFM
EMP News editor

Emer Kenny
Ireland
IAMP
EMP News editor

Efi Koutsouveli
Greece
HAMP
EMP News editor

Erato Stylianou Markidou
Cyprus
CAMPBE
EMP News editor

Borislava Petrović
Serbia
SAMP
EMP News editor

Tomasz Piotrowski
Poland
PSMP
EMP News editor

Jaroslav Ptáček
Czech Republic
CAMP
EMPNews editor

Veronica Rossetti
Italy
AIFM
EMP News editor

EFOMP President's Message

Paddy Gilligan, President of the EFOMP, provides an update on the most recent activities of the organisation, as well as important issues facing medical physicists.

Welcome to EMP's summer news 2022. I just recently returned from our officers' meeting in Helsinki, where we were treated to wonderful Finnish hospitality and warmth as well as great scientific knowledge and talks. While preparing for the meeting, I came across a new word: SISU, which is the Finnish for resilience and guts that I feel applies to EFOMP. We had lots to discuss, including reflecting on what a good shape EFOMP is in pulling out of the pandemic thanks to the work, and ethos of medical physics volunteers. By an entire coincidence, my twelve year-old son was singing with the Palestrina choir from Dublin in Helsinki Cathedral in a joint concert with the famous Cantata Minores choir from that cathedral. I had the pleasure of witnessing a spontaneous song when both the Irish and Finish choirs joined in together in the crypt after the concert. This reflected the power of a united European voice with a common purpose, which is always greater than the sum of even the most perfect parts, and is the theme of this edition's message.

Of course we still have challenges to overcome, in particular the unjustified invasion of Ukraine and its effect on Europe, as chancellor Scholz referred to as a turning point or zeitenwende in Europe's history. EFOMP has been early to condemn this invasion and its brutal effect on populations, which includes our medical physics colleagues. According to EFOMP statutes, the Lithuanian association of medical physics and engineers has proposed a special council meeting to address a motion of support to the Ukrainian NMO and call for a temporary suspension of the Russian NM AMPHR. The motion required the support of one tenth of our NMOS to bring it to a special council meeting to be held next month. It will require a majority of two thirds of NMOs to pass. The officers do not vote. The officers recognised that this is a complex and lamentable situation and that it is best dealt with at council level. If we are to act, it is important we act together with a unified voice and observe and respect the democratic processes of EFOMP.

Coming together: Multiple energies single patient focus

In practical terms, the war has already affected our congress in Dublin: as the congress is hosted in an Irish university, we are bound by the Irish Universities Association, which has suspended all scientific exchange with scientists from Russian and Byelorussian institutions. The recent financial sanctions also do not permit financial exchanges with physicists from Russian federation institutions. In a quote often incorrectly attributed to Albert Einstein, "the only reason for time is that everything doesn't happen at once" sums up where we are with the congress. The COVID pandemic robbed us of our normal chronology. Organizing the Dublin congress back to back with Torino and as the European Congress of Medical Physics grows in importance, has led those organising the congress to realise it's time to take stock and do a strategic review of the ECMP structure and delivery mechanism to get maximum strategic benefit for medical physics in Europe. Ideas being looked at include the potential to have a consistent software system and administration function that would be independent of the location of the congress; also, the potential for a consistent European approach to some of the aspects of sponsorship and the convergence to hybrid delivery. The good news for EFOMP was that we had three really strong bids for the 2024 congress; a tri-nation bid from the Austrian, Swiss and German NMOs for Munich; a bid for Valencia from SEFM; and a bid for Limassol from the Cypriot NMO. A review committee with an independent observer and detailed criteria has made a recommendation for the 24th congress, as well as some other recommendations which will be announced prior to the council meeting in Dublin in August. The review committee and EFOMP were humbled by the amount of work gone into such bids and really appreciate the efforts made for medical physics in Europe. Although we can have only one congress location, the other bids can learn from the process and build for the next competition.

This is the last EMP news before the Dublin congress. The medical physics in the Baltic States, the Helsinki congress, and the Prague school, where we, as EFOMP officers and school teachers, had the privilege of attending face-to-face meetings with our colleagues. The coffee-time conversations, the casual beer, the bit of dancing, and the shared journey to the airport all allow for the exchange of scientific information and contacts that improve medical physics in Europe. As you read this, many of you will have got notifications of the success of your abstract. The quality and volume of the abstracts and increasing the number of reviewers per abstract meant that the notifications are going out this week. The scientific committee has curated The Dublin Congress features many firsts, including a DIY fair, early career special areas and sessions, three exciting schools, and a Tempe atelier workshop.

We look forward to meeting you and having some great fun in our packed social program.

Mobility and Identity of the medical physicist: A common voice

Next week I travel to Budapest to open the IRPA congress and will meet the Hungarian NMO HSMP. HSMP is the ninth submission for national registration EFOMP approval by the professional matters committee after the Cypriot NMO. This is an important milestone for EFOMP as, according to EC 2005/36, it puts us in a position where, with a third of member states, we can, through our EU matters committee, apply for automatic recognition of a common training platform with the EU DG GROW directorate. If the common training platform is accepted by the commission, medical physics experts who meet the training platform standard will get the right to work and automatic recognition of their qualification in all member states of the European economic area. This will help harmonise a minimum standard of training and our identity as medical physicists. The recent work done on updating the radiotherapy core curriculum with ESTRO and the recently initiated update to the core curriculum in nuclear medicine with the EANM will form the basis of this common training platform. These qualifications and approach will also be used by EFOMP to update the medical physicist's ESCO classification. It is very important that our national member organisations understand the journey we are about to embark on and that we present a unified voice to the commission in our application. The harmonisation of training and medical physics in Europe has been a cornerstone of EFOMP's mission since its foundation.

EFOMP in full bloom:

We hope to repeat the successful town hall meeting this year, where we will update you on our working group heroes, who have completed their work under the scientific committee on the PETCT PET MRI, almost complete Deep Breast Tom synthesis and Angiography QC, some other groups are in mid cycle and others are about to begin or go to council for initiation approval. We will also update you on the very busy and hardworking period for the projects committee, who have been successful in four project applications from the EU. These projects have established us as the recognised voice of medical physics in Europe and are evidence of EFOMP's successful move of office to Utrecht. You will hear about the successful hybrid format shielding school in Prague in February, the upcoming editions in Dublin and the statistics school in Athens. The radionuclide internal dosimetry group special has been very active with over 100 members and is paving the way for our new dental and early career special interest groups. As we grow and evolve, we are looking at developing software, education platforms, and administrative support to allow us to concentrate our efforts on communicating, integrating, and educating and retain our volunteer-based federation structure.

It's impossible to describe all of the hard work of the EFOMP and ECMP volunteers' progress in medical physics in Europe. As I reach the halfway mark in the presidency, I have been privileged to work with and be supported by an excellent board and executive who have been inspirational. This month we put out the call for the next vice president, secretary general, treasurer and vice chairs of projects, communications and publications committees. It's very important that you put yourself forward, nominate and vote on applicants who will be the next leaders of EFOMP. This will be a sign of a healthy EFOMP with a strong unified voice for medical physics in Europe.

See you in Dublin,

Assoc. Prof. Paddy Giiligan, President of EFOMP

EFOMP Secretary General's Report (March 2022 – May 2022)

In this article you will find an update on the institutional matters of our organization during the last three months

EFOMP's Officer Meeting – Spring 2022

The EFOMP Officers' Spring meeting took place at Nuuksio National Park in Finland, in a typically Finnish scenery, with lovely lakes, green forests, and lots of saunas. The meeting was hosted by the Finnish Society for Medical Physics in conjuction with the Finnish Medical Physics days; two days full of novelties in Radiation Therapy, Nuclear Medicine, Radiology, Electrophysiology. A leadership between EFOMP and the Finnish Medical Physics board was scheduled on the last day, where topics such as engagement of Finnish colleagues in all EFOMP matters and joining forces at a European level have been discussed. Next Officer's meeting will be held in Dublin together with the Annual Council meeting in August.

Policy Statement Working Groups

EFOMP Policy Statement 18

A Working Group (WG) entitled "Medical Physics Education for the Non-Physics Healthcare Professions" will operate under the Education and Training Committee from February 2022 to February 2023. However, medical physicists teach the non-physics healthcare professions. However, there has never been a proper definition of the role and no policy document exists to guide role holders. A proposal by the E & T Committee for the formation of a working group and the development of a policy statement was approved by the Council. The chair of the WG is Carmel Caruana (MT), and the composition is as follows: Richard Amos (UK), Diego Burgos (ES), Stan Heukelom (NL), Marija Jeremic (RS), Petro Julkunen (FI), Violeta Karenauskaite (LT), Loredana Marcu (RO), Emmanouil Papanastasiou (GR), Csilla Pesznyak (HU). Marine Bodale (RO), Yuri Dekhtyar (LV), Niko Hyka (AL), Desislava Kostova-Lefterova (BG), Ioannis Seimenis (GR), Cinzia Talamonti (IT), Nolan Vella (MT), Dafina Xhako (AL). In order to build bridges with physics-friendly members from other professions and promote our work/role, EFOMP wishes to invite as observers non-physics colleagues.

EFOMP Policy Statement 19

The call for a Working Group (WG) entitled "Dosimetry in Nuclear Medicine Therapy" was launched in May 2022. The proposal for a Policy Statement on dosimetry in Nuclear Medicine Therapy - Molecular Therapy was approved by the Annual Council held both in person in Kaunas, Lithuania and online on the 6th November 2021. This PS statement will present EFOMP's point of view on the role that medical physicists should play in therapeutic applications of nuclear medicine. The WG will be chaired by Manuel Bardies (FR).

European Core Curricula for Medical Physics Experts

In October 2021, EFOMP together with ESTRO published the revised European Core Curriculum (CC) for Medical Physics Experts working in Radiotherapy. A similar revision is being planned for the European Core Curriculum (CC) for Medical Physics Experts working in the subspecialty of Nuclear Medicine. For this reason a WG has been formed which comprises representatives from EFOMP National Member Organisations and EANM, namely:

Farzaneh Adibpour (AT), Klaus Bacher (BE), Amra Skopljak-Beganović (BA), Anna Roumenova Zagorska (BG), Dimitris Kaolis (CY), Lars Jodal (DK), Søren Holm (DK), Dmitri Šutov (EE), Mikko Hakulinen (FI), Manuel Bardies (FR), Thomas Carlier (FR), Bernhard Sattler (DE), Stéphan Nekolla (DE), Kostas Perisinakis (GR), Mátyás Demeter (HU), Ernesto Amato (IT), Maria Dooley (IE), Kirill Skovorodko (LT), Nadine Napoli (MT), Hugo de Jong (NL), Krzysztof Matuszewski (PL), Jorge Isidoro (PT), Jelena Samac (RS), Elena Prieto (ES), Marcus Ressner (SE), Silvano Gnesin (CH), Glen Flux (UK), Dimitris Visvikis (UK), John Dickson (UK), Ana Bacelar (UK), Jonathan Gear (UK).

A kick off meeting of the WG took place online on the 27th of April 2022.

Open Calls

Nominations can be submitted to secreatray@efomp.org for the EFOMP's Honorary Membership award, namely: 'Recognizing an individual who through his/her career has contributed to advancements in research, education and training or organizational affairs and professional activities in medical physics in Europe'.

Publications

A survey was developed by EFOMP and circulated to all National Member Organisations (NMOs) to gather information on the status of early career groups in their respective societies and on the interest in partaking in such groups within the Federation. The results of the survey can be read here: Early career medical physicist groups in Europe: An EFOMP survey, European Journal of Medical Physics, March 2022.

Efi Koutsouveli works as a Medical Physics Expert in the Medical Physics department of Hygeia Hospital, Athens, Greece. Her professional focus is on radiotherapy units (external radiotherapy & brachytherapy). Her special interests are in Hospital Quality Management Systems and Oncology Information Systems. She is currently the Treasurer of the Hellenic Association of Medical Physicists (HAMP) and EFOMP's Secretary General. In 2019, she received the IOMP-IDMP award for promoting medical physics to a larger audience. Email: secretary@efomp.org

EFOMP COMPANY MEMBER ARTICLE

GE Healthcare: Q.Clear

Q.Clear

Accurate quantitation (SUV - Standardized Uptake Value) is becoming more important as clinicians seek to utilize PET imaging for more than just diagnosing and staging disease, but also for treatment monitoring. The significant challenge with delivering consistently accurate SUV measurements in PET imaging is that lesion size, volume and contrast recovery are highly impacted by today's reconstruction algorithm. Q.Clear technology is a step forward in providing quantitation accuracy while not sacrificing excellent image quality in PET imaging. This new approach considers all aspects of the imaging chain and the cumulative effect of all improvements, from small to large, to make PET/CT imaging an accurate tool for enabling both confident diagnosis and precise treatment response assessment.

INTRODUCTION

There is renewed interest in the PET imaging community in obtaining quantitative information about lesion uptake values. Because of this, improvements in image reconstruction algorithms that offer the ability to obtain more accurate estimates of uptake in lesions are of significant interest. Many advancements have been made towards this end, including improvements in system corrections such as randoms and fully 3D scatters [1,2], advances in motion correction [3], modelling of the system point spread function [4], and the inclusion of more accurate projectors and the incorporation of all system corrections into a fully 3D PET image reconstruction model [5].

A core tenet of PET image reconstruction algorithms is the modelling of the underlying PET Poisson noise statistics. Iterative image reconstruction techniques that accurately model the inherent PET physics are generally preferred over standard analytic methods including filtered backprojection (FBP) because of significant increases in signal-to-noise (SNR). The most commonly used clinical PET reconstruction algorithm is the Ordered Subsets Expectation Maximization (OSEM) algorithm. OSEM offers the advantage of accurately modelling the underlying PET physics and also generating the PET images in clinically relevant times via accelerated convergence through the use of subsets.

One drawback to the OSEM algorithm is that it generally cannot be run to full convergence because the noise in the image grows with each iteration. To compensate for this, the algorithm is generally stopped after a predetermined number of iterations, typically two to four, resulting in an under-converged image. Because PET contrast recovery depends on OSEM convergence rates, an under-converged image may produce bias, directly impacting lesion quantitation.

To address the effects of convergence and provide more accuracy in PET quantitation, the Regularized Reconstruction iterative algorithm (Q.Clear) is being introduced, incorporating prior knowledge about the image quality into the reconstruction. This prior knowledge is incorporated as a term in the algorithm discouraging differences in neighbouring image voxel values. By incorporating this factor into the reconstruction algorithm, the algorithm can be run to full convergence and provide more accurate quantitation levels and improved SNR over OSEM.

You can read or download the full white paper here

REFERENCES

[1] C. Stearns, D. McDaniel, S. Kohlmyer, P. Arul, B. Geiser and V. Shanmugam, "Random coincidence estimation from single event rates on the Discovery ST PET/CT scanner", IEEE Nuclear Science Symposium Conference Record, 2003. https://doi.org/10.1109/NSSMIC.2003.1352545

[2] M. Iatrou, R. Manjeshwar, S. Ross, K. Thielemans, and C. Stearns, "3D implementation of scatter estimation in 3D PET", IEEE Nuclear Science Symposium Conference Record, 2006, pp2142-2145. https://doi.org/10.1109/NSSMIC.2006.354338

[3] S. D. Wollenweber, G. Gopalakrishnan, K. Thielemans, and R. M. Manjeshwar, "Evaluation of the Accuracy and Robustness of a Motion Correction Algorithm for PET Using a Novel Phantom Approach", 2012, IEEE Transactions on Nuclear Science, Vol. 59 (1), pp. 123–130. https://doi.org/10.1109/NSSMIC.2010.5874232

[4] A. Alessio, C. Stearns, S. Tong, S. Ross, S. Kohlmyer, A. Ganin, P. Kinahan, "Application and evaluation of a measured spatially variant system model for PET image reconstruction", IEEE Transactions on Medical Imaging, 2010, Vol. 29 (3), pp 938-949. https://doi.org/10.1109/TMI.2010.2040188

[5] R. Manjeshwar, S. Ross, M. Iatrou, T. Deller, and C. Stearns, "Fully 3D PET iterative reconstruction using distance-driven projectors and native scanner geometry", IEEE Nuclear Science Symposium Conference Record, 2006, pp 2804-2807. https://doi.org/10.1109/NSSMIC.2006.356461

EFOMP REFRESHER COURSE

ECMP 2022 Diagnostic and Interventional Radiology Refresher Course: MRI

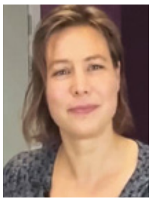
A special ECMP 2022 (17-20 August 2022) session discusses the advantages and disadvantages of very high field and very low field MRI – chaired by Professor Andrew Webb

Most medical physicists who have responsibilities for MRI are familiar with 1.5 and 3 Tesla clinical scanners in terms of quality assessment, safety, maintenance and performance. However, there are an increasing number of systems being used clinically that operate at very different field strengths. At one extreme is the Hyperfine point-of-care scanner which is a permanent magnet based scanner operating at 64 mT. At the other are the CE-approved 7 Tesla whole body scanners.

The two talks in this session will discuss the advantages and disadvantages of very high field and very low field MRI. The primary advantages of high field relate to its very high signal-to-noise, very high spatial resolution, large spectral dispersion, excellent parallel imaging performance and sensitivity to microscopic magnetic susceptibility. The main challenges relate to image inhomogeneities which arise from the relatively short wavelength of electromagnetic energy in tissue at high frequencies, concerns about specific absorption rate, and safety of medical implants. Conversely, low field MRI inherently suffers from low signal-to-noise and, in point-of-care systems, relatively poor static field homogeneity and field drift. However, the cost, maintenance, and siting of such devices is much less expensive and easier, and safety and concerns about contraindications are much less of an issue.

The two speakers are experts in their respective fields. Dr. Karin Markenroth-Bloch is the National Facility Manager and Researcher at the Lund University Bioimaging Center in Sweden. She co-ordinates the activities on the 7 Tesla Philips whole-body scanner for the Swedish National Consortium. She is on the ISMRM Board of Trustees and co-organized the ISMRM Workshop on High Field MRI in 2022. Professor Najat Salameh is an SNSF Professor in the Department of Biomedical Imaging at Basel University in Switzerland. She co-heads the Center for Adaptable MRI Technology, a one-of-a-kind low magnetic field MRI platform that aims to develop disruptive MRI technology to push the boundary of diagnosis and monitoring in environments and settings usually out of reach.

Prof Najat Salameh



Dr Karin Markenroth-Bloch

Andrew Webb is a Professor of MR Physics in the Department of Radiology at the Leiden University Medical Center and the Department of Electrical Engineering at the Technical University of Delft. His research concentrates on the development of new hardware for both high field and low field MRI and its translation to clinical applications.

EFOMP REFRESHER COURSE

ECMP 2022 Diagnostic Nuclear Medicine Refresher Course

A special ECMP 2022 (17-20 August 2022) session discusses innovations in detector technology and how these can lead to improved image quality for dedicated PET and SPECT examinations, by Irene Polycarpou.

The PET and SPECT modalities have considerably improved in recent years. The two talks hosted in this session will touch upon innovations in detector technology and how these can lead to improved image quality for dedicated examinations. The first talk will focus on progress regarding improvements in the timing capabilities of PET scanners. Many studies have proven the advantages of systems enabling accurate Time of Flight (TOF), such as improved image contrast and better recovery and characterization of small or low uptake lesions. Precise TOF is possible with both PMT and silicon photomultiplier (SiPM), but integration in PET scanners and into high-density electronics has been better realised with SiPM. There is a wider accessibility to SiPM technology than there is to PMTs. This talk will also discuss the motivations and reinforcement of the developments towards more accurate TOF electronics, such as ASIC-based solutions. The second talk of this session will provide an overview of both PET and SPECT hardware improvements and then analyse how iterative reconstructions have been ameliorated with better corrections and more accurate models, improving the quantification accuracy. Finally, Artificial Intelligence and deep learning cannot only aid in image processing tasks like segmentation and analysis, but also support in improving the noise in the reconstructed images and may even replace the iterative reconstruction methods and deliver faster image reconstruction.

The two speakers are experts in their respective fields. ***Dr. Antonio J. González Martínez*** is a researcher at the Spanish National Research Council (CSIC) and the group leader of the Detectors for Molecular Imaging Lab at the Institute for Instrumentation in Molecular Imaging, i3M. He obtained a physics degree from the University of Valencia and a physics doctorate from the University of Heidelberg. He has been working on the development of molecular imaging systems since 2006 and has developed dedicated PET systems. He is currently leading the design and construction of the first Total-Body PET in Europe with TOF and DOI capabilities. ***Prof. Stefaan Vandenberghe*** is a full time research professor at Ghent University and leads the Medical Image and Signal Processing (MEDISIP) research group. He obtained an MSc in Physics and an additional degree in Biomedical Engineering from KU Leuven. He received a Ph.D. in Engineering from the University of Ghent in 2002, which was awarded the Scientific Prize of Barco. In 2004, he joined Philips Research USA (Briarcliff) as a Senior Scientist where he worked on simulations, reconstructions, and measurements for the first clinical TOF PET systems (LaBr3 and LYSO). He received the EANM Young Investigator award in 2007. In 2009, he started the Infinity lab for non-invasive in vivo imaging of laboratory animals, which has become one of the expertise core facility centres of Ghent University. More recently, his research has focused on monolithic detectors for high resolution PET and total body PET system design using artificial intelligence and deep learning.

Dr Antonio J. González Martínez

Prof Stefaan Vandenberghe

Chair: Dr Irene Polycarpou

Dr. Irene Polycarpou is an Assistant Professor in Medical Physics and the Vice Chair of the Department of Health Sciences at European University Cyprus. She attained an MSc and a PhD from King's College London and undertook postdoctoral research at St Thomas' Hospital London. Her research interests include enhancement of the diagnostic value of Positron Emission Tomography (PET) and its integration with simultaneous Magnetic Resonance Imaging (MRI). She was involved in the development of simulated 4D PET-MR datasets that can be used freely by academia and industry for any scientific investigation. She has participated in several EU projects. She is an active member of the board of the Society of Medical Physicists Cyprus and is the President of the Cyprus Association of Medical Physics and Biomedical Engineering.

EFOMP REFRESHER COURSE

ECMP 2022 Nuclear Medicine Refresher Course: Molecular Radiotherapy

ecmp 4th Dublin 2022

A special ECMP 2022 (17-20 August 2022) session discusses radioprotection optimization in radionuclide therapy by Ana Millan and waste management and errors in administration by Mario Marengo.

The discipline of Nuclear Medicine adheres to severe radiation protection recommendations in order to guarantee the safety of both patients and workers, and high safety standards are particularly important when molecular radiotherapy is considered.

In the last years, nuclear medicine therapeutic treatments have been increasing, thanks to new radiopharmaceuticals that allow targeting malignancy with a high level of selectivity, releasing limited radiation dose to the healthy tissues and considering the potential of the theragnostic approach.

NM staff are exposed to the radiation emitted directly by the radiopharmaceuticals contained within vials and syringes during labelling, partitioning, and administration of radiopharmaceuticals and to irradiation during patient monitoring and assistance. Poor planning of work procedures that do not provide sufficient protection can increase staff members' doses considerably. Since radionuclides used for therapy emit radiation particles which are capable of delivering significant doses, consideration of potential finger doses and protection is extremely important.

The facility design with proper and accurate room shielding calculations with specific attention to room layout is the additional key point for the optimization of the radiation protection of a nuclear medicine department with molecular radiotherapy activities.

In a complex, highly structured discipline like nuclear medicine, there remains the probability of procedural errors, unexpected events, or unforeseeable aspects that may lead to inappropriate delivery of the therapy, undesired patient exposure, or other consequences potentially harmful to patients. Limited but significant reports are effectively presented in the current scientific literature.

Incident reporting systems are a tool in health institutions to monitor unexpected events, incidents, and close calls, activate corrective actions, and provide useful information to clinicians to prevent repetitions. The IAEA introduced Safety in Radiation Oncology (SAFRON) as an integrated voluntary reporting and learning system for radiotherapy and radionuclide therapy incidents and near misses in 2012, a web-based system for incident reporting. A meeting on prevention of incidents in nuclear medicine, held in May 2018, with the participation of an international, multidisciplinary panel of experts, produced a series of recommendations, including extending SAFRON to incidents in nuclear medicine therapeutics. applications, such as therapies with radiopharmaceuticals and radioactive medical devices, such as selective internal radiation therapy (SIRT). A specific task group convened in November 2018 reviewed existing reports and experiences and developed the parameters of the application, defining the scheme of incident models, the modality of registration, and the possible safety barriers.

The new addition to the SAFRON platform is under development at the IAEA with expectations that it will be tested and available in the second half of 2019. The introduction of data is easy and anonymous, guaranteeing the privacy of patients and reporting institutions but nevertheless making it possible for professionals in the field to obtain relevant information on incidents, their modality, consequences, and possibilities for mitigation, and thus contributing to the diffusion of knowledge and learning from previous lessons. Participating facilities will be able to use SAFRON NM as their local incident learning system as well as contribute to an international incident learning system, looking for opportunities to improve the safety systems and reduce potential errors.

The SAFRON NM is a state-of-the-art, safe and effective incident learning tool that the IAEA will make available to the nuclear medicine community to foster prevention of incidents and improve the safe administration of radionuclide therapy.

Dr. Mario Marengo is a Medical Physicist and an expert in radiation protection. He has work experience at University Hospital S. Orsola – Malpighi (Bologna, Italy-former Director of the Medical Physics Department), Adjunct Professor for the University of Bologna, and Technical Expert for the International Atomic Energy Agency (IAEA). He contributed to the design and construction of the PET Centre of the S. Orsola Hospital, as well as of other PET and Nuclear Medicine Centres, both nationally and internationally. He is an expert in quality systems in medicine and a quality auditor. He is also the author of a book on Physics in Nuclear Medicine and of several chapters and contributions on Physics in Nuclear Medicine texts and monographs, of more than ninety original publications in peer-reviewed scientific journals, and of numerous reports at national and international congresses.

Dr. Ana Millan is a Medical Physicist and an Expert in Radiation Protection. He has work experience at Christie Hospital (Ultrasound department, Manchester, UK), and Clinica de La Luz (Radiotherapy department, Madrid, Spain). He is a Consultant for Tecnicas Radiofisicas S.L. (TRF) (Spain) for Radiation Protection Services, development of a Treatment Planning System for external beam radiotherapy and brachytherapy, and manufacturing of a liquid radioactive waste management system for nuclear medicine departments. He has university teaching experience at the Medicine Faculty in Zaragoza (Spain) in 2009–2013 and 2018–2021.

EFOMP REFRESHER COURSE

ECMP 2022 Multiple Energies Single Patient Focus Refresher Course: New Technologies

A special ECMP 2022 (17-20 August 2022) session discusses recent advances in CBCT technology as well as an overview of some of the most important applications, by Geraldine O'Reilly

The first presentation by **Osvaldo Rampado**, entitled "CBCT: technological developments and dosimetric challenges", will look at the technology for different imaging fields, with a focus on the performance of the latest generation detectors, a panoramic view of the main acquisition geometries with related sampling strategies, and state-of-the-art algorithms. The impact of the latest deep learning methods to remove scatter contributions and improve image quality will be presented. The role of the different proposed dose indicators and the approaches to estimating organ doses and effective doses will be critically discussed. The RC will conclude with a review of the current standards for quality assurance in CBCT.

This will be followed by a presentation by **Aoife Gallagher**, entitled "CBCT in Diagnostic Modalities and the Role of CBCT in RT", which will look at different applications of CBCT in diagnostic modalities, including its use in dental imaging and interventional radiology procedures. The presentation will also outline the role of CBCT in therapy equipment. Factors for consideration when planning to purchase CBCT equipment will be considered.

Osvaldo Rampado is a senior medical physicist at the Medical Physics Unit of the University Hospital "Città della Salute e della Scienza" in Torino, Italy. His professional focus is on radiation protection, dosimetry, and image quality optimization in medical imaging, for all the different X-ray imaging modalities. He is currently teaching medical radiation physics and radiation protection at the University of Torino. His main research interests are in the fields of patient dose assessment and management, quantification of radiological image quality parameters; and more recently, in radiomics analysis.

Aoife Gallagher is Chief Physicist in the UL Hospitals Group and an Adjunct Lecturer in the Department of Physics, University of Limerick, Ireland. She is a Registered Radiation Protection Adviser and Medical Physics Expert and has over 25 years' experience working in diagnostic imaging and nuclear medicine. During this time, she gained experience working with a wide range of imaging technologies and, in particular, assessing equipment performance. She has presented the findings of these assessments at national and international conferences and has published on the topic. She was a contributor to the European Commission publication "Criteria for Acceptability of Medical Radiological Equipment used in Diagnostic Radiology, Nuclear Medicine, and Radiotherapy," Radiation Protection No. 162.

Aoife is an active member of EURADOS Working Group 12 Dosimetry in medical imaging; she was a member of the VERIDIC (Validation and Estimation of Radiation Skin Dose in Interventional Cardiology) Project team. She also contributed to the EURADOS EFOMP discussion on patient dosimetry for dental CBCT imaging referred to in the "Quality control in cone-beam computed tomography (CBCT). EFOMP-ESTRO-IAEA protocol".

Geraldine O'Reilly is the Chief Physicist and Head of the Medical Physics and Bioengineering Department (MPBE) in St. James's Hospital, Dublin. Geraldine is the Radiation Protection Adviser to the hospital and is a registered Medical Physics Expert. In addition to her hospital role, Geraldine has been actively involved in the development of radiation safety legislation and standards for over 20 years, working with a number of national and international groups. She is a member of the Article 31 Group of Experts, which advises the European Commission on matters relating to radiation safety and chairs the sub-committee of that group that looks specifically at medical exposures. She lectures on a number of undergraduate and postgraduate academic programmes.

Art to Challenge and Inspire: Images and Reflections for Medical Physics (4)

Professor Jim Malone writes about a beautiful painting with a special twist for medical physics.

Please look at the picture on the next page prior to reading the caption. The artist, William Leech, was born and educated in Ireland and lived in France and the UK. His painting transports us to a bright, sunny, French walled garden. The attractive young woman gazing upward is the centre of attention.

The colours, composition, speckled sunlight, and subject matter are undeniably beautiful, and account for the work's popularity and presence on book covers, fridge magnets, and tea towels etc. I pass it regularly, and almost always pause. Hopefully, you will find it rewarding. Feedback to: jifmal@gmail.com

A Convent Garden

(see next page)

The beautiful young woman is absorbed in whatever has taken her attention. But, the title: A Convent Garden suggests much more about her life and the culture in which she lives.

The culture of a life lived in medical physics is also surprisingly well defined. It is easy for outsiders to identify, almost as clearly as the culture of the convent. But those who inhabit a culture are seldom aware of its qualities, its strengths or weaknesses. We are good at identifying these in other professions we work or compete with (e.g. technologists, radiologists, radiotherapists to name but a few). They, no doubt, are equally incisive in identifying our strange ways. We need qualitative research that describes the lifestyle/anthropology of our profession (or tribe). I'm sorry to admit that this thought sometimes intrudes when the beautiful Convent Garden crosses my path!

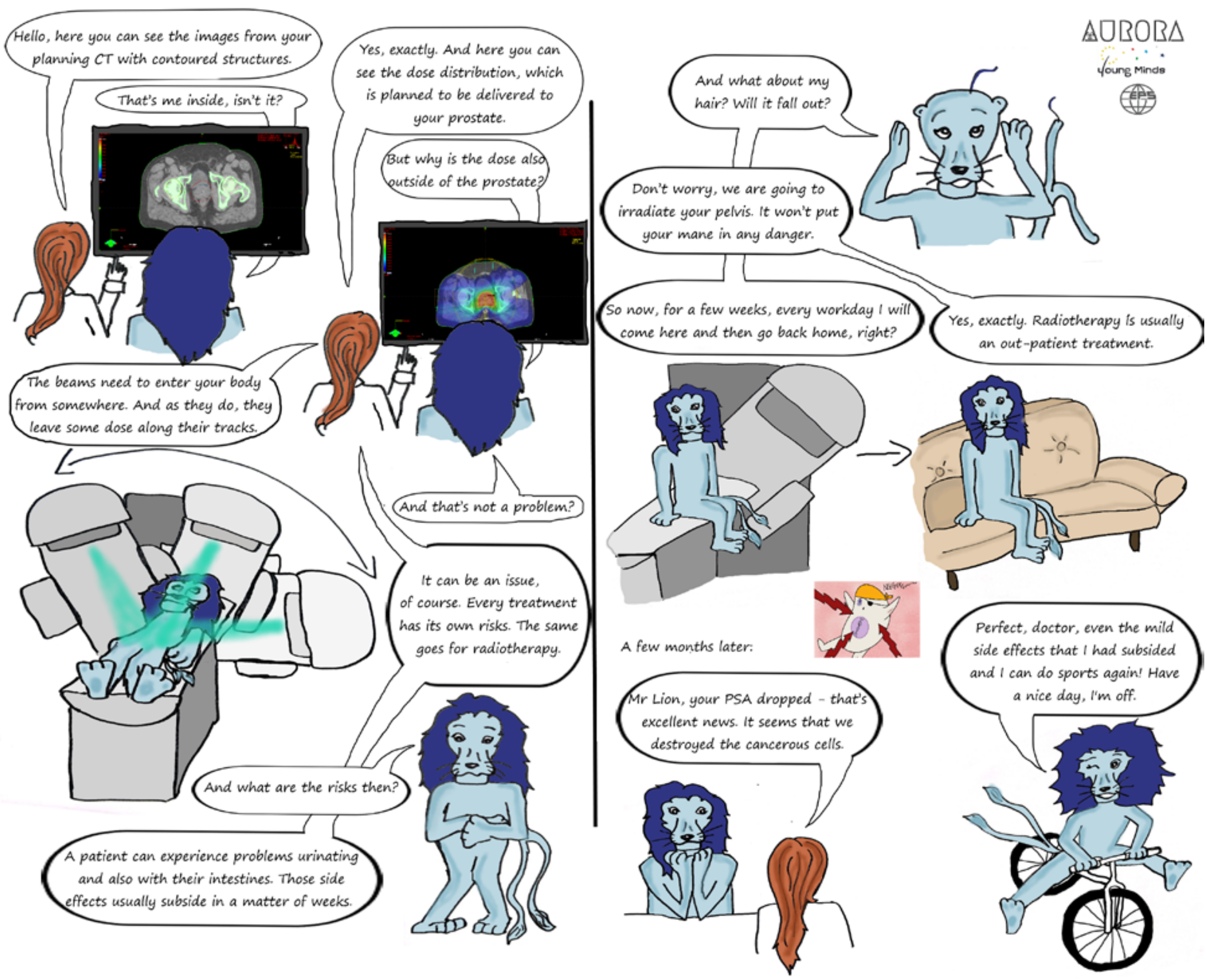
Jim Malone is Professor (Emeritus) of Medical Physics and was Dean of the School of Medicine at Trinity College Dublin/ St James's Hospital. He also works/worked regularly with the WHO, IAEA, IEC, ICRP and the EC. He was recently awarded the EFOMP Medal, is an active researcher and has wide interests in the humanities. Recent publications include books on Ethics for Radiation Protection in Medicine, and on Mystery and the Culture of Science.

The drawing to the left is a study for a portrait, pencil on card, by Desmond Hickey (gifted by the artist).

A Convent Garden (c 1913) by Willian Leech (1881 - 1968). (See previous page). Permanent collection at National Gallery of Ireland, Dublin. A large painting, oil on canvas, 132 x 106 cm (c 1913).

The Aurora Project: Informing About Medical Technology Through Comic Strips

This is the latest comic strip from the Czech Republic's Aurora team, aimed at educating the public about the benefits of technology in medicine, in a highly original way. In this episode, Lev the lion has his radiotherapy treatment and learns about the outcome.



Aurora is a project of the Prague section of the European Physical Society (EPS) Young Minds. The main aim of Aurora is to spread knowledge about ionizing radiation in general, ionizing radiation in medicine and cancer. And how do we intend to spread this knowledge? For example by creating topical comics. Our team is still expanding. Now, we have two main painters, Markéta Farníková and Anežka Kabátová. Then, there are four people who create stories for the comics, consult with the painters and translate texts, Barbora Dršková, Petra Osmančíková, Jana Crkovská and Anna Jelínek Michaelidesová. Anna is also the coordinator and the person in charge of the whole project.

The Aurora team grants permission and consent to EFOMP and EFOMP NMOs to use the comic strips for educational purposes. In case you would like to translate the comics into another language, email us the translated text and we will modify the comic and send it back to you. No other modifications to the content are allowed. You can contact the Aurora team at aurora@youngminds.cz

The Aurora team are:

Marketa Hurychova
studied Medical Physics at the Czech Technical University in Prague, gaining an MSc degree in 2019. She worked at the Department of Medical Physics at Hospital Na Homolce from 2018, at the Department of Radiation Dosimetry Nuclear Physics Institute of the Czech Academy of Sciences from 2019 and since 2020 she has worked at the Department of Medical Physics at Motol University Hospital.

Anezka Kabatova
has been studying Experimental Nuclear and Particle Physics at the Czech Technical University in Prague since 2015. After receiving her MSc degree, she plans to start a PhD in Astronomy. She has been an active member of the Prague section of EPS Young Minds since 2017, acting as a vice-president of the section between 2018 and 2019.

Barbora Drskova
finished her Medical Physics Masters programme at the Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering in 2019. Since then, she has been working on her PhD. She works as a medical physicist in radiotherapy at General University Hospital in Prague and University Hospital Královské Vinohrady.

Petra Osmancikova graduated from the CTU and holds an M.Sc. and a Ph.D. degree in Medical Physics. She is a clinical medical physicist in radiotherapy in Motol University Hospital in Prague.

Jana Crkovska
received her PhD in High Energy Nuclear Physics from the Universite Paris Sud in 2018. Since then, she has continued her research on charmed particles production in the Los Alamos National Laboratory. She is part of the LHCb Collaboration, one of the experiments at the Large Hadron Collider (LHC) in CERN.

Anna Michaelidesova received her MSc and PhD degrees in Medical Physics from the Faculty of Nuclear Physics and Physical Engineering of the Czech Technical University in Prague. She worked as a researcher at the Nuclear Physics Institute of the Czech Academy of Sciences from 2010 to mid 2019. In the period 2012-2017, she was employed as a medical physicist at the Czech Proton Therapy Center. From 2018 to mid 2019, she also worked as a researcher at the Faculty of Nuclear Physics and Physical Engineering of the Czech Technical University in Prague. Since June 2019, she has been a postdoctoral researcher at the department of Translational Radiooncology and Clinical Radiotherapy of the OncoRay® - National Center for Radiation Research in Oncology at the Medizinische Fakultät Dresden Carl Gustav Carus in Germany. She has been a member of the leadership committees of the Prague section of EPS Young Minds and of the IRPA YGN since 2019.

EFOMP COMPANY MEMBER ARTICLE

IBA Dosimetry: myQA® SRS and MatriXX Resolution™ - The Current Application in a Modern Facility

Heart and Brain Center of Clinical Excellence in Pleven recommends the use of myQA® SRS and MatriXX Resolution™. An interview with Ivo Petrov, MSc, MPE, Head of Medical Physics, Heart and Brain Centre of Clinical Excellence, Pleven, Bulgaria.

Heart and Brain Center of Clinical Excellence is part of the Bulgarian Cardiac Institute, one of the leading healthcare organisations in the Balkans, specialising in rare and complex cases. Along with an advanced linear accelerator suite for IMRT, VMAT, SRS and SBRT, the hospital has the first and only Gamma Knife® and stereotactic MRI solution in the country.

The challenges of patient QA

Patient Specific Quality Assurance (PSQA/PQA) was introduced to detect errors in treatment plans prior to treatment delivery. To perform PQA, point dose measurements, film dosimetry, or 2D detector arrays are commonly used.

Film dosimetry is considered the most accurate PQA, but it can be:

- Expensive
- Error prone
- Time-consuming

Generally, 2D detector arrays are efficient and easy to use. However, they can have

- Low resolution
- Volume averaging issues
- Dosimetric gaps
- Effective plane or measurement discrepancies

These are concerns for techniques with small target volumes and very steep dose gradients with high inhomogeneities.

MatriXX Resolution™

The Medical Physics team of the Heart and Brain Centre of Clinical Excellence was one of the first to test the MatriXX Resolution™ and myQA® SRS dosimetry systems. Measurements and analysis were performed using pre-existing myQA® software for seamless integration of the new tools.

The Heart and Brain Centre of Clinical Excellence Medical Physics team, with the MatriXX Resolution™ system (courtesy of Heart and Brain Centre of Clinical Excellence, Pleven),

To validate MatriXX Resolution™, Petrov and his team used existing head and neck, pelvic, thorax, breast, and brain cases and plans based on previously treated patients. These plans have been measured with MatriXX Evolution™.

Petrov explains their findings: "Both systems had similar results, with a slightly higher pass rate at 3%/3mm for MatriXX Resolution™. With tighter gamma criteria, our results with MatriXX Resolution™ were more meaningful. We attribute this to the increased resolution and better effective and setup plane coincidence of the array. " The MatriXX Resolution™ has 50% more measurement points compared to previous MatriXX detectors, for the highest IMRT and VMAT measurement resolution.

Petrov also appreciates the fast and easy set-up and beam triggered measurements, which optimise the MatriXX

Resolution™ workflow. "What is just as important for us as dosimetric performance is ease of operation and safety." MatriXX Resolution™ is lightweight, battery powered, with wireless connectivity, which means no worrying about cables while rotating the gantry. One can set it up, turn it on and connect in less than 1 minute, "states Petrov."

myQA® SRS

myQA® SRS was validated using patient plans for lung, liver, head and neck and paraaortic lymph nodes, gynaecological, and head and neck recurrent SBRT cases with critically close structures at risk. Its silicon complementary metal-oxide-semiconductor (CMOS) platform provides a compact design with a spatial resolution of 0.4 mm and 105,000 pixels across a 12×14 cm^2 field size.

"In almost all cases we had strikingly good results similar to multi-channel film dosimetry, with gamma pass rates around 98-99% even with tighter gamma criteria of 2%/2mm or 3%/1mm," Petrov explains. The team also detected 3 cases with inconsistent results. "We believe these new systems are a 'game changer' in not only providing us with unmatched film-class resolution, but also in reducing the number of false positive and false negative cases."

For more information please see the website for myQA® SRS and MatriXX Resolution™. General information about IBA Dosimetry can be found here.

myQA® SRS clinical setup (courtesy of Ivo Petrov)

Ivo Petrov has been Head of Medical Physics at the Heart and Brain Centre of Clinical Excellence in Pleven since 2019. Prior to his 10 years as a clinical physicist, he taught medical physics and biophysics at the Medical University in Pleven. Ivo has an MSc and is a certified MPE in Radiation Therapy, Medical Imaging, and Nuclear Medicine.

MEETING REPORT

Finnish Medical Physics Days, May 13-14, 2022

The Finnish Medical Physics Days were organised together with the EFOMP officers' spring meeting in Espoo, Hotel Nuuksio, May 13–14, 2022.

Finnish Medical Physics Days were organised in Espoo, Hotel Nuuksio, May 13–14, 2022. We had the pleasure of hosting the EFOMP governing committee. On the previous evening, the board of the Finnish Association had already arrived at the conference venue. In addition, Jaroslav Ptáek, Efi Koutsouveli, Constantinos Koutsogiannis and his lovely wife, and Brendan McClean were early arrivals. In Jarda, Efi and Brendan had a chance to get familiar with Finnish nature in the Nuuksio National Park, with Mika Kortesniemi as their qualified guide. After the Finnish registration board and association board meetings, we had a get-together event with EFOMP guests. The rest of the night was spent enjoying a fine dinner and pleasant, friendly conversations.

A surprisingly sunny Friday morning started our symposium. Before the educational program, it was a good time to visit the exhibition area. Four companies participated in the event, with Divicon presenting Eizo medical products; Cephalon Finland for neuro and imaging applications; Siemens Healthineers for diagnostic imaging; and Varian for radiotherapy solutions. At the same time, more EFOMP guests, Brenda Byrne, Paddy Gilligan, Mohamed Metwaly, and Veronica Rossetti, also arrived.

The educational programme started with a high-quality lecture by Prof. McClean on novelties in radiotherapy research at St. Luke's hospital. The day continued with Jarda's lecture on PET-CT and PET-MRI quality control protocols. There were still four excellent talks in English before the EFOMP committee started their own meetings and Finnish physicists continued their educational programme in our mother tongue. During the day, Marco Brambilla joined us and received a traditional Finnish snack: fish pasty (Kalakukko) and Kossu (Finnish Vodka) served by Mika K. After the Finnish Association's annual meeting, it was time to enjoy a Finnish sauna. Some brave ones swam in the lake outdoors, even though the water temperature was around 6 degrees. The day culminated in the conference dinner, with a tasty meal and again, very nice company and conversations.

On Saturday morning, President Paddy gave an excellent talk on EFOMP activities. After that, the EFOMP committee continued their meetings, and Finnish physicists had their own labour union and scientific lectures. The day was still completed with the leadership meeting, where the EFOMP committee and Finnish chair and delegates shared their common interests and planned some future projects and tasks.

To wrap up the atmosphere of our event: The board of EFOMP was so privileged to experience the warm welcome, enthusiasm, energy, and scientific excellence at our meeting in ESPOO, and the beautiful location, great dialogue, and brilliant hosting reflect the contribution of the Finnish association to European Medical Physics, "Paddy Gilligan said."

The EFOMP Spring Officers' Meeting took place on the sidelines of the Finnish Medical Physics Days.

Sampsa Turunen, Finnish Association chair, he received a Master of Science degree in Physics in 2008 and a Licentiate of Philosophy (Physics) in 2014. He qualified as a medical physicist in 2014 and as a medical physicist specialist in clinical neurophysiology in 2021. He has been working at Helsinki University Hospital, mainly in the Department of Clinical Neurophysiology, since 2008. He is serving as the chair of the Finnish Association of Medical Physicists for the years 2021–2022.

Tommi Noponen, EFOMP delegate, received a Master of Science degree in Technical Physics in 2001, a Licentiate of Science in 2004 and a Doctor of Science in 2009 from Helsinki University of Technology. He qualified as a medical physicist in 2010 and received an Adjunct Professor in Biomedical Engineering and Physics in 2012 from the University of Turku. In 2016 he became a Medical Physics Specialist in Nuclear Medicine. Since 2007, he has been working at Turku University Hospital, the last 12 years in the Department of Nuclear Medicine. Since 2019, he has been the EFOMP delegate of Finland.

EFOMP COMPANY MEMBER ARTICLE

New Version of LAP's Patient QA Software Radcalc Raises the Bar for Automation

This new RadCalc patient QA software release includes new workflow features for intelligent automation, 3D Monte Carlo for TomoTherapy and a technical preview of what is to come in the next release.

Eclipse TPS users will be pleased to learn that a new Varian ESAPI script was developed that allows one click dose analysis and RadCalc report upload into ARIA. Users will be able to review and import RadCalc computation results without ever having to leave the Eclipse environment.

For our EPID Dosimetry customers, reconstructing the true composite of the delivered treatment is now a single click process. This is made possible with the addition of our Treatment Performance Profiles, which also allow defining multiple physical machines to a single beam model!

3D Monte Carlo for TomoTherapy

The current release adds a new dimension to TomoTherapy calculations introducing 3D Monte Carlo dose volume verification. RadCalc's Monte Carlo algorithm offers benefits in the dose volume calculation for small heterogeneous cases, as well as highly modulated plans with large dose gradients where sparing normal healthy tissues can be more critical. Clinically relevant deviations within the entire patient volume are identified thus increasing patient safety and plan quality by enhancing the user's ability to verify complicated treatment plans more accurately. With this new 3D functionality users will now be able to take advantage of the intelligent automation with RadCalcAIR (Automated Import and Report) that users have enjoyed with other treatment modalities for many years.

A sneak preview of what's to come
RadCalc 7.2.2 already lays the foundation for an exciting new development. The image analysis layout was modified to follow the same pattern as the 3D dose analysis. Here you can look at the technical preview of our upcoming feature for the treatment performance of your patient throughout the entire workflow. MLC log files can now be used to generate a 3D dose volume and can subsequently be compared to the treatment planning system. This upcoming feature will provide a full set of tools for true end to end patient QA making sure patients are treated with the best available quality.

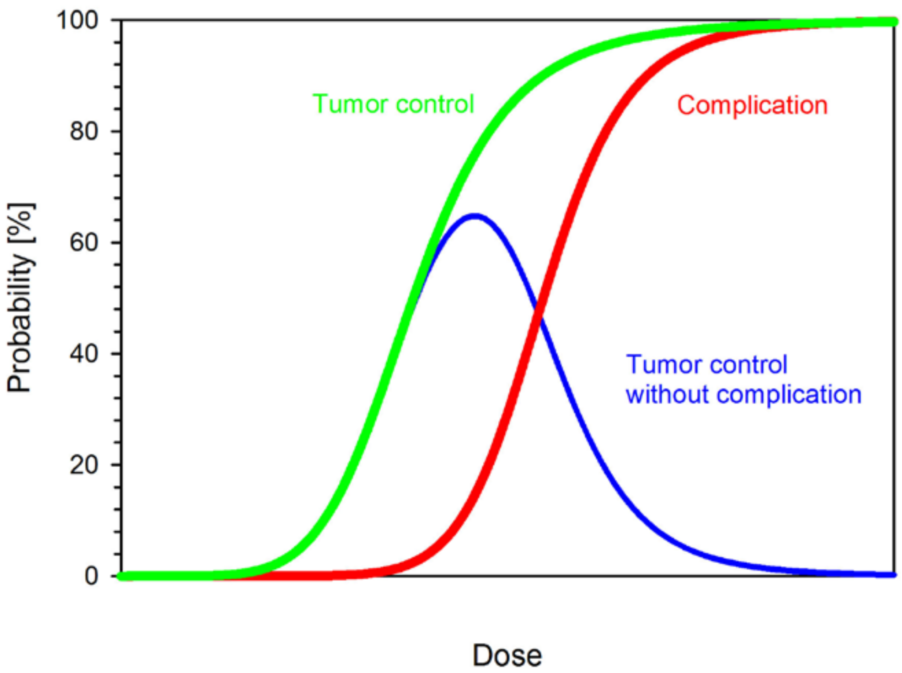
More information and public courses to find on radcalc.com.

Carlos Bohorquez, M.S., D.A.B.R is the product manager for RadCalc at LifeLine Software, Inc., a part of the LAP Group. An experienced board-certified clinical physicist with a proven history of working in the clinic and medical device industry. Carlos' passion for clinical quality assurance is demonstrated in the research and development of RadCalc into the future.

UPCOMING MEETING

4th Summer School in Medical Physics 2022: Radiobiology and Radiobiological Modelling for Radiotherapy

After three very successful summer schools in Medical Physics on different topics since 2017 (see www.dkfz.de/medphys_edu), we are very happy to announce our 4th Summer School in Medical Physics, about **Radiobiology and Radiobiological Modelling for Radiotherapy**, to be held in September 2022.



The effect of radiotherapy as a trade-off between tumour control and normal tissue complication probability. Widening the therapeutic window by using modern treatment techniques increases the probability of tumour control without complications.

The course is subdivided in an **online phase** of about four weeks and an **attendance phase** in **Heidelberg**, Germany of one week, following the **hybrid mode**, so all sessions of the attendance phase are additionally available online as **Live Online Phase** via **Zoom**. Thus, participants can decide to follow the course online and on-site or 100% virtually.

During the online phase, the biological background, biological modelling and the dose-volume effects will be introduced. The attendance phase or Live Online Phase will deepen the knowledge on high-**LET radiation** and **hypoxia** and the impact of oxygen. Furthermore, devices for **small animal imaging** and irradiation as well as special techniques such as **FLASH** and **Mini Beam Radiotherapy** will be presented. Interactive sessions like **Journal Club**, **Pro-Contra-Discussions**, **Panel Discussions** and interactive **Discussion Rounds** take place to strengthen active participation and to initiate scientific exchange between our experts and participants.

We are very glad to welcome **national** and **international speakers** from The Netherlands, Switzerland, France, Denmark, Italy, Austria and from the US contributing to our course to offer interesting sessions and discussions.

The summer school is dedicated to **national** and **international students** on different levels (BSc, MSc or PhD) as well as young Post-Docs. Participation is free of charge, but limited. We are happy to receive your application!

Dates:

1. Application Deadline: July 1st 2022
2. Online Phase: **September 5th - 25th 2022**
3. Attendance Phase in Heidelberg or Live Online Phase via Zoom: **September 26th - 30th 2022**

Programme:

The programme can be downloaded from the website: www.dkfz.de/summer_school2022

Hosts:

Prof. Oliver Jäkel, PhD
Division of Medical Physics in Radiation Oncology, German Cancer Research Center, Heidelberg, Germany

Prof. Jürgen Debus, MD, PhD
Department of Radiation Oncology and Radiotherapy, Heidelberg University Hospital, Heidelberg, Germany

Course Leaders:

Prof. Christian Karger, PhD
Division of Medical Physics in Radiation Oncology, German Cancer Research Center, Heidelberg, Germany
Ina Kurth, PhD

Division of Radiooncology / Radiobiology, German Cancer Research Center, Heidelberg, Germany

Contact:

Local Organizing Team
Anna Moshanina, Simone Barthold-Beß, PhD, Marcel Schäfer

Division of Medical Physics in Radiation Oncology

German Cancer Research Center
Im Neuenheimer Feld 280

DE-69120 Heidelberg, Germany
E-Mail: symposium.medphys@dkfz-heidelberg.de
Web:
www.dkfz.de/summer_school2022

Bio-sketch of Hosts:

Prof. Jäkel is head of the Division of Medical Physics in Radiation Oncology at the German Cancer Research Center. He holds a PhD in Physics and since 2014 he is a full professor at the Medical Faculty Heidelberg of Heidelberg University.

Prof. Debus is a Medical Doctor in radiation oncology and holds a PhD in Physics. Since 2003 he is a full professor at the Medical Faculty Heidelberg of Heidelberg University and since 2014 its Vice Dean. He is also Chairman of the Department "Radiation Oncology" at the Heidelberg University Hospital.

Bio-sketch of Course Leaders:

Prof. Karger leads the research group Applied Medical Radiation Physics at the German Cancer Research Center. He holds a PhD in Physics and since 2007 he is Associate Professor at the Medical Faculty Heidelberg of Heidelberg University. His research focusses on ion beam and MR-guided radiotherapy, experimental radiobiology and radiobiological modeling.

Dr. Ina Kurth is the laboratory head of the Radiooncology/ Radiobiology laboratory and leads service units for radiopharmaceuticals and preclinical studies at the German Cancer Research Center. Her expertise is the radiobiology of solid tumors and their heterogeneous response to tumor therapy, esp. in the development of resistance mechanisms to therapy.

Physica Medica: Editor's Choice

Iuliana Toma-Dasu chose four articles from Physica Medica (EJMP) that she found particularly interesting for this summer issue of EMP News

V. Badiu et al **Improved healthy tissue sparing in proton therapy of lung tumors using statistically sound robust optimization and evaluation** Phys. Med. 2022;96:62-69 https://doi.org/10.1016/j.ejmp.2022.02.018 https://www.physicamedica.com/article/S1120-1797(22)01432-6/fulltext

Using proton radiotherapy at its full potential depends on the approach used for treatment planning. This study presents a comparison between techniques for robust planning and evaluation in proton therapy with respect to target coverage and the doses to the organs at risk (OARs). The results show that the robust optimization method based on scenario selection from joint probabilities that selects errors on a predefined 90% hypersurface results in a significant sparring of the OARs while the coverage of the target is within the clinical objectives. Thus, despite the rather limited number of patients included in the study that prompts some further validation, the study might be of high clinical relevance for the proton radiotherapy centres.

João M. Sousa et al **Composite attenuation correction method using a 68Ge-transmission multi-atlas for quantitative brain PET/MR** Phys. Med. 2022;97: 36-43 https://doi.org/10.1016/j.ejmp.2022.03.012 https://www.physicamedica.com/article/S1120-1797(22)01949-4/fulltext

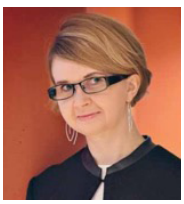
This proof-of-concept study investigates a novel attenuation correction (AC) method for PET/MR imaging which is based on a composite database of multiple ^{68}Ge-transmission maps and T1-weighted (T1w) MR image-pairs (composite transmission, CTR-AC). The method and the prototype for CTR-AC were able to generate accurate MRAC-maps with continuous linear attenuation coefficients with high accuracy for both static and dynamic data, competing with the commercially available MRAC methods. Although still in its infancy, namely in the experimental phase and thus not yet ready for routine application, the CTR-AC method is promising, and therefore we look further for its full potential.

A. Sarno et al **Comparisons of glandular breast dose between digital mammography, tomosynthesis, and breast CT based on anthropomorphic patient-derived breast phantoms** Phys. Med. 2022;97: 50-58 https://doi.org/10.1016/j.ejmp.2022.03.016 https://www.physicamedica.com/article/S1120-1797(21)00343-4/fulltext

This study evaluated the importance of employing breast models with realistic glandular tissue distribution and organ silhouettes instead of homogeneous breast models in digital breast tomosynthesis (DBT) by estimating the differences in the mean glandular dose (MGD) in both cases. The results indicate that the MGD is overestimated by 18% in homogeneous phantoms compared to MGD estimated via anthropomorphic phantoms, clearly indicating the need for considering realistic glandular tissue distribution and organ silhouette when designing the model.

J.A. Baeza et al **Automatic dose verification system for breast radiotherapy: Method validation, contour propagation and DVH parameters evaluation** Phys. Med. 2022;97: 44-49 https://doi.org/10.1016/j.ejmp.2022.03.017 https://www.physicamedica.com/article/S1120-1797(22)01954-8/fulltext

This technical note presents a feasibility study on using automatically calculated parameters for determining the dose volume histograms (DVHs) in CBCTs using an independent dose calculation engine and propagated contours based on a prospective study involving thirty-one breast cancer patients who received additional CBCT imaging. The feasibility was demonstrated and deemed sufficiently reliable to recalculate CBCT-based DVHs during breast EBRT. Having an independent fully automatic dose verification system with contour propagation is very much needed in radiotherapy, and therefore the results of this study are highly relevant.

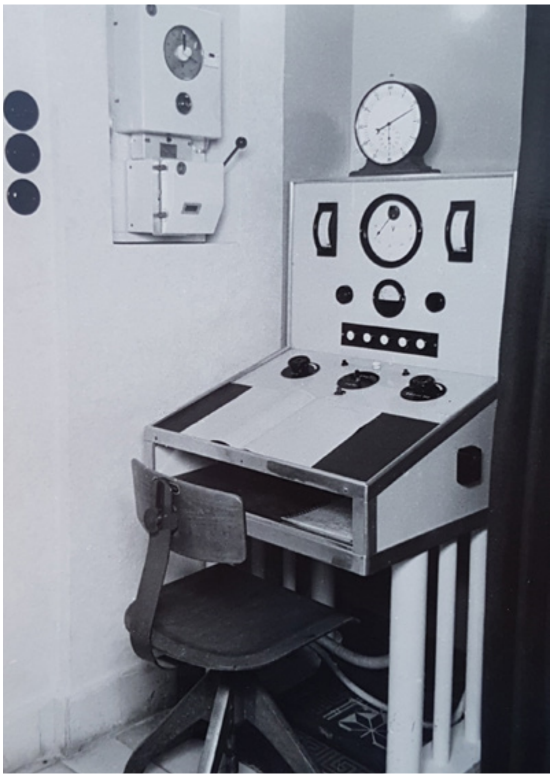


Iuliana Toma-Dasu,
Editor-in-Chief of Physica Medica – European Journal of Medical Physics

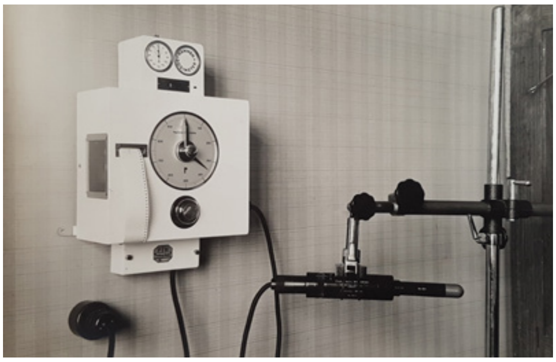
EFOMP COMPANY MEMBER ARTICLE

100 Years of Inventive Spirit at PTW: From Hammer Dosemeter to Today and Beyond

PTW Freiburg can look back on 100 years of advances in dosimetry technology and positive business development. Thanks to the innovative spirit of its employees, the company has been able to stay successful on the global market over the decades.



PTW: The Hammer Dosemeter control room in 1922



PTW: The Hammer Dosemeter in 1922

PTW: Today and beyond 2022

UNIDOS Tango: Newest dosemeter generation by PTW and in clinical use since 2021

The technical know-how and application knowledge developed over a century is also based on an open-minded management style at PTW. Ideas can be considered, tried out and sometimes controversially discussed, and not every idea must necessarily result in a product. The management of the family-run company has always trusted its developers' intuition and allowed them a great deal of freedom – even if this may result in delays. After all , the decision-makers are sure that the quality of their devices speaks for itself as soon as the PTW developers have given the green light for it.

Always with a finger on the pulse of the market

When developing innovative dosimetry solutions, the company has always kept the practical needs of users, e.g., medical physicists, in mind. The automatic tank leveling feature of the latest water phantom generation is a good example: The PTW R&D team has developed a unique function that automatically levels the heavy water tank for a time-saving, quick and, above all, simple and precise measurement setup. This is a huge improvement for users in clinical medical physics, since it eliminates the laborious and error-prone manual adjustment of the water phantom.

From Germany to the whole world

PTW set its sights on the world market at an early stage, and its products were already in great demand internationally shortly after the company had started operation. As early as 1935, the first brochure was printed in Portuguese – for Brazil. While the export share of sales in the early 1980s was still 15 percent, today it is 85 percent. The internationalization of the company gained momentum in the mid-1990s when it became clear that cooperation with foreign representatives alone was no longer sufficient for long-term growth. In 1995, the first subsidiary was founded in New York. Today, PTW has ten subsidiaries and affiliates worldwide.

From invention to industry standard

It is less well known that PTW also invented an important measurement parameter for quality assurance in diagnostic imaging and developed the first measuring instrument for it. The "Diamentor", which was launched on the market in 1959, made it possible for the first time to determine the dose-area product. The radiation exposure of patients in radiology is monitored worldwide based on the standard introduced for this purpose. With the development of the first DAP measuring instrument, PTW set an industry standard that has helped to protect countless patients worldwide from skin damage and other health effects.

The first dosemeter – and its further developments

The Hammer dosemeter was one of the first reliable measuring instruments for determining the dose in radiation therapy. It was based on the electrostatic relay invented by Professor Wilhelm Hammer and bears the name of its inventor, who founded the Physikalisch-Technische Werkstätten (PTW) in 1922 to market it. Over the years, this absolute dosemeter has experienced numerous technological advances. With the beginning of tube electronics, a new generation of devices replaced the first absolute dosemeter. While its predecessor had an electric counting function, the new model had a preamplifier located close to the detector.

With the introduction of integrated circuits, the dosemeter was provided with an interface to be connected to a computer. Always keeping pace with technological progress, the company continued to develop its dosemeter: The first model of the modern generation was controlled by a microprocessor. Its resolution of one femtoampere, already achieved in the early 1990s, made PTW clearly stand out from the competition. The current dosemeter generation can be operated via WiFi using a smartphone. With its integrated camera, it can automatically detect the data matrix code printed on the label of the measurement detector in use. In addition, the resolution of the latest generation has again been increased by a factor of 10.

Water phantom with a vision

PTW has also continuously adapted the water phantom to the requirements in medical physics: The original device, which could only be controlled manually, was later replaced by a product with a process computer. When the first personal PCs were launched, the company decided to continue working with clearly defined interfaces so that it could always participate in the latest computer technology. The water phantom of today's generation is a smart measuring device that can be operated and set up automatically via WiFi.

The successes of the past continue to inspire PTW to develop the technologies of the future. PTW is the world's first dosimetry company to launch an artificial intelligence (AI) product. Thanks to the AI algorithm used in the latest water phantom software, measuring time and quality can be significantly improved. The challenges of new technologies in radiation therapy, such as flash dosimetry or image-based techniques, e.g., MRgRT, are accepted by the PTW engineers. In the future, the further development of web-based software and integrated, automated solutions will likewise play a central role in paving the way for true innovations and new technological standards in dosimetry and quality assurance.

The engineer Dr. Christian Pychlau is a managing partner and one of the leading minds of PTW. He is the third generation in the leadership of the globally successful dosimetry company, which was built up by his grandfather Herbert Pychlau in the 1920s.

Jürgen Kiehne is a graduate engineer and can look back on many years of service at PTW. He was long-time head of research and development until he moved to product management in 2012.

UPCOMING MEETING

Do You Need Further Temptation to Attend ECMP2022 and Explore What Ireland Has to Offer?

Naomi McElroy recently highlighted places to visit near the Congress venue and in Dublin city centre. In this article, Naomi will expand on other areas, near and far, in case you want to combine a conference with a vacation.

By Naomi Mc Elroy (with thanks to fellow LOC member Aibhilinn Mc Hugh for the tips on Galway and Brenda Byrne for Donegal!)

Coastline by Bray next to Dublin in Ireland.

In the last article I wrote, I focused on highlighting a few places and things to do in near the Congress venue and in Dublin city centre. But for this article I am going to expand out on other areas, both near and far, in cas e some of you want to combine in person conference attendance with a holiday while you are here!

Starting in Dublin itself, it is located on the east coast of Ireland within a natural bay. To the north is Howth, and to the south is Bray in County Wicklow, and these points can both be reached by taking the DART rail line running through the city (faster than taking the bus!). Howth is a fishing village well known for its plethora of seafood restaurants. There are also a number of walking trails available around the area, with plenty of stunning scenery along the coastal path offering breath-taking views of Dublin City, the Wicklow Mountains, and the Baily Lighthouse.

If you decide to head south to Bray instead, there are also plenty of options. If taking the DART rather than driving, be sure to sit on the left hand side facing south. One of my favourite views happens after you exit the tunnel between Dalkey and Killiney stations. But if you continue on to the seaside town of Bray, the DART also stops close to the waterfront promenade, which is always a busy spot. You can also reach Bray via car, train, or Dublin bus. Once there, get

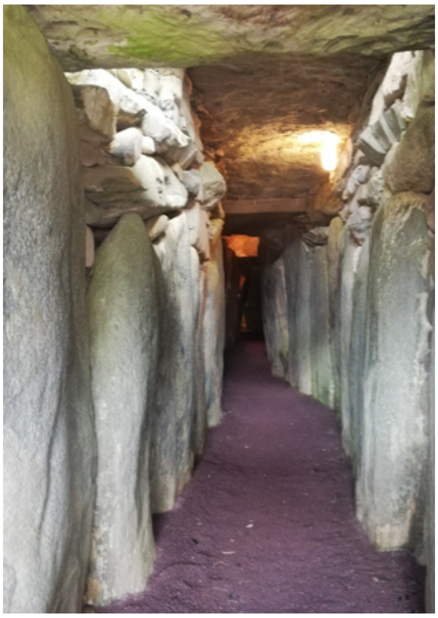
Howth Coastal Path

exploring: you can choose to climb Bray Head, visit the National Aquarium Sealife Centre, take t he cliff walk from Bray to Greystones (and get the DART back), or visit Kilruddery House – an 800-acre estate with a Tudor revival mansion, with an original 17th century fountain that has featured in numerous films, including "My Left Foot" and "The Turning". If you have a car with you, Ennsikerry village, which has the popular Powerscourt Gardens and nearby waterfalls, is a short drive away, or if hiking is what you are after, there is the Great Sugarloaf to climb for fabulous views looking over Dublin and surrounds.

Newgrange entrance stone

Howth statue to fishermen

Moving away from Dublin, but again, within an easy drive, there is plenty to see in Ireland's Ancient East. I might be slightly biased because I grew up near the next few spots, but I still think they are worth a visit. The first is the UNESCO world heritage site of Newgrange – a fascinating Neolithic passage tomb that is older than the Pyramids and contains a significant collection of European Neolithic art. Knowth, another passage grave, is also close by and is part of the tour offered when visiting Newgrange.



Newgrange tomb passage

The Hill of Tara is an ancient ceremonial burial site and the seat of the old High Kings of Ireland—with plenty of space for children to run about and explore and a nice tea room for refreshments afterwards. Both Trim and Slane have castles with claims to fame – Trim Castle was used for t he filming of parts of the Mel Gibson "Braveheart" movie. It was a sight to see when lit up for the night scenes! Slane Castle, owned by Lord Henry Mountcharles, is best known as a concert venue due to the natural amphitheatre created within the grounds, but it does also have a whiskey distillery.

Howth statue to fishermen

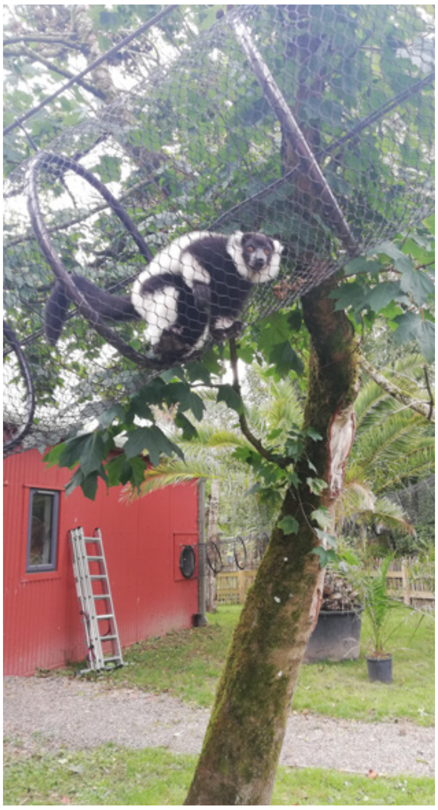
Wolf on the prowl in Kilkenny

Kilkenny is a compact city an hour and a half southwest of Dublin. There are also regular bus or train services to get you there! You can lose yourself in the small winding streets or take a wander down the Medieval Mile from King John's Castle and gardens to St Canice's Cathedral. Kilkenny is also host to Cartoon Saloon, who have received 5 Oscar nominations for their animated films – the most recent one being Wolfwalkers. You

Ogham stones in Cork City

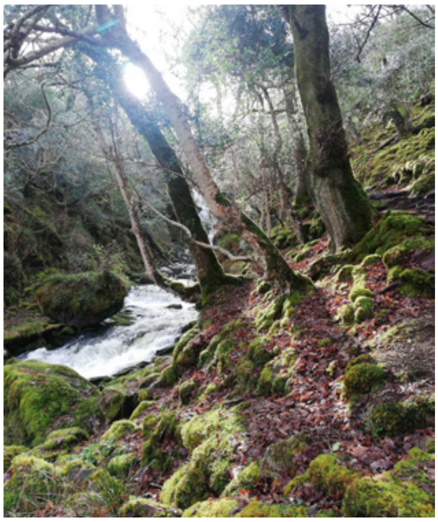
might find some street art dedicated to the films on your walks. One thing Kilkenny does have is some seriously tasty food – Aroi Asian Fusion, Truffles, La Rivista restaurant and market, Zuni, Arán artisan bakery and bistro, Campagne, Murphy's ice-cream shop (available in Dublin too among other locations, try their brown bread ice-cream or dingle gin ice-cream!!), Butlers House & Garden for afternoon tea… I am lucky to have friends living in this city, and they have brought me to all of these places, and in some instances, I have been more than once!

For those of you interested in cycling, Ireland has started to open a few greenways in recent years. The Waterford greenway, situated in the sunny south-east, is one that has gotten a lot of coverage, especially with people appreciating the great outdoors in recent COVID times. You can bring your own bike, or you can rent one to travel the 46km route from Waterford City to Dungarvan, with plenty to see along the way on this repurposed old railway line. If you don't want to cycle, you can walk parts of it. The Waterford Greenway also forms part of the Atlantic Coast Route, a European long-distance north-south cycling route which passes through Norway, the UK, Ireland, France, Spain, and Portugal.



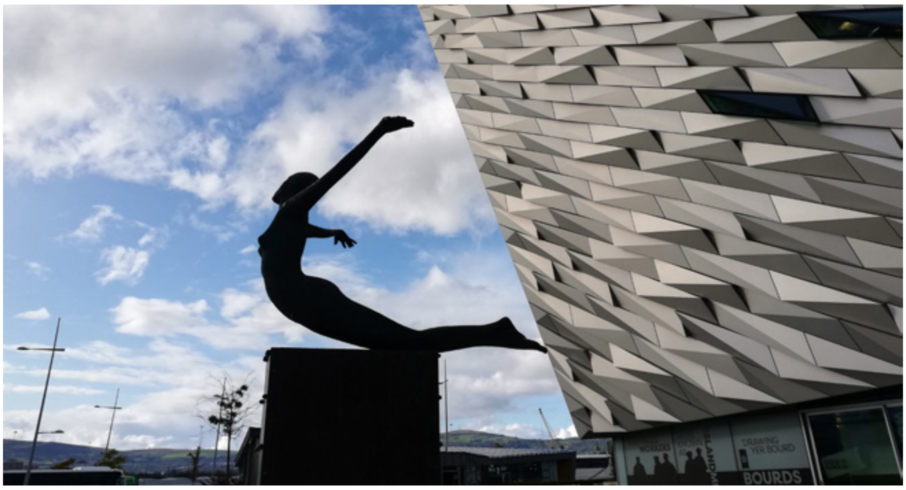
Ring Tailed Lemur at Fota Wildlife park

Cork City, which would be argued by those living there to be the real capital, is a large city in southern Ireland. The start, or end, depending on which way you choose to drive it, of the Wild Atlantic Way is located and also where the Titanic departed from on her fateful voyage. Yet again, this region is brimming with things to see and do: bend over backwards to go kiss the Blarney stone at Blarney Castle and get the gift of eloquence and persuasion; see the maritime traditions by visiting the Titanic experience in Cobh; Walk the quadrangle in University College Cork and see the Ogham stones containing an old form of writing in Ireland (and visit the Honan Chapel for more fantastic Harry Clarke stained glass windows). Take a tour of Spike Island in Cork Harbour to see the former fort/prison, Explore Fota Wildlife Park or stay in the Fota Island Resort, Visit Kinsale's Charles Fort – a well preserved coastal star fort, Take a trip to the English market in the City Centre to taste the finest produce or wander the Cork Heritage pub trail for a traditional take on city night life.



Kerry Wilderness

Salthill promenade Galway city



Belfast Titanic Museum

On your trip to Ireland, why not take some time and visit Galway in the west of Ireland along the Wild Atlantic Way? Connemara is at the heart of Galway. Clifden is the capital of Connemara. Here you will find the landing site of the first non-stop transatlantic flight by Alcock and Brown in 1919. Here, John Alcock and Aurthur Whitten Brown crashed landed into the bog beside the Marconi wireless station, where the first commercial wireless messages were transmitted. There is a lovely interactive walk through the bog at the site of the landing and the Marconi Station. Why not take a trek on one of the magnificent Connemara ponies along some of the beautiful white sandy beaches? Visit one of the many harbours around the Connemara area, notably Roundstone, Cleggan or Killary. From Cleggan, you can take a short boat ride to Inishbofin, the largest populated island in western Connemara. For some added wildlife, take a walk through the Connemara National Park in Letterfrack and climb Diamond Hill for som e elevated views. There are plenty of routes for cyclists, walkers, hikers and numerous water sports activities all across Connemara.

For some food and refreshments, there is an abundance of choice. There are many food trucks dotted around the coastline. Roundstone-O'Dowds seafood restaurant, Ballyconneely-Keogh's bar and restaurant, Clifden-Guy's Bar and restaurant, and Marconi restaurant, Kylemore—Kylemore Abbey Kitchen Café. There is plenty of varied accommodation, from hotels and B&Bs to camping, glamping, and hostels. There is also plenty of retail therapy to be had. From jewellery making to contemporary fused glass making, pottery studios and even some wool craft demonstrations at the Connemara Sheep and Wool Centre. There are lots of family-run shops and boutiques, like Standun in Spiddal and Oughterard and Ohh! By Gum in the heart of Clifden. From small local independent bookshops to vintage clothing, local breweries to tweed stores, there is a little something for everyone.

As you can tell, there is a lot to see and do, and there is only so much I can cram into this article, so here is a snapshot of a few other things that might tempt you:

- Take a trip to Belfast to visit the Titanic Museum, walk the decks of the SS Nomadic and see the huge cranes used in the building of the ships, Samson and Goliath.

- Take a trip on the Antrim coastal road to see the Carrick-a-Reed rope bridge, the Giant's Causeway (get your tide times right!), the Bushmills Whiskey Distillery and some of the filming locations from Game of Thrones (the Dark Hedges anyone?).
- Go to the wilds of Kerry, visit the Dingle peninsula, and don't miss Skellig Chocolate Factory (my favourites are the strawberry and champagne truffles).From here, you can take a trip out to the Skellig Islands, where parts of one of the more recent Star Wars movies were filmed.

- Visit the rugged beauty of Donegal in the country's north west – fly to Donegal in to the World's Most Scenic Airport (voted three years in a row!)a trip to see the wildlife sanctuary created by the Bearman of Buncrana or visit the haunting wilderness of Glenveagh National Park.

- Take a trip to the Aran Islands off the west coast and visit the ancient hill fort of Dun Aengus on Inis Mór.

- Find those hidden sea or picturesque swimming spots and take a dip: the Forty Foot in Dublin; Salthill in Galway; Solomon's Hole, the Hook, County Wexford;

Salthill promenade Galway city

Pollock Holes, Kilkee; Annagh Bay, Achill Island, County Mayo or Belmullet Tidal Pool, also in Mayo, to name just a few.

- Visit the karst landscape of the Burren to see if you can spot three-quarters of Ireland's 900 native plants (yes, you might find some orchids), delve into the Doolin Caves, visit the Polnabrone Dolmen or watch the raptor display at the Aillwee Caves Birds of Prey centre.

Samson or Goliath - They are the twin shipbuilding gantry cranes situated at Queen's Island, Belfast, Northern Ireland.

- Visit the Marble Arch UNESCO Geopark or walk the nearby Stairway to Heaven.

Whatever you decide, I definitely think you should take a few days to relax in Ireland around the ECMP 2022 Congress dates!

References:

https://www.discoverireland.ie/irelands-ancient-east

https://greenwaysireland.org/

https://www.thewildatlanticway.com/

Naomi McElroy, B.Eng. M.Sc. has been working in the field of Medical Physics for almost half her life. She works as a Senior Medical Physicist in St Lukes's Hospital, Rathgar which is part of the St Luke's Radiation Oncology Network (SLRON) in Dublin. Her current work focuses on nuclear medicine therapies, and providing physics support in diagnostic imaging and radiation protection. She is a past Honorary Treasurer for the IAPM, currently serves on the IAPM Council and is registered as an MPE with the Irish College of Physicists in Medicine (ICPM). She is on the Local Organising Committee(LOC) for ECMP 2022 and looks forward to welcoming you to Dublin later this year.

EFOMP COMPANY MEMBER ARTICLE

Qaelum: CT Patient Positioning – More Important Than You Think

By Anna Romanyukha, PhD, Steve Nzitunga, Radiographer, Ana Dolcet, MPE, Application & Training team at Qaelum

Techniques to reduce patient radiation dose during computer tomography (CT) examinations have improved drastically since their first introduction into clinical practice.

Automatic tube current modulation (ATCM) is one of the most important improvements in the history of computed tomography. Since the concept was introduced by Haaga et al. [1] in 1981, and made commercially available by GE Medical Systems in 1994 [2], ATCM has become one of the principal techniques for the optimization of patient radiation dose and image quality. In order to use ATCM, the scanner must estimate the attenuation characteristics of the patient over the range of the scan provided by one or two localizer radiographs (LRs, or topograms) [3]. ATCM then automatically adjusts the tube current according to the patient size and attenuation to maintain the noise level indicated by the user.

The **bowtie filter** was introduced to compensate for the variation of patient attenuation at the level of the detector during scan rotation [4]. The filter is composed of a thinner and thicker segment. The thinner segment allows maximum beam intensity for anatomical regions with high attenuation while the thicker segment is used to reduce beam intensity for anatomical regions with lower attenuation, in the peripheral areas of the patient [5]. A Teflon bowtie filter is shown in Figure 1.

Figure 1: A Teflon bowtie filter. Reproduced from M.A.Habibzadeh et al. [6].

In order to ensure that ATCM and bowtie filter techniques work as intended, the patient must be correctly centered with respect to the CT gantry. Proper centering will lead to accurate localizer radiographs and therefore optimal ATCM performance (Fig. 2a). If the patient is positioned too close to the X-ray source, the scanner will overestimate the patient size and thus the patient attenuation (Fig. 2b). This will cause the ATCM system to transmit a higher tube current, causing an unnecessary increase in dose. If the patient is positioned too far from the X-ray source, the opposite will happen: an underestimation of the patient size and attenuation, leading to potentially noisy images (Fig. 2c) [5].

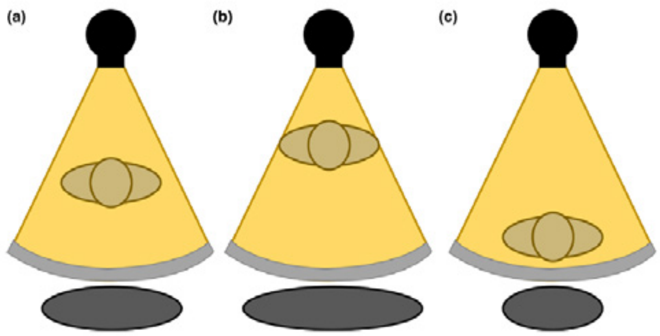


Figure 2: The grey circle at the bottom represents patient size when a) the patient is centered at the gantry b) an anterior shift is present in patient positioning c) a posterior shift is present in patient positioning. Reproduced from Barreto et al. [5].

The correct function of the bowtie filter also relies on centering, and the assumption that the thickest region of the patient is positioned in the center of the beam (Fig. 3). If the patient is not centered with respect to the gantry, dose will be higher than necessary in some regions of the patient, and lower than necessary in other regions.

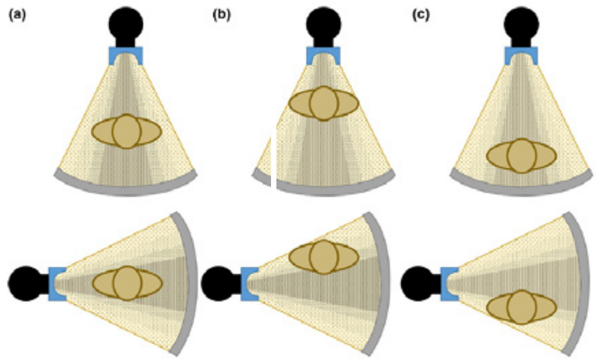


Figure 3: Not all repeated scans are superfluous. Clinically relevant repeats can be excluded from the repeat rate analysis in an easy way, with possibility to also select the type of repeat that needs to be excluded. This allows for rare and clinically needed delayed or optional phases to not raise false alarms. For commonly performance optional phases, like delayed phase in the setting of a slow bleed, the algorithm will learn those behaviours on its own without user input needed.

This can cause non-uniform noise in the image following reconstruction. Moreover, possible shading artifacts may occur due to beam hardening from changes in the mean beam energy that can lead to artifactual changes in organ density (Fig. 4) [7].

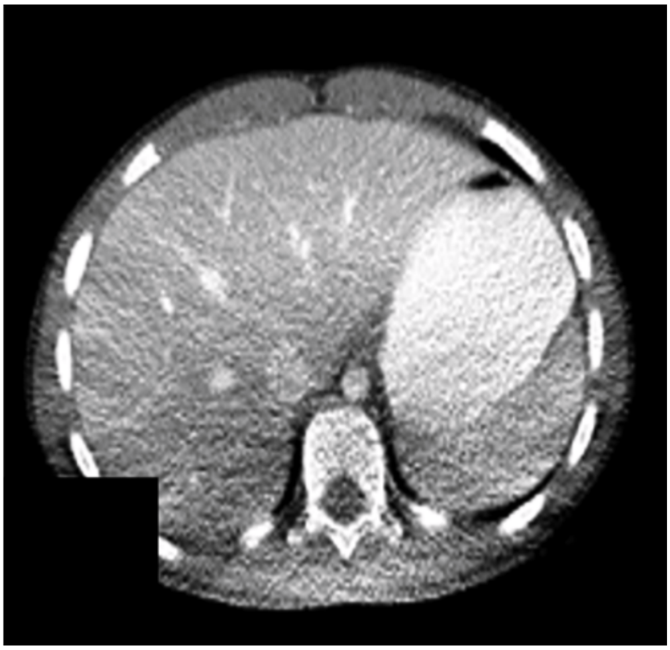


Figure 4: Shading artifacts as a result of beam hardening can be seen on the CT scan in the posterior region of the patient, causing an artifactual change in liver density. Reproduced from Szczykutowicz et al. [7].

Vertical and lateral shifts: quantified

Vertical miscentering has been reported for 73% [5] to 95% [8] of patients in various hospitals [9,10]. Maximum reported vertical miscenterings were 6.6 cm and 3.4 cm below and above the isocenter, respectively [10], with mean shifts in the range of -2.3-2.6 cm [10,11].

Miscentering was found to be more likely for smaller patients: slim adults [4,6] and smaller pediatric [4] patients. Moreover, many technologists often use only the AP topogram, as opposed to both AP and lateral topograms [6]. Vertical shifts of > 3 cm were found to occur in 7.7-22% of the cases, and such shifts are expected to be detected by technologists [5,9,10].

Lateral miscentering with respect to the x-ray tube was reported for 80% of patients in one study [5], but the shift was > 0.5 mm, and supports the overall small shifts in lateral patient position across multiple studies [4, 10, 11]. It is assumed that this is due to the fact that the borders of the patient table provide sufficient reference for the technologist.

How DOSE by Qaelum can help

DOSE by Qaelum performs a detailed analysis of the actual patient positioning during each scan, allowing the end-user to detect and address potential technologist training needs. Patient positioning can be evaluated for different operators, protocols, study descriptions, patient body size, tube current, scanner, and much more.

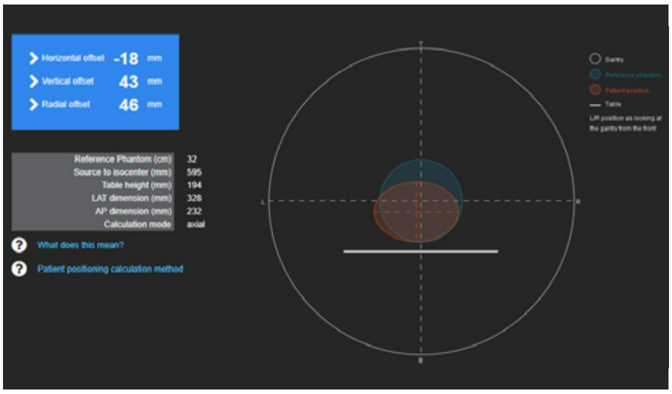
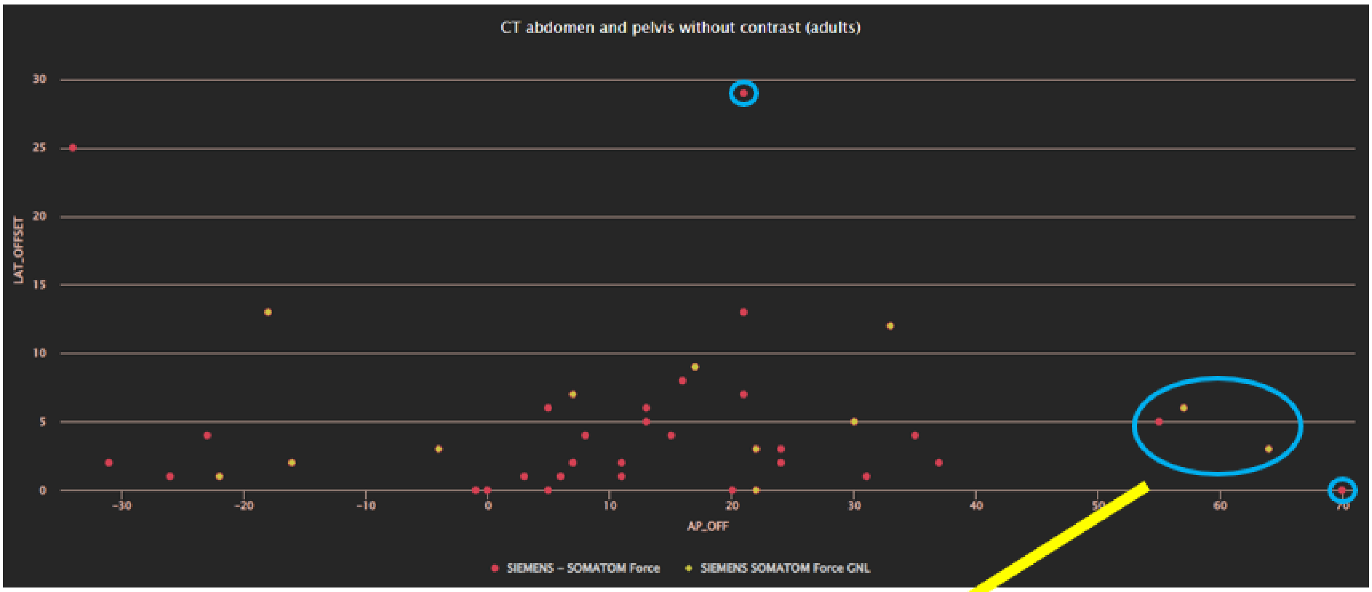


Figure 5: Patient positioning during the scan is represented by the orange ellipse, while the position assumed by the scanner is represented by the blue circle. Exact horizontal, vertical, and radial offsets are displayed in the blue box on the top left.

In Figure 5 the blue circle indicates the position of the reference phantom assumed by the scanner, while the orange ellipse shows the actual position of the patient in the exam. A significant deviation can be easily spotted. The exact offset values are displayed for horizontal, vertical, and radial offsets in the blue box.

The software also offers charts that display positional offsets for every study (Fig. 6). Here any of the points i.e. series can be clicked to open the study and series details of interest for a full analysis of outliers



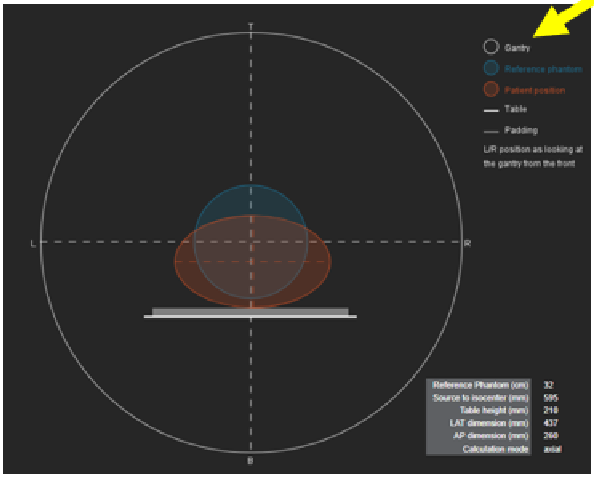


Figure 6: Offsets in patient positioning for studies in two CT scanners. Patient positioning in all cases can be evaluated by clicking on the individual series.

Extended analyses can be performed and customized by the user, such as evaluating which operators need most training in positioning the patient (Fig. 7).

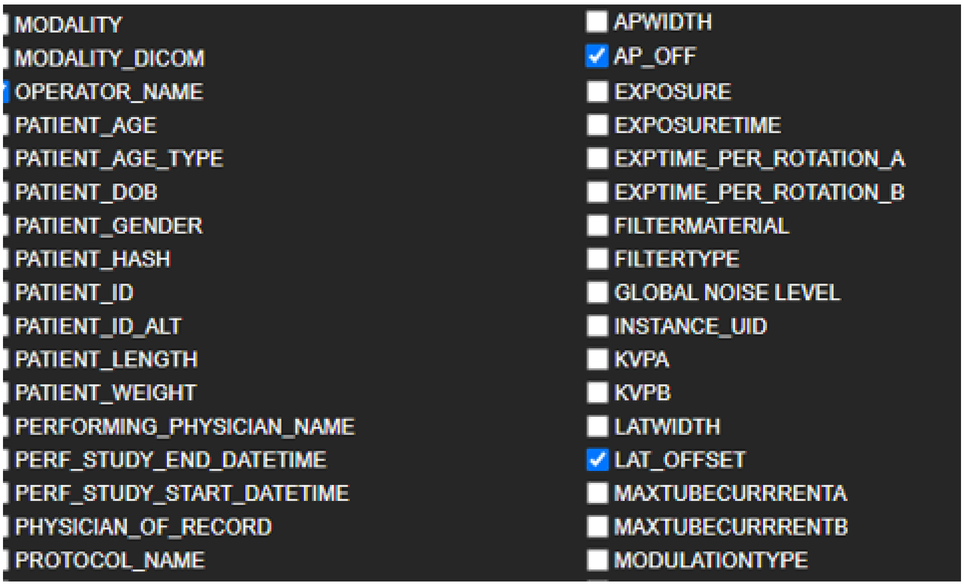


Figure 7: All study and series data can be evaluated and related to offsets in patient positioning.

DOSE by Qaelum does not only evaluate patient positioning, but all the components of a good CT examination. In our Advanced CT Analysis calculations of the size-specific dose estimate (SSDE), blindscan (i.e. area scanned in the spiral acquisition but excluded from the topogram), ATCM, image noise and more are performed. All data are exportable and easy to evaluate.

DOSE can help detect technologist training needs to ensure proper use of ATCM and bowtie filter. This can in turn help to reduce the patient dose and improve image quality in your department.

References:

1] Haaga, J.R., Miraldi, F., Macintyre, W., LiPuma, J.P., Bryan, P.J. and Wiesen, E., 1981. The effect of mAs variation upon computed tomography image quality as evaluated by in vivo and in vitro studies. *Radiology, 138(2)*, pp.449-454.

[2] Kopka, L., Funke, M., Breiter, N., Vosshenrich, R. and Grabbe, E., 1995, November. Anatomically adapted CT tube current-dose reduction and image quality in phantom and patient studies. *Radiology, 197,* pp. 292-292.

[3] Merzan, D., Nowik, P., Poludniowski, G. and Bujila, R., 2017. Evaluating the impact of scan settings on automatic tube current modulation in CT using a novel phantom. *The British journal of radiology, 90(1069)*, p.20160308.

[4] Kaasalainen, T., Palmu, K., Reijonen, V. and Kortesniemi, M., 2014. Effect of patient centering on patient dose and image noise in chest CT. *American journal of roentgenology, 203(1)*, pp.123-130.

[5] Barreto, I., Lamoureux, R., Olguin, C., Quails, N., Correa, N., Rill, L. and Arreola, M., 2019. Impact of patient centering in CT on organ dose and the effect of using a positioning compensation system: Evidence from OSLD measurements in postmortem subjects. *Journal of applied clinical medical physics, 20(6)*, pp.141-151.

[6] Habibzadeh, M.A., Ay, M.R., Asl, A.K., Ghadiri, H. and Zaidi, H., 2012. Impact of miscentering on patient dose and image noise in x-ray CT imaging: phantom and clinical studies. *Physica Medica, 28(3)*, pp.191-199.

[7] Szczykutowicz, T.P., DuPlissis, A. and Pickhardt, P.J., 2017. Variation in CT number and image noise uniformity according to patient positioning in MDCT. *American Journal of Roentgenology, 208(5)*, pp.1064-1072.

[8] Namasivayam, S., Kalra, M.K., Mittal, P. and Small, W.C., 2006. Can radiation exposure associated with abdominal and/or pelvic CT be minimized with better practice. *Vancouver, canada: ARRS*.

[9] Kim, M.S., Singh, S., Halpern, E., Saini, S. and Kalra, M.K., 2012. Relationship between patient centering, mean computed tomography numbers and noise in abdominal computed tomography: Influence of anthropomorphic parameters. *World J. Radiol., 4(3)*, pp.102-108.

[10] Toth, T., Ge, Z. and Daly, M.P., 2007. The influence of patient centering on CT dose and image noise. *Medical physics, 34(7)*, pp.3093-3101.

[11] Li, J., Udayasankar, U.K., Toth, T.L., Seamans, J., Small, W.C. and Kalra, M.K., 2007. Automatic patient centering for MDCT: effect on radiation dose. *American journal of roentgenology, 188(2)*, pp.547-552.

Anna Romanyukha received her Ph.D. degree in medical physics from the Centre of Medical Radiation Physics (UOW, Australia) and her M.Sc. degree in health physics from Georgetown University (Washington DC, USA). She worked as a post baccalaureate and pre doctoral fellow at the National Cancer Institute (NIH, Washington DC) on various projects including radiation dose estimation from diagnostic exposures. She now works in Qaelum NV, focusing on advanced software tools in patient radiation dose management and quality.

Steve Nzitunga worked 5 years in AZ Monica as Radiographer for General radiology, CT, MRI and Cone beam for ankle and feet (pedCAT). He also took care for radio-protection. Currently, he works in Qaelum as Application Specialist for all products.

Ana Dolcet Llerena is a medical physicist from Spain and member of the Spanish Society of Medical Physics. She did her residency in Granada and, after working in a radiation protection technical unit, she is now employed by Qaelum NV as Application Specialist for Iberia, focused on patient radiation dose management.

MEDICAL PHYSICS IT AND SOFTWARE

Hacking Medical Physics: Part 3. Visual Programming with Hero - Medical Image Analysis Made Easy!

Dr. Brynolfsson, Dr Jonsson, and Prof. Nyholm, the shareholders in Nonpi Medical AB, Sweden, announce Hero, the successor to MICE Toolkit after summer 2022, is a visual programming tool for image analysis workflows that provides basic and advanced functions for medical imaging applications and visualisation.

Healthcare digitalization is fundamentally changing the opportunities and challenges of the medical physics profession. Most aspects of the work in clinical development, research and quality control require, or are greatly simplified by, skills in programming and data management. Having the proficiency to set up, execute and evaluate manual or automated image analysis tasks such as image registration, calculations of dose volume histograms and gamma index calculations takes years of practice and experience in both programming and interfacing with different clinical systems.

The Hero (Nonpi Medical AB, Sweden), the successor to MICE Toolkit, after summer 2022, is a tool for visual programming of image analysis workflows and provides a broad range of basic and advanced functions for medical imaging applications and visualization. Setting up and executing an image analysis pipeline takes seconds to minutes, and only the conceptual knowledge of the analysis steps is needed, no programming skills are required. All analyses can be applied to cohorts of patients, and it is possible to generate custom-made reports or export DICOM images to disc or directly to a DICOM-server.

The Hero and the MICE toolkit originate from the Radiation Physics department at Umeå University, and was created to lower the technical skills threshold required to design and evaluate image analysis pipelines for research, and to simplify and automate quality assurance tasks. It is now a spin-off company with users on four continents, and a steadily increasing number of scientific publications are based on analysis performed with the software. The first version of Hero, demonstrated for the first time at the ESTRO conference in May 2022, maintains the look and feel of Mice Toolkit, but under the hood everything is new. Hero has multi-dimensional image support, a larger selection of available functions, simple access to creating lists of images, masks or contours, and support for native GPU acceleration have been prepared for an upcoming release.

We provide our users with easily accessible tools for basic functionality such as import and export of images in different formats; import, construction and export of DICOM RTStructs, and we supply a large collection of different filters, functions and operations. A majority of the functionality is based on established, open-source packages such as ITK and VTK, and all functions are well documented with references for traceability. More advanced functionalities are also available such as rigid, affine and deformable image registrations, model fitting for quantitative, diffusion and perfusion MRI, and tools for radiomics analyses. It is also possible to include Python or MATLAB code anywhere in the pipeline. Applications in radiotherapy include e.g. functions to build DVHs and gamma index maps, tools for dose warping and accumulation and propagation of contours. Every user has a 45-day trial, after which a restricted free version can be used that does not allow loading of user-created workflows or saving workflows.

In the example below, we illustrate a scenario where a bladder treatment has been planned with a certain bladder filling. However, at the second treatment fraction, the bladder is significantly smaller as seen in the CT (see figure 1). To get an estimate of the total delivered dose, we use deformable registration to propagate the dose distribution from the two fractions to the anatomy of fraction 1.

With this example we want to demonstrate how easily a complex task can be achieved, and how the user always has an accessible overview of the analysis pipeline (figure 2). The result of each processing step is saved in each node, which makes debugging or optimization very simple.

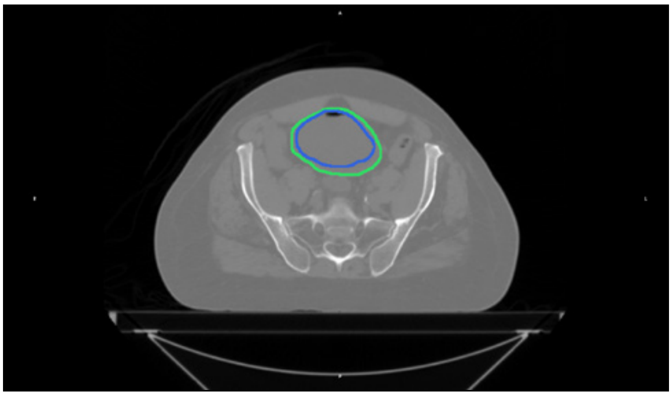


Figure 1. The bladder filling at the first treatment is represented by the green contour, and the bladder filling at the second treatment is represented by the blue contour.

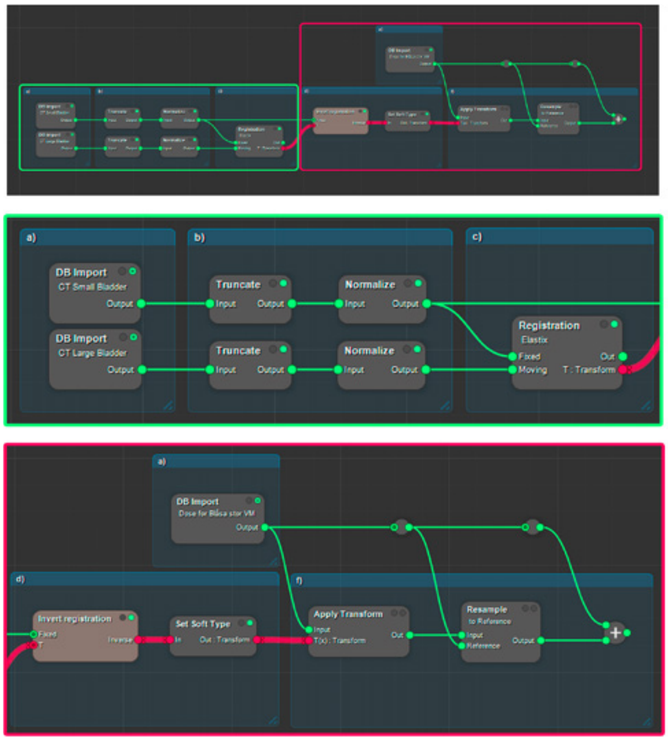


Figure 2. A workflow created in Hero which accumulates the dose given with the planned dose to a patient with two different bladder fillings. The different steps are described below. The upper part shows the entire workflow, with parts zoomed in within the green and red rectangles.

a) *Import nodes which retrieve images or data from the Hero database. Imports the CT images, dose distribution, and structure set associated with "CT Large Bladder" (reference, first fraction) and the CT images associated with "CT Small Bladder" (second fraction).*

b) *Truncation and normalization of the CT data. This is a trick to avoid influence of implants with very high CT-numbers in the intensity binning which is always a part of a registration procedure. The truncation and normalization can be configured (not shown)*

c) *A deformable registration using the Elastix package. The setting can be configured (not shown). In the present example we use a mutual information metric with transform bending energy penalty. All settings can be accessed and modified by double clicking on the registration node.*

d) *We will approximate the dose matrix in the "small bladder" case as the same as the "larger bladder" case, but with the anatomy shifted and deformed relative to this. We register the large bladder CT to the small bladder CT. However, we want to know what happens when the doses in the small bladder voxels are deformed back to their positions in the first fraction. This means that we need to invert the transform.*

e) *The dose distribution for the large bladder scenario is transformed using the inverted deformation field and resampled to fit with the coordinate system of the large bladder scenario again. Finally, the doses from the two first fractions are summed up and can be displayed.*

The example described above can be downloaded from the software repository for this series of articles (https://github.com/rvbCMTS/EMP-News). The documentation for Hero and the MICE Toolkit contains many working examples of image analysis operations (https://micetoolkit.com/docs/).

Conflict of interest

All three authors are shareholders in Nonpi medical AB which develops and sells Hero and the Mice Toolkit.

Dr. Patrik Brynolfsson
Medical physicist specialized in MR at the University hospital of Umeå. Part owner of Nonpi Medical AB

Dr. Joakim Jonsson
Medical physicist specialized in Radiotherapy at the University of Umeå, Sweden.
Part owner of Nonpi Medical AB

Prof. Tufve Nyholm
Professor in Medical Physics at the University of Umeå, Sweden. Part owner of Nonpi Medical AB.

EFOMP COMPANY MEMBER ARTICLE

University of Wisconsin-Madison and Qaelum NV Finalise a Partnership to Distribute a Novel Algorithm to Track Repeated CT Scans and Improve Patient Safety and Efficiency

Qaelum

Qaelum NV announces today that they have entered into a licensing agreement with the intellectual property agency Wisconsin Alumni Research Foundation (WARF), a nonprofit foundation associated with the University of Wisconsin-Madison, to distribute and further develop their novel repeat metric for CT studies. Madison, Wisconsin USA / Leuven, Belgium – March 1, 2022.

Superfluous repeated scans in CT examinations are an often-overlooked cause for increased radiation dose, hence increasing the risks for patients. Also, it has an adverse effect on the efficiency of the department, and it increases the waste in iodine contrast. With this state-of-the-art algorithm, CT studies are automatically analyzed for these unjustified scans. Actionable insights are presented and end-users can start improvement trajectories from within the solution. This new product will help to increase patient safety, better manage efficiency and reduce overall costs.

Automatically analyze CT studies for unjustified repeated scans, directly integrated in the existing PACS environment

With this collaborative partnership, Qaelum NV will bring the research that has been conducted by the University of Wisconsin-Madison to the global market. This vendor-neutral solution needs only a limited time investment of the local IT department and can run both in an on-premise or cloud-based version.

"This new repeat rate metric is what you need in a radiology quality metric. It provides actionable advice, that we can directly link to money lost due to wasted contrast agent and scanner time. It identifies the operators, the scanner, and the protocols where problems exist, making targeted intervention easy for managers." says Professor Tim Szczykutowicz, inventor of the repeat metric and Associate professor at the University of Wisconsin Madison. "I think for Qaelum NV, it will be a great tool to allow them as a company to further solidify their offerings of productivity analysis tools; they are not just another dose monitoring company."

"It is a pleasure to start this collaboration with Professor Tim Szczykutowicz and his team at the University of Wisconsin-Madison." says Jurgen Jacobs, CEO and co-founder of Qaelum NV. "Implementing this novel, vendor-neutral repeat metric helps organizations find the unjustified repeated parts of CT studies. Such a matric, is an integral part of our long-term strategy to increase patient safety and efficiency in medical imaging environments."

"WARF is pleased to partner with Qaelum NV on this bringing this cutting-edge technology to the market," says Jeanine Burmania, WARF's Senior Director of Intellectual Property and Licensing. "The partnership is sure to enhance patient safety and efficiencies."

What is CT repeat by Qaelum?

The vendor-neutral CT repeat analysis software monitors how CT scans are performed in practice. Based on an algorithm originally developed by the University of Wisconsin-Madison, it identifies unnecessarily repeated scans and highlights the protocols that require intervention. Its advanced analytics provide direct insights into the costs and the overall impact on the efficiency of the department with the goal of continuous quality improvement.

Why CT repeat by Qaelum?

The CT repeat analysis module is based on technology originally developed by the University of Wisconsin-Madison. It identifies protocols that contain scans that are often repeated, while differentiating between clinically relevant repeated scans and superfluous ones. Recent publications show that this is a hidden and often overlooked problem in hospitals that should be addressed. Numerical results indicate that medical imaging departments have resources loss due to this, while the patients get additional radiation dose and potentially contrast dose, which add uncontrolled risks and compromise the exam safety. The CT repeat software is the ideal solution to assess how CT rooms operate, assess the financial and other liabilities due to unnecessarily repeated scans and achieve productivity gains and optimal performance.

About Qaelum NV

Qaelum NV is a Leuven, Belgium-based medical software solutions provider advocating patient safety and quality improvement in medical imaging environments. Begun as an academic project at the University Hospitals of Leuven, it is now the preferred choice for leading European institutions. Qaelum's mission is to help various social healthcare stakeholders, from patients and healthcare professionals to regulators, in creating patient safe and optimized medical imaging environments. Qaelum does this by developing and implementing user-friendly and state of the art software solutions extensively validated by key opinion leaders in the field. www.qaelum.com

About the University of Wisconsin-Madison

Since its founding in 1848, the University of Wisconsin campus has been a catalyst for the extraordinary. As a public land-grant university and prolific research institution, its students, staff, and faculty members partake in a world-class education and solve real-world problems. Innovations specific to the radiology and medical physics space include digital subtraction angiography, TomoTherapy, multiple commercialized solutions in MRA, and Neuwave Medical. https://www.wisc.edu/

About WARF

The Wisconsin Alumni Research Foundation (WARF) helps steward the cycle of research, discovery, commercialization and investment for the University of Wisconsin-Madison. Founded in 1925 as an independent, nonprofit foundation, WARF manages more than 2,000 patents and an investment portfolio as it funds university research, obtains patents for campus discoveries and licenses inventions to industry. WARF is home to WARF Accelerator advancing promising university technologies, WARF Therapeutics combining world-renowned research and an industry-focused approach to improve value propositions of drug candidates and WARF Ventures which actively invests in startups with UW-Madison technology over two decades. For more information, visit warf.org and view WARF's Cycle of Innovation

Radformation Clinic in Focus - Clinical Validation of EZFluence Automated Breast Planning

Meet Jérôme Anfray, Medical Physicist at Centre d'Oncologie Saint-Yves, in Vannes, France.

Centre d'Oncologie Saint-Yves was searching for an alternative to VMAT/IMRT breast treatments for their Halcyon™ machines in an attempt to reduce the dose to contralateral organs. Jérôme was introduced to EZFluence by a colleague and reached out to learn more. He explains, "The installation of the EZFluence tool was done very quickly after our request, and the support team is very responsive to our questions and requests."

Alternatives to IMRT and VMAT, such as field-in-field (FiF) and electronic compensation (ecomp), can be challenging for the Halcyon, which features an unflattened beam. The team had evaluated many planning options and found that using EZFluence reduced planning time by two-thirds compared to manual FiF planning. They also noted that the plans created with EZFluence had better target volume coverage, minimal dose to contralateral OARs, and the planners had more control over the max dose.

Jérôme quickly became a Radformation believer, expanding the use of EZFluence not only to all other linacs in the department but also to additional planning sites as well, including whole brain, cervical spine, and others.

"We did not want to use VMAT or IMRT for the treatment of the mammary gland on our Halcyon™ because the contralateral organs receive low doses whose long-term effect is unknown. **EZFluence** allows us to improve our treatment plans by achieving better target volume coverage, having more control over the max dose and minimizing dose to contralateral OARs."

Jérôme Anfray, Medical Physicist

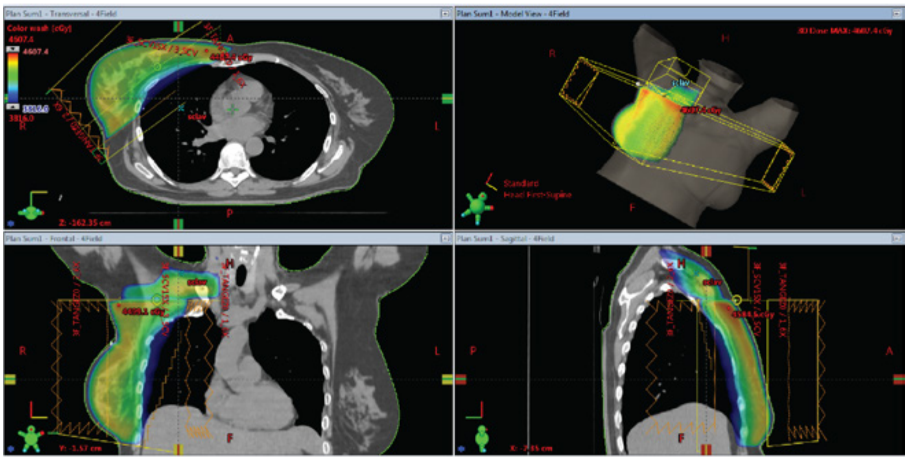
Centre d'Oncologie Saint-Yves
Vannes, France

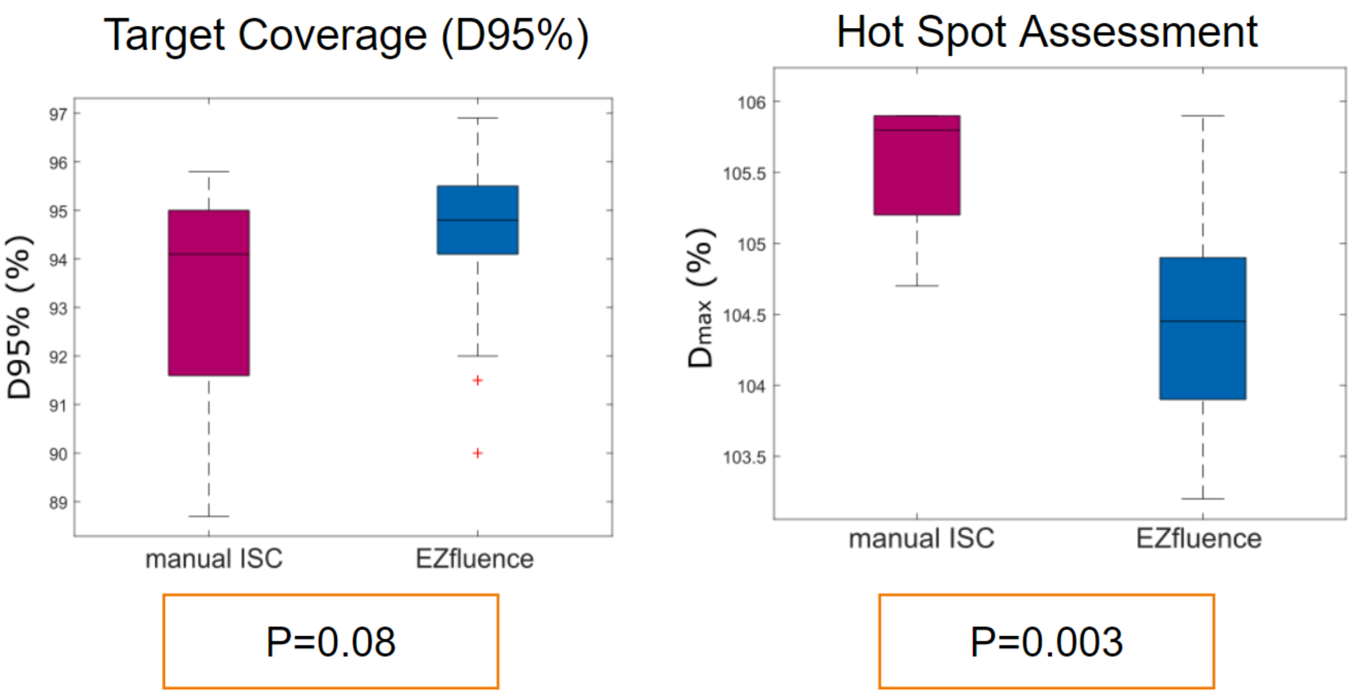
CLINIC IN FOCUS

EZFLUENCE: Automated 3D Planning

If you have ever spent too long making multiple iterations in the treatment planning system to develop an acceptable field-in-field or electronic compensation plan, you'll know why we decided to create EZFluence. As Jérôme Anfray attests above, EZFluence automates the tedious aspects of these planning techniques, delivering high-quality plans in a fraction of the time needed for manual planning.

Effective for any site from head to toe, EZFluence optimizes target coverage while minimizing hot spots. That's just what the University of Zurich discovered when they evaluated EZFluence for breast patient planning using electronic compensation. Their work presented at





SASRO 2019[1] showed an increase in coverage using the D95% metric while decreasing the average hot spot. These metrics were improved without compromising doses to organs-at-risk, which were unchanged from baseline. In addition to improving plan quality, automating the FiF and ecomp planning processes saves valuable clinical resources. In a study presented at the 2020 ESTRO meeting, a team led by Juan Francisco Calvo Ortega at Hospital Quirónsalud showed an 80% reduction in the planning time required to produce their hypofractionated FiF breast plans[2]. For Sheba Medical Centre in Israel, the efficiency of automated FiF planning results in 37 minutes of time savings—from 52 minutes required for manual planning to just 15 minutes with EZFluence[3].

Whether your department plans using FiF or ecomp techniques—or you have a Halcyon like Jérôme Anfray at Centre d'Oncologie Saint-Yves in France—EZFluence has been shown to have a clinical impact where it matters, with significant improvements in plan quality and time savings. Schedule a demo to see how EZFluence can remove the frustrations involved with these planning techniques and accelerate your planning workflow.

Disclaimer: Some products may not be available in all markets.

References:

1. J. van Rossum, et al. "Evaluation of an Automatic Planning Solution for Breast Cancer." SASRO. 2019.

2. J Calvo-Ortega, et al. "Analysis of Breast Radiotherapy Plans Generated by the EZFluence Software." Radiotherapy and Oncology. November 1, 2020.

3. Benayun, et al. "Implementation of an Automatic Planning System for Breast Cancer Radiotherapy Planning." International Journal of Radiation Oncology, Biology, Physics. November 1, 2020.

Tyler Blackwell, MS, DABR, is a medical physicist at Radformation, where he focuses on clinical collaborations and community engagement. Before joining Radformation, he spent a decade working as a clinical medical physicist in radiation therapy. He is active in several AAPM committees and is a member of the AAPM Board of Directors.

EUROPEAN FEDERATION OF ORGANISATIONS FOR MEDICAL PHYSICS

EFOMP'S GUIDELINE QUALITY CONTROLS IN PET/CT AND PET/MR

VERSION 02.03.2022

Becoming a Medical Physicist in Spain

Leticia Irazola, Ph.D., discusses the requirements for becoming a recognized medical physicist in Spain.

According to the National Royal Decree 183/2008 Medical Physics in Spain is recognized as a specialty in Health Sciences accredited by a 3-year teaching program.

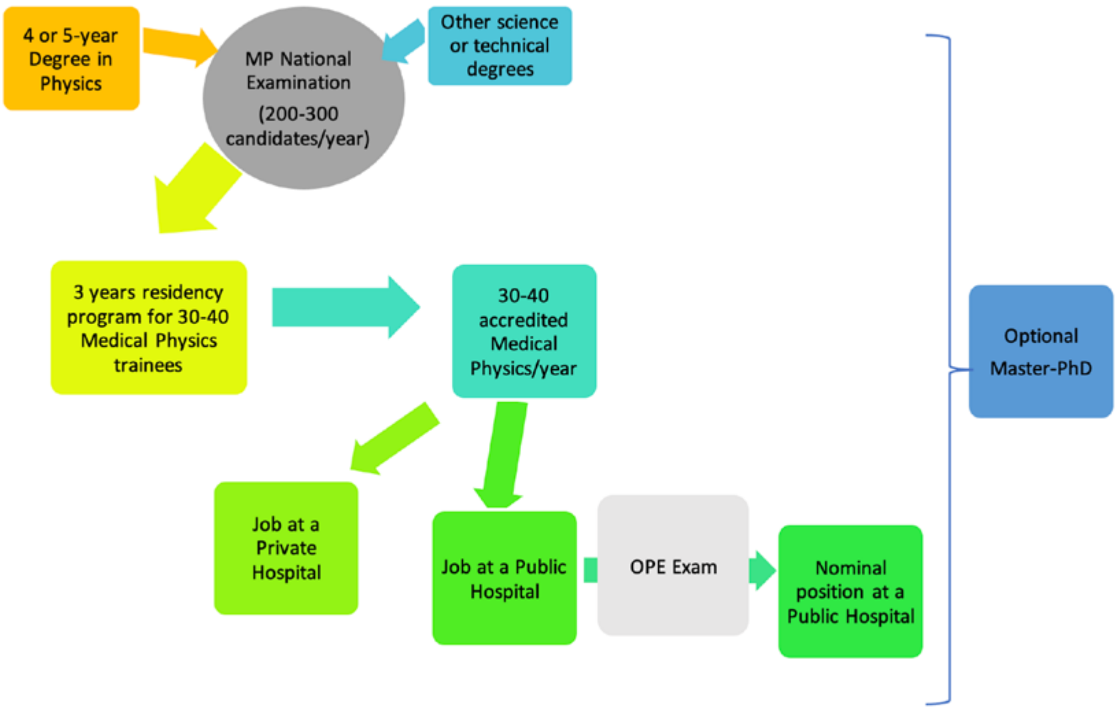
Access to this formation requires having a degree in Sciences or other technical careers, with no Master in Medical Physics required, plus passing a national selective process (based on a general physics exam, publicly available). Until 2008 Physics was a licentiate degree (300 ECTS) while currently is a 4-year degree (240 ECTS). In the past years, around 200-300 applicants are registered for 30-40 training positions, being the 95% of them physicists.**

Once the candidate has succeeded in the exam, the residency consists of 3-year and follows a training program approved in 1996 that is divided into the three main areas of Medical Physics: 18 months in Radiotherapy, 12 months in Diagnostic Imaging and 6 months in Radiation Protection and other medical uses of radiation. Practical and theoretical formation and evaluation on these areas is slightly subjected to the conditions of each center, having all the same basis since they all have been previously accredited by a National Commission. Also, National and International stages can be performed (up to 6 months in total) along these years.

This residency is a paid professional service for the Public Health system, supervised by a tutor and several collaborators on each Hospital. Currently there are 40 accredited teaching units (with 43 training posts) that need to fulfil some requirements in terms of equipment, techniques, and Medical Physics staff to get this accreditation.

Once the specialists have finished their trainees, they get an official Medical Physics accreditation recognized by the Health Ministry, which are mandatory to work on either Public or Private Health Systems. Those specialists that strive for a job in the National Healthcare system are hired according to their CV and expertise. Later they may opt for a permanent position (public servant) by performing another competitive exam. Once they enter into the Public Health System they are automatically included by their own hospital onto a National Sanitary Specialists Registry. Although not all the regions work the same way for temporary jobs, for the permanent position it is mandatory to pass a Public Employment Offer exam that considers mark in the examination as well as working experience and personal CV. Throughout the specialist's professional life, there is also the concept of continuing education accreditation (called a professional career within the public administration).

Medical Physics Health Specialty is regulated by the Spanish Health Ministry, having as a consultant organism the National Commission of



the Specialty. According to, its main missions are watching for the goodness of the Health Specialties teaching programs, as well as the assessment in the recognition of foreign Medical Physicists before working into the National Health System, accreditation of new training units. It is made of members from the main National Scientific Physics Societies, Health Ministry, University, Human Resources Committee, National Autonomies as well as representatives from tutors and residents. Nowadays, one of their tasks is focused on the renovation and enlargement of the training. The increase of years is mainly based in the necessity of updating the responsibilities for MPEs in order to better adapt to new technologies and procedures (referred in the 2013/59 EURATOM as well as the European Guideliness on MPE published by the European Commission in 2014 and the European Commission Radiation Protection Report 174). It is also well known the situation in Spain that 11 new protontherapy machines will be installed within the next years besides the two currently working, which may imply including this topic into the residency program.

Acknowledgement:
The author would like to acknowledge to Antonio Lopez (EFOMP EuM Committee), Guadalupe Martín (EFOMP PM Committee) and Samuel Ruiz (EFOMP PM Committee) for the help provided to this article as well as to the Spanish Commission of Medical Physics (CNRFH).

References

- Medical Physics In Spain: Current Status And Challenges http://www.mpijournal.org/pdf/2021-02/MPI-2021-02-p171.pdf
- National Spanish Law, Article 18 https://www.boe.es/eli/es/l/2003/11/21/44/con
- National Royal Decree 183/2008: https://www.boe.es/eli/es/rd/2008/02/08/183
- 2013/59 EURATOM: https://eur-lex.europa.eu/legal-content/es/TXT/?uri=CELEX%3A32013L0059
- European Guideliness on MPE: https://op.europa.eu/es/publication-detail/-/publication/b82ed768-4c50-4c9a-a789-98a3b0df5391
- European Commission Radiation Protection Report 174: https://ec.europa.eu/energy/sites/ener/files/documents/174.pdf

Leticia Irazola Rosales, is a PhD graduate in Medical Physics who has recently become a Medical Physicist in Spain. She has been an assistant teacher at the University of Valencia since 2014. She is a member of the Communications and Publications Committee of EFOMP, the Scientific Committee of the 4th ECMP Congress, the Medical Physics trainee programme (CNRFH) in Spain, the Young Section of the Spanish Medical Physics Society (SEFM), and the Lu-177 dosimetry Spanish Group.

MEDICAL PHYSICS PRACTICE AROUND EUROPE

Department of Medical Physics and Radiation Protection, University Hospital Olomouc, Czech Republic

Jaroslav Ptáček informs us about the history, structure and operation of his medical physics department

The team of the Department of medical physics and radiation protection, University Hospital Olomouc. Back row from left: David, Václav, Michal, Jaroslav, David, Petr. Front row from left: Eliška, Lenka, Martina, Kateřina, Pavel, Aleksi.

In 1997, Czech legislation for the first time mentioned a recommendation for stakeholders to establish departments of medical physics and radiation protection. A few years later, the management of the University Hospital in Olomouc took advantage of this, and the department's history began in the year 2000.

The department was established as an autonomous entity inside the hospital due to the foresight of the Deputy for Medical Care. When it comes to medical physics, the superior to the head of the department has always been the Deputy for Medical Care, and when it comes to radiation protection, it has always been the Director of the hospital. This assures that medical physicists may talk freely about any subject in nuclear medicine, diagnostic and interventional radiology, or radiation oncology that comes up.

There are also disadvantages in being an independent department. The most significant is, of course, in finance. Medical physicists participate in medical irradiation operations but are not compensated directly by healthcare payers. Because these processes are exclusively carried out through physicians in the Czech Republic, all payments are sent directly to the relevant departments' accounts. This implies that medical physicists cannot earn a living from the healthcare system. According to an economist, the department merely consumes resources and generates no money. A few sessions with a new economist in the hospital generally suffice to clarify the situation.

Ivo Přidal was the department's first head. He had 17 years of experience as a medical physicist in the field of radiation oncology by the year 2000. The idea of an independent department was very well accepted by medical physicists in the hospital at that time. They felt that their opinions and thoughts were quite frequently trivialized or just simply ignored by the heads of clinical departments.

Creating an independent department from scratch is not an easy process. A whole new set of hospital regulations had to be developed. Needless to say, that the departments from where the first medical physicists originated were not very enthusiastic about such an idea. They knew physicists speak the truth, and it's difficult to dispute with precisely measured data. The ability to silence physicists whenever it was convenient was gone with their independence. Throughout those years, we discovered that there are significant discrepancies in how physicists and physicians think about medical irradiation processes, which could only be resolved via discussion – a process made possible by our independence. Ivo Přidal fought for the department for 9 years. I took over as his successor in 2009.

Medical physics has always been a part of nuclear medicine and radiation oncology. In the year 2000, medical physicists working in diagnostic and interventional radiology was a rarity in our country. Soon after the department gained independence, it began to expand. New colleagues were joining the department as a result of thorough arguments to hospital administration rather than the strictly economic point of view of specific departments. This is a fantastic prize that is well worth the effort. We now have the ability to cover all aspects of medical physics.

There are 12 people in the department. One secretary, one technician, one dosimetrist, two clinical biomedical engineers, three medical physicists, and four medical physics specialists make up our team.

Our responsibilities include medical physics in all areas of medicine that deal with ionizing radiation, as well as radiation protection in the hospital. As the hospital's services expand, so must our department. Given the existing and anticipated workload, we will shortly be looking for two more colleagues in diagnostic and interventional radiology, as well as radiation oncology.

In our hospital, the following diagnostic and therapeutic modalities are used:

Diagnostic and interventional radiology:
14x stationary or mobile radiography units, 14x mobile fluoroscopy units, 4x stationary fluoroscopy units, 2x mammography units, 3x CT, 5x interventional angiographic units;

Nuclear medicine:
1x SPECT, 1x dedicated CZT camera (myocardial studies), 2x SPECT/CT, 1 PET/CT;

Radiation oncology:
3x linear accelerator, 2x CT, 1x therapeutic x-ray, 1x brachytherapy unit.

Members of the department create a unique group of individuals. Some people have joined and departed in the past. But those who remained! We like each other, there are no fights among us, and we all support our department. Based on our age profile (min = 26, max = 51, mean = 39, median = 40) we consider ourselves young.
Medical physicists are involved in teaching at Palacký University in Olomouc and Masaryk University in Brno. Our department also provides clinical training courses in the field of radiotherapy and nuclear medicine for medical physicists. We attempt to publish the findings of our work from time to time, but there isn't much time for science. The hospital is referred to be a university hospital, yet our department is not affiliated with the university. We are here to support clinical departments in their daily tasks. More than a decade ago, this department established the Czech Association of Medical Physics conference as a tradition. There is no other department of medical physics in the Czech Republic that covers all subjects of medical physics and has been in operation for such a long time without interruption.

I enjoy the time spent together with my colleagues and friends. We like working together, solving medical physics challenges that come up in our everyday jobs, and protecting our department when necessary. Despite the fact that our areas of expertise are diverse, we always pull on the same rope. As Paddy Gilligan's father told him, "Choose a job you love and you will never have to work a day in your life". This applies also to me.

Thank you Petře, Davide, Martino, Michale, Lenko, Pavle, Davide, Václave, Kateřino, Eliško, and Aleksi.

Jaroslav Ptáček studied medical physics at the Czech Technical University in Prague, gaining his Master's degree in 2003 and his Ph.D. in 2014. He has worked at the Department of Medical Physics and Radiation Protection at University Hospital Olomouc since 2003. He has been a clinical medical physicist in nuclear medicine from 2006 and he became the head of the department in 2009. He was the member of the board of the Czech Association of Medical Physicists between 2006-2010 and was its president from 2010-2018. From 2013 he became involved in EFOMP, first as one of the organizers of ESMPE editions in Prague, then in 2017 as an Assistant Secretary General, for the period of 2018-2020 as Secretary General and he has been the Treasurer of EFOMP since 2021

EFOMP COMPANY MEMBER ARTICLE

RaySearch Laboratories: Faster Treatment Planning Using GPU-Accelerated Computations in RayStation

RayStation, a Treatment Planning System by the medical device manufacturer RaySearch Laboratories, supports the radiation oncology clinic by running computations on GPUs, which are computer chips much faster than the normal CPUs used in all computers.

Treatment Planning System (TPS) is at the heart of any radiation oncology clinic and is used to create the optimal radiation strategy for each individual patient. As the importance of efficiency at a radiation oncology clinic cannot be overstated, the speed of treatment planning computations is essential to save valuable clinician time.

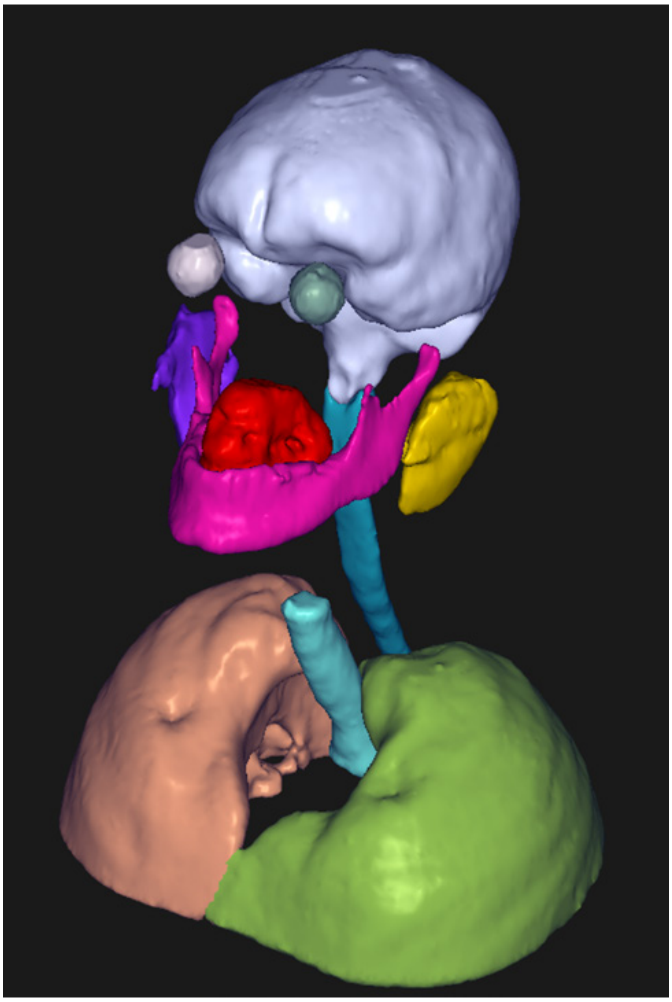


Figure 1: Automated organ segmentation using Deep Learning. Segmentation of all relevant structures for a specific body site, typically 5-30 structures, takes 30-75 s.

RayStation GPU-enabled algorithms include dose computation and optimization for photon, proton, carbon/helium and brachytherapy planning, dose computation for electron planning, deformable image registration and other image processing algorithms. RayStation also contains machine learning applications such as automated organ segmentation (Figure 1) and automated treatment plan generation.

So why are TPS algorithms running faster on GPU than on CPU? One part of the answer is that these types of algorithms can be made to operate on mostly regular independent data, e.g., pixels, voxels, ray-traces, or, for Monte Carlo transport, particles. GPUs were originally designed just for such regular operations, but for graphics processing of pixels on a computer screen. Since the data consists of large sets of independent elements, processing can be run in parallel on the many thousands of processing elements on a GPU.

Another part of the answer lies in the semi-conductor physics of computer memories. The speed of most performance optimized TPS algorithms is limited by reading and writing data in memory, rather than the actual operations carried out on the data. Computer memories (RAM) generally access several contiguous memory values, even if an algorithm only requests a single value. This is because semi-conductor physics makes it much faster to access several values at a time. In the case of CPUs, redundant values are put in fast cache memory on the CPU chip since they will, on average, often be accessed later in typical algorithms. GPUs, instead, require programs to make regular accesses that do not waste neighbouring values. This in itself improves performance, but it also makes cache memories much less important, freeing up a lot of silicon area that can be used for more processing elements on the GPU chip. To feed these with data, GPU memories with even greater bandwidth are used, further improving performance. In the end, it is all about algorithms that are carefully designed for the inner workings of GPUs and computer memories.

As an example of the performance of GPU algorithms, and their practical use in cancer radiation treatment planning, consider the child cranial-spinal proton PBS case shown in Figure 2. This case was planned using the RaySearch proton Monte Carlo GPU-algorithm, which is up to 30 times faster than a previous, already very fast, CPU-algorithm. The speed is comparable to, and often even faster than RaySearch's older, less accurate analytical dose algorithm. The spot doses used in optimization (40000 protons/spot) were computed in less than 17 s, and the final dose computation took only 5 s (0.5% uncertainty/field) on a standard RayStation server.

GPUs are similar to a complete separate computer-within-the-computer connected to the CPU, and all GPU-computations thus involve moving data to and from the GPU. To minimize this overhead RaySearch is aiming to run all parts of the algorithms on GPU, avoiding storing almost any data in CPU memory, which will further improve performance. A potential useful side effect of this is significantly reduced CPU use and thus reduced computer hardware costs. Future plans include adding more machine learning GPU-algorithms and enabling simultaneous use of multiple GPUs in more algorithms. These performance enhancements will further increase the speed of RayStation, thus enabling clinicians to spend more time on refining patient treatments.

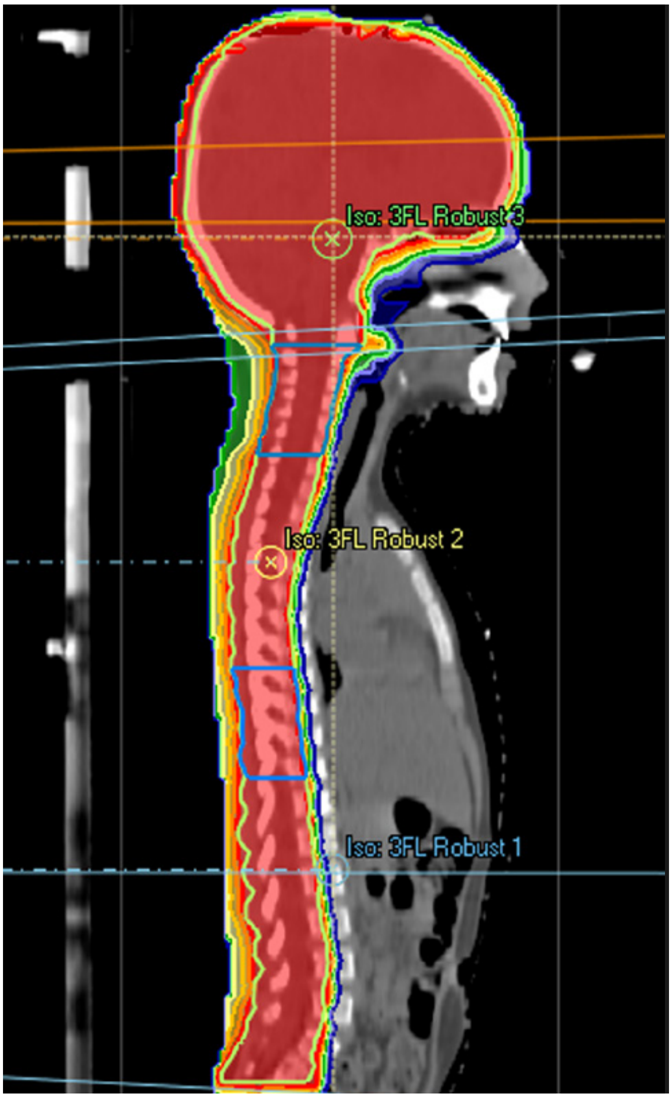


Figure 2: Child cranial-spinal proton PBS case. Optimization spot doses were computed on GPU with Monte Carlo in less than 17 s and final dose computation took only 5 s.

Tore Ersmark, Ph.D., is GPU Computations Architect and Researcher at RaySearch Laboratories, Sweden, where he is developing safety-critical high-performance algorithms that improves cancer radiation treatments. He has previously worked on space radiation shielding studies for human spaceflight. Tore obtained his degrees from KTH Royal Institute of Technology.

ESMPE

ESMPE European School for Medical Physics Experts

Statistics in Medical Physics

13^{th}-15^{th} October 2022, Athens, Greece

EFOMP in collaboration with the Hellenic Association of Medical Physics (HAMP) and the 2nd Department of Radiology, Medical School, National and Kapodistrian University of Athens would like to invite you to the next ESMPE on **13^{th}-15^{th} October 2022**.

The school will be aimed at advanced tasks connected with the use of statistical methods in data handling and interpretation. The school will cover the methods of inferential statistics most frequently used in the medical field, the statistical methods used in radiomics, the treatment of errors an uncertainties in radiation dosimetry.

This two-day event has been accredited by EBAMP (European Board of Accreditation for Medical Physics) as a CPD event for Medical Physicists at EQF Level 8 and awarded 39 CPD credit points (33 CPD credit points for those who do not sit for or do not pass the examination) and is intended for practicing clinical Medical Physicists who are involved in data management and research. As in past school editions, there will be an optional examination at the end for those seeking a higher level of certification beyond attendance.

Please note: All times shown are in CET

Content

Sample Size determination. Sample size determination for different study designs
Evaluation of a diagnostic test– Sensitivity, specificity, diagnostic accuracy, ROC methods
Applied regression analysis. Analysis of variance, Analysis of Covariance, multiple regression, logistic regression
Survival analysis – Relative risks Odds ratio. Survival curves with Kaplan Meyer; Log-rank test; Cox models
Statistical methods in radiomics.
Errors an uncertainties in radiation dosimetry – Theory of error and uncertainty analysis: Type A and B uncertainty, assessment of the quality of a measurement or calculation.
Agreement in Radiotherapy – How to assess agreement in Dose distributions and Volumes

Final exam

The final exam is voluntary. Participants can gain additional credits when successfully pass the test.

Organisers

Brendan McClean (Chair of the School)
Marco Brambilla (Scientific Chair)
Efi Koutsouveli, Pola Platoni (HAMP)

HELLENIC REPUBLIC
National and Kapodistrian University of Athens
EST. 1837

ΕΦΙΕ
Ένωση Φυσικών Ιατρικής Ελλάδος
HELLENIC ASSOCIATION of MEDICAL PHYSICISTS

Faculty

Marco Brambilla	University Hospital, Novara, Italy
Mathieu Hatt	LaTIM INSERM, Brest, France
Renata Longo	University of Trieste, Trieste, Italy
Brendan Mc Clean	Saint Lukes Radiation Oncology Network, Dublin, Ireland
Michael Sandborg	Linköping University hospital, Linköping, Sweden
Peter Sharp	University of Aberdeen, Scotland
Dimitris Visvikis	LaTIM INSERM, Brest, France
Federica Zanca	Palindromo Consulting, Leuven, Belgium

ESMPE

Thursday 13th October 2022				
	Session	**Title**	**Description**	**Lecturer**
8:00-9:00	Registration			
9:00-9:15	Introduction	Setting the scene	Presentation of the ESMPE and introduction to the course	Brendan McClean/IE
9.15-10.00		Statistics with Confidence	How to design the experiment How to analyze the data How to report the data: Hypothesis testing or confidence intervals?	Marco Brambilla/IT
10:00-10.30	Coffee break			
10:30-11:15	Diagnostic tests	Evaluation of a diagnostic test. I: Theory	Sensitivity, specificity, diagnostic accuracy, ROC, FROC, AFROC	Federica Zanca/BE
11.15-12.00		Evaluation of a diagnostic test. I: Worked examples	The practical session will focus on how to lead ROC analyses	Federica Zanca/BE
12:00-12:30			Question and Answer discussion on the morning lectures	All Faculty
12:30-14:00	Lunch break			
14.00-14.45	Applied Regression Analysis	ANOVA, ANCOVA. I Theory	Design of the experiment. One-Way ANOVA; Multiple-way ANOVA (Main effects; Factorial; Repeated Measures). Analysis of Variance Tables	Marco Brambilla/IT
14.45-15.30		ANOVA, ANCOVA. II Worked Examples	The practical session will focus on how to interpret the results of ANOVA/ANCOVA studies lead in the field of medical physics	Marco Brambilla/IT
15:30-15:50	Coffee break			
15:50-16:20	Applied Regression Analysis	Logistic Regression. I Theory	Logistic Function, Logistic Transformation; odds	Michael Sandborg/SE
16:20-17:10		Logistic Regression. II Worked examples	Analyzing data from visual grading experiments with logistic regression models	Michael Sandborg/SE
17.10-17.30			Question and Answer discussion on the afternoon lectures	All Faculty
20:00-23:00	Social dinner - participants + lecturers			

HELLENIC REPUBLIC
National and Kapodistrian University of Athens
EST. 1837

ΕΦΙΕ
Ένωση Φυσικών Ιατρικής Ελλάδος
Hellenic Association of Medical Physicists

ESMPE

Friday 14th October 2022				
	Session	**Title**	**Description**	**Lecturer**
09:00-09:45	Applied Regression Analysis	Multiple linear regression. I: Theory	Selecting the best regression equation; Strategy for selecting variables; Reliability with split samples. Coefficient of determination, Standardized regression coefficients	Renata Longo/IT
09:45 – 10:30	Applied Regression Analysis	Multiple linear regression. II Worked examples	The practical session will focus how on how to lead and interpret multiple regression studies in the field of medical physics.	Renata Longo/IT
10:30-10.50	Coffee break			
10:50-11:40	Survival Analysis	Survival Analysis. I. Theory	Relative Risks. Odds ratio. Survival curves with Kaplan Meyer; Log-rank Test; Cox Models	Peter Sharp/UK
11:40-12:10		Survival Analysis. II. Worked examples	The practical session will focus how on to build and interpret survival curves	Peter Sharp/UK
12:10-12:30			Question and Answer discussion on the morning lectures	All Faculty
12:30-14:00	Lunch break			
14:00-15.00	Statistical Methods in Radiomics	Workflow and Feature Categories	Image acquisition. Region segmentation. Features extraction. Histogram-based features (first order statistics). Textural features (second order statistics). Higher order statistical features	Dimitris Visvikis/FR
15.00-16:00		Properties of an ideal radiomics feature and methodology for evaluation	Test-retest data; Compare metrics through different analysis pipelines; quantify and rank statistical correlation between features; improved models	Mathieu Hatt/FR
16:00-16:20	Coffee break			
16:20-17:00	Statistical Methods in Radiomics	Challenges and Limitations	Guidelines to improve the reporting quality and the reproducibility of radiomics studies, as well as the statistical quality of radiomics analyses	Mathieu Hatt/FR
17:00-17.30			Question and Answer discussion on the afternoon lectures	All Faculty

HELLENIC REPUBLIC
National and Kapodistrian University of Athens
EST. 1837

ΕΦΙΕ
Ένωση Φυσικών Ιατρικής Ελλάδος
Hellenic Association of Medical Physicists

ESMPE

Saturday 15th October 2022				
	Session	**Title**	**Description**	**Lecturer**
09:00-9.45	Error and Uncertainty analysis in Radiation Dosimetry	Treatment of uncertainties in Radiation Dosimetry. I: Theory	The lecture will go through theory of error and uncertainty analysis: Type A and B uncertainty, Standard deviation of the mean, probability density functions	Brendan McClean/IE
09:45-10:30		Treatment of uncertainties in Radiation Dosimetry. II: worked examples	The practical session will focus on the assessment of the quality of a measurement or calculation; the quantitative comparison of results from different investigators; the critical analysis of measurement or calculation method	Brendan McClean/IE
10:30-10:50	Coffee break			
10:50-11:40	Agreement in Radiotherapy	Comparing doses	Comparing measured and calculated dose distributions: distance to agreement, dose difference and gamma evaluation	
11.40-12.30		Comparing Volumes	Determining volume differences by means of DICE, Hausdorff distance	
12:30-13:30	Final examination			

HELLENIC REPUBLIC
National and Kapodistrian University of Athens
EST. 1837

ΕΦΙΕ
Ένωση Φυσικών Ιατρικής Ελλάδος
Hellenic Association of Medical Physicists

Course language	English
Level	MPE
Registration fee* (2 main meals, 5 coffee breaks, 1 social dinner)	300 € 350 € (from 10th September 2022)
Reduced registration fee* • subsidized by EFOMP • first-come, first-served policy	150 € - for the first 15 attendees (max. 2 from one country) coming from the following European countries: Albania, Belarus, Bosnia & Herzegovina, Bulgaria, Croatia, Cyprus, Estonia, Greece, Hungary, Kosovo, Latvia, Lithuania, North Macedonia, Moldova, Montenegro, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Ukraine.
Maximum number of participants	80
Duration	13th-15th October 2022
Study load	15 hours of lectures and demonstrations
Venue	National and Kapodistrian University of Athens (NKUA), "Alkis Argyriadis" Amphitheatre Central building, Panepistimiou 30, Athens 106 79
GPS coordinates	https://goo.gl/maps/t7yPZdYAJZS5tGSw7
Accommodation	Individual
Information, programme at:	www.efomp.org
Registration	Electronic registration via EFOMP website
Registration period	1st April - 30th September 2022

* payment must be done in 14 days following the pre-registration, otherwise pre-registration will be cancelled and neither free place nor subsidized or ordinary fee can be granted for repeated registration

Follow ESMPE editions on
EFOMP website
EFOMP Twitter
EFOMP LinkedIn
EFOMP Facebook
EFOMP Instagram

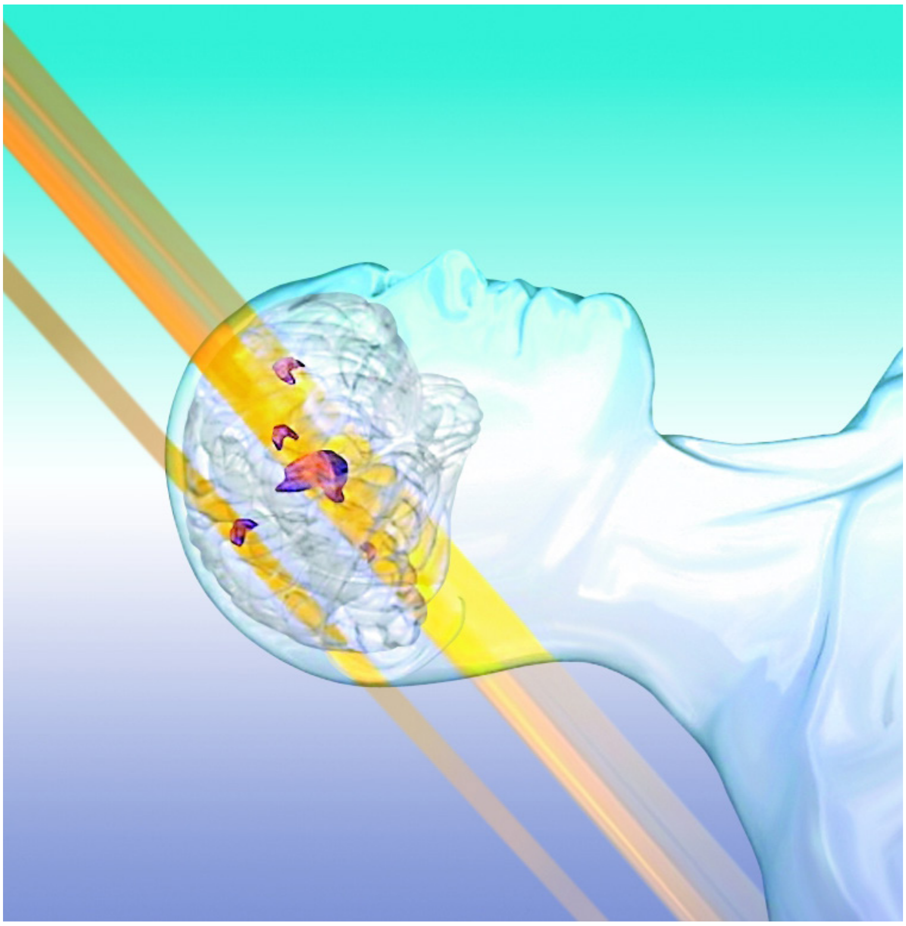
HELLENIC REPUBLIC
National and Kapodistrian University of Athens
EST. 1837

ΕΦΙΕ
Ένωση Φυσικών Ιατρικής Ελλάδος
Hellenic Association of Medical Physicists

EFOMP COMPANY MEMBER ARTICLE

Varian: HyperArc High-Definition Radiotherapy – Simplified Delivery of Radiosurgery for Brain Indications

varian
A Siemens Healthineers Company



In 2017, Varian's HyperArc® high-definition radiotherapy, an approach for delivering noncoplanar stereotactic radiosurgery (SRS) on Varian's TrueBeam® and Edge® systems, was first used to treat patients with multiple brain metastases. Using HyperArc, clinicians can deliver these treatments within the 15-20-minute time slot normally used for conventional radiotherapy treatments.

Noncoplanar SRS offers dosimetric advantages over conventional SRS in terms of target conformity and dose gradients. HyperArc simplifies and automates much of the planning and delivery of non-coplanar SRS, including single-isocentre treatment of multiple brain metastases.

UAB Radiation Oncology Team Compares Conventional VMAT with HyperArc

In late 2017, the University of Alabama at Birmingham (UAB) became the first centre in the U.S. to offer HyperArc high-definition radiotherapy for complex radiosurgical procedures. More recently, UAB researchers published a report on their transition from manual to automated planning and delivery with HyperArc, including the clinical, dosimetric, and quality assurance results associated with the two approaches. [1]

The UAB team reports that HyperArc plans are at least as good as conventional (i.e., manually generated) VMAT plans, while being easier and more efficient both to plan AND to deliver. In addition, the UAB team found that a less experienced planner can produce high-quality SRS plans using HyperArc, even for patients with more than ten targets.

"The use of a single-isocentre technique for multiple targets with no PTV margin did not compromise clinical outcomes, and one-year local control for treated targets remained congruent with historical series," the authors concluded.

Read more about the UAB study.

Expanded Intracranial Applications for HyperArc Therapy

Recent publications show that HyperArc can be a viable approach for whole-brain radiotherapy with hippocampal sparing, as well as other intracranial targets, including benign brain tumours such as acoustic neuromas and meningiomas.

Whole-Brain Radiotherapy with Hippocampal Sparing

A study in ten patients by Sprowls et al [3] evaluating HyperArc for WBRT with hippocampal sparing following RTOG 0933 dosimetric criteria concluded: "The primary advantages of WBRT with hippocampal sparing using HyperArc, compared to coplanar VMAT, are the gains in OAR sparing and reduced high dose volumes to the PTV, while still fully complying with RTOG dosimetric criteria."

HyperArc Plans for Skull-Based Meningiomas

In a study that evaluated HyperArc treatment planning for skull-based meningiomas, Snyder et al [4] report: "HyperArc can be beneficial both in treatment planning by using the SRS-NTO and in delivery efficiency through the decrease in monitor units and automated delivery." This team used a multicriteria optimization algorithm when developing their HyperArc treatment plans.

Bossart et al [5] looked at HyperArc plans for a spectrum of cancerous and benign brain lesions including ten base-of-skull meningiomas, acoustic neuromas, and pituitary adenomas. This team compared HyperArc plans with plans for patients previously treated using a GammaKnife® (GK) Perfexion system. They found that the HyperArc plans compared positively to GK plans when using a high-definition multileaf collimator (HDMLC).

"As more cancer centres around the world develop programmes for treating new indications or replace existing SRS techniques with HyperArc, we fully anticipate that studies will continue to accrue showing that HyperArc enables high-quality SRS treatment for brain tumours, multiple mets, and other types of intracranial targets, benign and cancerous," said Raymond Schulz, Director, Global Radiosurgery Programs in the Office of Medical Affairs at Varian.

Read more about the use of HyperArc for expanded intracranial indications.

References

[1] Popple RA, Brown MH, Thomas EM et al. Transition From Manual to Automated Planning and Delivery of Volumetric Modulated Arc Therapy Stereotactic Radiosurgery: Clinical, Dosimetric, and Quality Assurance Results, Practical Radiation Oncology, 11:2, March 2021, pages E163-E171.

[2] Li J, Ludmir EB, Wang Y et al. Stereotactic Radiosurgery versus Whole-brain Radiation Therapy for Patients with 4-15 Brain Metastases: A Phase III Randomized Controlled Trial. Int J Radiat Oncol Biol Phys. 2020; 108:3, S21 - S22.

[3] Sprowls, CJ, Shah AP, Kelly P et al. Whole brain radiotherapy with hippocampal sparing using Varian HyperArc. Med Dosim. 2021;46(3):264-268.

[4] Snyder KC, Cunningham J, Huang Y, et al. Dosimetric Evaluation of Fractionated Stereotactic Radiation Therapy for Skull Base Meningiomas Using HyperArc and Multicriteria Optimization. Adv Radiat Oncol. 2021;6(4):100663. Published 2021 Feb 6.

[5] Bossart E, Mellon EA, Monterroso I et al. Assessment of single isocenter linear accelerator radiosurgery for metastases and base of skull lesions. Phys Med. 2021 Jan;81:1-8.

Julie Jervis is a California-based science and technology writer. Her articles have appeared in magazines and websites around the world, covering a diverse range of medical and technology topics, and her book, 'The World Beneath Their Wings', follows the careers of leading women in aviation. In addition to editorial roles in the private sector, her background includes working for the World Health Organization, the International Maritime Satellite Organization, and NASA Ames Research Center.

EJMP ANNOUNCEMENT

Announcement of Galileo Galilei Award

Prof. Iuliana Toma-Dasu, Editor-in-Chief of Physica Medica, writes about the Galileo Galilei Award in Medical Physics, which is given annually to the best paper published in this journal in the previous year

In 2020, the prize was awarded to Simon Jolly et al., "Technical challenges for FLASH proton therapy", Phys. Med. 2020;78:71-82.

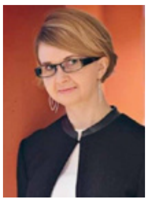
Physica Medica - the European Journal of Medical Physics, is happy to announce that the paper **"Data preparation for artificial intelligence in medical imaging: A comprehensive guide to open-access platforms and tools"** by Oliver Diaz, Kaisar Kushibar, Richard Osuala, Akis Linardos, Lidia Garrucho, Laura Igual, Petia Radeva, Fred Prior, Polyxeni Gkontra, and Karim Lekadir, published in Physica Medica, Volume 83, March 2021, Pages 25-37, DOI: https://doi.org/10.1016/j.ejmp.2021.02.007, has been elected the best paper published in the journal in the year 2021.

In this paper the authors focused on essential aspects for applying AI-based solutions in medical imaging. They elaborated a comprehensive guide to select the computational tools and platforms for preparing medical images before applying AI algorithms. The key steps that were included in the guideline cover the deidentification, curation and storage of data as well as the annotations tools. The structured summary provided in the paper allows the readers of Physica Medica to navigate easier through the many available tools and platforms to prepare data prior to developing or applying AI algorithms and thus to make informed choices – a key step towards successfully making use the AI-based solutions in medical imaging.

The selection of the best paper was performed on the basis of citations and downloads together with assessment by the Editors, Associate Editors and members of the Editorial Board.

We congratulate the authors of this paper, as the winners of the Galileo Galilei Award 2021.

The Galileo Galilei Award, consisting of a medal and a certificate, will be presented to the authors during the ECMP 2022 Conference in Dublin, Ireland, 17-20 August 2022 (https://www.ecmp2022.org/).



Prof. Iuliana Toma-Dasu
Physica Medica Editor-in-Chief

Physica Medica: European Journal of Medical Physics (EJMP) is published by Elsevier B.V. for the European Federation of Organisations for Medical Physics (EFOMP) and Associazione Italiana di Fisica Medica e Sanitaria (AIFM). EJMP is the official journal of the Irish Association of Physicists in Medicine, the Société Française de Physique Médicale, the Czech Association of Medical Physicists, the Hellenic Association of Medical Physicists. EJMP is also a scientific journal of the International Organization for Medical Physics (IOMP).

WHAT MEDICAL PHYSICISTS DO IN THEIR FREE TIME

Acrylic Painting

David Lurie, from Aberdeen in Scotland, writes about his most recent hobby

I was never very good at art when I was at school, though I did quite enjoy the graphical design elements of the subject. In any case, I was only able to take art for one year at secondary school, before concentrating on more "academic" subjects. As a teenager, I did develop a keen interest in photography (which continues to this day), through which I guess I developed an eye for composition. However, until recently, I never contemplated using a pencil or a paintbrush in creative mode.

Fast forward several decades. Late in 2020, my wife and I started watching a TV programme called "Landscape Artist of the Year", where groups of artists (amateur and professional) would be taken to a location and given 4 hours to create their impression of the landscape, using the media of their choice; each week, one artist out of eight was chosen to go forward in the competition. I found it very interesting to see the artistic process, from initial sketch to finished piece, and to observe the different approaches taken by the artists. This got me wondering, could I have a go at drawing and painting? So I gave it a try!

First, I bought a book about drawing for beginners, as well as a selection of pencils and a sketchpad. Then I tried sketching a few things around the house, including the mortar and pestle shown here. Although I realised that my sketches would not bear too much artistic scrutiny, nevertheless, I was quite pleased with the initial results (and somewhat amazed that I was able to produce recognisable drawings).

Mortar and Pestle, pencil on paper, © David Lurie, 2021

Next I was keen to try something colourful, so I took the plunge and got hold of some acrylic paints, along with brushes and a couple of instructional books. I also found some excellent "how to paint" websites and YouTube videos, which were very helpful in getting me started. I found the online Will Kemp Art School to be particularly good and I have followed several of the video tutorials there. These helped me to get to grips with the essential painting techniques, including painting a ground layer (a background colour on the whole canvas), as well as how to create different colours by mixing paints on the palette and how to blend colours on the canvas. Armed with these basics, and working from a photograph I had taken during a walk in the snow near our home, in January 2021 I produced my first acrylic painting, "Sunnyside Walk".
Up to now, all my original paintings have been based on photographs I have taken (and as I have over 50,000 in my photo library, there are plenty to choose from!). My workflow tends to be that I choose a scene from my photo library, then follow an online tutorial that is closest to it in terms of content, to get me up to speed with the techniques most appropriate for the type of scene. After that, I tackled my own painting, taking inspiration from my own photograph. Below you can see one of my recent paintings, along with my photo of the scene.

I am finding painting to be a very enjoyable and relaxing hobby. I am hoping that before too long I will be able to join a local art class, to engage with other artists and to continue my artistic journey; there is certainly a lot to learn!

Sunnyside Walk, acrylic on paper, 30x21 cm, © David Lurie, 2021

Left: Venetian Café, acrylic on canvas board, 30x30 cm, © David Lurie 2021; Right: the original photo

David Lurie is an Emeritus Professor at the University of Aberdeen, UK. Prior to his retirement in October 2021, he held a Chair in Biomedical Physics, having researched and taught MRI Physics at the University of Aberdeen since 1983. Prof. Lurie was awarded the Academic Gold Medal of IPEM in 2017 and was named a Senior Fellow of ISMRM in 2021. He was Chair of the Communications and Publications Committee of EFOMP from January 2020 until February 2022.

EFOMP COMPANY MEMBER ARTICLE

RTsafe Remote Dosimetry Services: Advanced Dosimetry Is a Simple Implementation

Radiation medicine is advancing, and technological innovations pave the way to more efficient and safer treatments. Stereotactic radiosurgery (SRS) is at the forefront of this technological leap, and contemporary SRS applications continuously gain ground against conventional methodologies.

The outcome of SRS advancement is better treatment of brain lesions and a better quality of life for patients. Efficient application of SRS, however, has higher technological requirements compared to conventional radiotherapy. Systems and procedures that are routinely considered sufficient for standard radiotherapy techniques cannot be applied to SRS. The complex nature of the SRS treatment process demands a commitment to the highest levels of accuracy and precision.

While more complex treatments usually translate to more targeted treatments, at the same time, they require more complex QA. This fact has highlighted the necessity of independent dosimetry audits, as an effective way to verify whether the quality of dosimetry practices at a radiotherapy centre are adequate to achieve treatment objectives and minimise the possibility of unintended exposures. Audits can also provide support and confidence for the introduction of new and complex techniques. Although international recommendations regarding the benefits of external verification of the accuracy and reliability of a radiotherapy practice exist, the current access of several countries' radiotherapy centres across the world to audit opportunities is not sufficient.

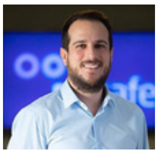
RTsafe, which envisages more efficient radiotherapy worldwide, has developed a novel approach to End-to-End QA testing, focused on SRS modalities. Under the umbrella of the PseudoPatient® technology, a set of remote dosimetry services have been introduced to support radiotherapy centres in promoting best practise and assuring high quality SRS treatments by outsourcing the routine quality control programme of their radiation oncology QMS using a cost-effective solution.

Combining Prime phantom with point, 2D, and 3D remote dosimetry services provides confidence and reliability for challenging SRS applications.

RTsafe's remote dosimetry services provide point (OSLs, TLDs), 2D (EBT3 films) and 3D (polymer gel) dosimetric and geometric accuracy through independent dose measurements, assuring traceability to a secondary standard dosimetry laboratory. It is set up to evaluate the whole treatment chain, including clinical and technical aspects, by reviewing at the same time the procedures and protocols of the radiotherapy centre. At the end, the user receives a comprehensive dosimetric report based on Level 2 reporting rules recommendations of ICRU 91 and tolerance values of TG-142. Results include comparisons between measurements and Treatment Planning System (TPS) calculations in terms of: 1D dose profiles and 1D gamma index, 2D isolines and 2D gamma index maps, 3D gamma index passing rates, Dose Volume Histograms (DVHs), DVHs metrics, dosimetric indices and spatial offsets, for each target and/or Organ-at-Risk (OAR), defined by the end-user at the planning stage.

For more information on RTsafe remote dosimetry services and its PseudoPatient® technology, please visit rt-safe.com.

Kyveli Zourari is a medical physicist and a product manager. Kyveli is focused on developing a comprehensive dosimetry audit programme dedicated to SRS and SBRT applications. Prior to RTsafe, she gained experience in computational and experimental dosimetry as well as dosimetry audits in radiotherapy as a scientific associate at the Medical Physics Laboratory of the Medical School, National and Kapodistrian University of Athens, and medical physics at the Greek Atomic Energy Commission. She has a PhD in Medical Physics from the Medical School of the University of Athens.



Emmanouil Zoros is a medical physicist and a product manager. Emmanouil is responsible for product management, data analysis, and film dosimetry at RTsafe. He has a Diploma in Applied Mathematics & Physics from the National Technical University of Athens and a Master of Science in Medical Physics from the National and Kapodistrian University of Athens. His research interests focus on radiation therapy with an emphasis on quality assurance in stereotactic radiosurgery and experimental and computational dosimetry using Monte Carlo simulation techniques.

IAEA Marie Skłodowska-Curie Fellowship Programme

*Together for more **women** in nuclear*

Scholarships for Master’s degrees in nuclear related fields

Internships facilitated by IAEA

www.iaea.org/mscfp

IAEA
International Atomic Energy Agency
Atoms for Peace and Development

MEDICAL PHYSICS THESIS

Myocardial Perfusion Imaging (MPI) with Positron Emission Tomography (PET)

Reetta Siekkinen, MSc, is part of a team that compare the performance of a digital PET/CT system (DMI) to an analogue PET/CT system (Discovery 690, D690, GE Healthcare, Milwaukee, US) in terms of count-rate performance, reconstruction, and system-to-system harmonisation. She obtained her Master's degree in Medical Physics from the University of Turku in 2018. In this article, she provides a summary of her thesis.

Myocardial perfusion imaging (MPI) with Positron Emission Tomography (PET) allows diagnostic testing of patients with suspected coronary artery disease. MPI allows quantifying myocardial blood flow (MBF) which helps to estimate the presence of myocardial ischemia when short-lived tracers such as 15O-H2O are used. Therefore, accurate MBF quantification is essential in order to decrease the possibility of false patient interpretations. However, varying count-rates during MPI studies cause challenges for the PET system and its reconstruction capabilities and the novel reconstruction procedures need careful optimization to maintain the diagnostic accuracy in O-15-H2O MPI and quantification of MBF.

In recent years, PET systems and their reconstruction techniques have evolved and resulted in the introduction of digital PET/CT systems such as Discovery MI from GE Healthcare (DMI) and Bayesian-penalized reconstruction method (Q.Clear). Previously, the count-rate capabilities of several PET/CT systems have been under investigation in MPI studies as the ideal operating range of the system has to be evaluated for studies with high count-rate conditions. However, the investigations have been mainly performed with 82-Rb radioactive tracers with static phantoms [1, 2]. Therefore, there is a need for digital and analog PET/CT system comparison in 15O-H2O MPI studies with dynamic phantoms.

In addition, the reconstruction techniques have mainly been studied in static 18F-FDG oncologic or 13N-NH3 perfusion studies [3, 4]. Therefore, studies with recently introduced reconstruction algorithms should be conducted in 15O-H2O studies with the digital PET/CT system. However, such investigations require reference test objects that simulate MBF in order to perform system and method validation in a reproducible manner. In the paper by Gabrani-Juma et al., a perfusion phantom that simulates realistic acquisition conditions in MPI was introduced [5]. This allows performing an assessment of the accuracy and reproducibility of MBF in MPI studies between several systems, with the potential for further harmonisation attempts.

Our group is currently evaluating a digital PET/CT system (DMI) in comparison with an analogue PET/CT system (Discovery 690, D690, GE Healthcare, Milwaukee, US) in terms of system count-rate performance, reconstruction, and system-to-system harmonization. The goal of these studies is to achieve accurate system-to-system MBF quantification in MPI studies.

We have assessed the effect of count-rate performance on flow quantification over various injected activities using the perfusion phantom. The study was performed on the digital 4-ring Discovery MI (DMI-20) and analogue Discovery 690 (D690) PET/CT systems, using 325-1257 MBq of 15O-H2O. PET performance and flow quantification accuracy were assessed in terms of count-rates and flow values. Figure 1 shows the flow value errors on DMI and D690. The measurement with the highest prompt rate of 12.8 Mcps produced a flow quantification error of -12% on DMI. On D690, the highest prompt rate of 6.85 Mcps showed an error of -7% [6].

The reconstruction methods were evaluated with the DMI over several reconstruction techniques using the perfusion phantom. Figure 2 shows the image-derived flow value error with respect to the phantom-derived flow value error. The error was smaller than -7.6% on the DMI for all reconstruction techniques [7].

In conclusion, DMI and D690 preserved accurate flow quantification over all injected activities with similar flow quantification errors on both systems. In addition, all the reconstruction algorithms evaluated in the phantom study can be applied in MPI studies for accurate flow quantification.

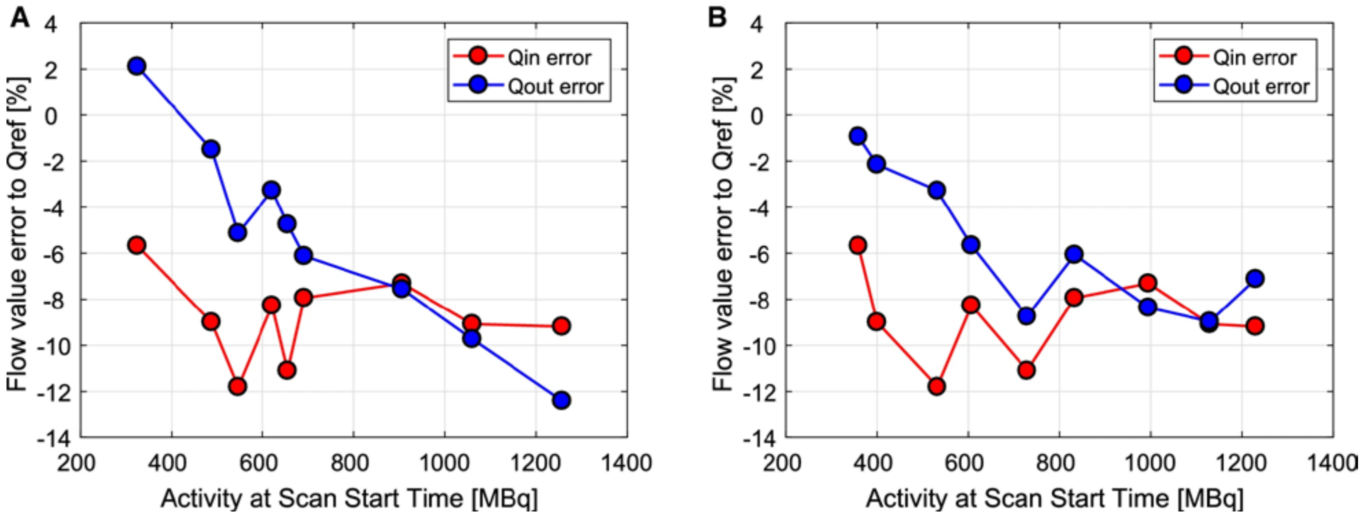


Figure 1: Flow value errors of the digital PET/CT system Discovery MI (DMI) and analog PET/CT system Discovery 690 (D690). The flow value errors were smaller than -12 % and -7 % on DMI and D690, respectively [6].

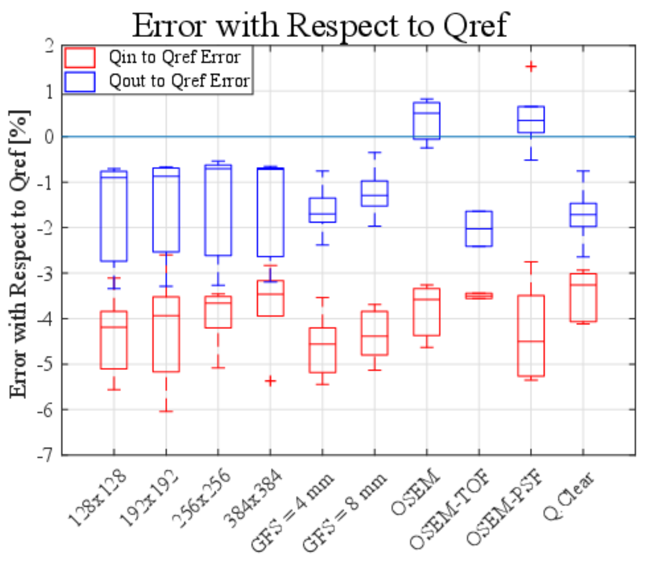


Figure 2: Relative errors of image-derived flow values with respect to phantom-derived flow values on the digital PET/CT system Discovery MI. The errors were smaller than -7 % over all reconstructions applied [7].

References

1. Renaud JM, Yip K, Guimond J, et al (2017) Characterization of 3-Dimensional PET Systems for Accurate Quantification of Myocardial Blood Flow. J Nucl Med 58:103–109. https://doi.org/10.2967/jnumed.116.174565

2. van Dijk JD, Jager PL, van Osch JAC, van Dalen JA (2017) Variation in Maximum Counting Rates During Myocardial Blood Flow Quantification Using 82 Rb PET. J Nucl Med 58:519–520. https://doi.org/10.2967/jnumed.116.188086

3. te Riet J, Rijnsdorp S, Roef MJ, Arends AJ (2019) Evaluation of a Bayesian penalized likelihood reconstruction algorithm for low-count clinical 18F-FDG PET/CT. EJNMMI Phys 6:. https://doi.org/10.1186/s40658-019-0262-y

4. O' Doherty J, McGowan DR, Abreu C, Barrington S (2017) Effect of Bayesian-penalized likelihood reconstruction on [13N]-NH3 rest perfusion quantification. J Nucl Cardiol 24:282–290. https://doi.org/10.1007/s12350-016-0554-8

5. Gabrani−Juma H, Clarkin OJ, Pourmoghaddas A, et al Validation of a Multimodality Flow Phantom and Its Application for Assessment of Dynamic SPECT and PET Technologies. IEEE Trans Med Imaging. 2017 36:132-141. https://doi.org/10.1109/TMI.2016.2599779

6. Siekkinen R, Kirjavainen AK, Koskensalo K, et al (2021) Assessment of a digital and an analog PET/CT system for accurate myocardial perfusion imaging with a flow phantom. J Nucl Cardiol. https://doi.org/10.1007/s12350-021-02631-9

7. Siekkinen R, Teuho J, Smith NAS, et al (2020) Study of the Effect of Reconstruction Parameters for Myocardial Perfusion Imaging in PET With a Novel Flow Phantom. Front Phys 8:1–10. https://doi.org/10.3389/fphy.2020.00148

Reetta Siekkinen is a specializing medical physicist at Turku University Hospital, Turku, Finland and a PhD candidate at the Turku PET Centre, University of Turku and Turku University Hospital, Turku, Finland. Her research concentrates on evaluating the visual and quantitative accuracy of 15O-H2O myocardial perfusion imaging with the digital PET/CT systems. She obtained her Master's degree in Medical Physics from the University of Turku in 2018.

EFOMP COMPANY MEMBER ARTICLE

Out of the Gray (Gy) Podcast: Filling the Gap

Just over one year ago, Standard Imaging launched a new podcast: Out of the Gray (Gy), hosted by Traci Conley. What started as a platform to share the stories and experiences of the community has grown into the largest Radiation Therapy podcast in the world with almost 50 episodes featuring guests from across the globe and all areas of Medical Physics, Radiation Therapy, and Radiation Oncology.

The podcast not only allows professionals to share their experiences and insight into technical subjects, but also provides a forum for them to delve into topics ranging from technology, philanthropy, and communication skills to burnout, equity, research, advocacy, and leadership.

"Originally, I was interested in the podcast because I felt that my little niche corner of medical physics expertise might be useful or interesting for a few listeners in the audience, but my attitude has changed and changed dramatically since starting to collaborate with Traci," said Matthew Goss, MS, DABR, Senior Medical Physicist at Allegheny Health Network. "While I did talk about some specific and technical things in my first episode, it organically shifted towards volunteerism, professional development, trends in the field, and soft skills, observations, and ideas for general improvement."

"Talking with Traci on Out of the Gray about gender equity and parental leave in medical physics was half advocacy work and half personal therapy session," said Kelly Paradis, Ph.D., DABR, Associate Professor, Department of Radiation Oncology at Michigan Medicine. "Thanks so much to Traci and Standard Imaging for getting the conversation going on important issues in the world of Radiation Oncology."

Since its inception, the podcast has featured more than 50 guests including many joint episodes and a video podcast episode. It's a one-of-a-kind platform that provides a space to share about issues and experiences that influence all areas of the field and impact listeners and the radiotherapy industry.

"It is really nice to have such a forum where your research can be discussed without the limitation of eight-minute intensive talks and two minutes of questions," said Christian Jamtheim Gustafsson, Ph.D., Medical Physicist Expert, AI Researcher, and Project Manager at Region Skåne.

"I had the honour of being on Out of the Gray to discuss what it's like to be a veterinary radiation therapist and all the similarities and differences between the two [human and veterinary]," said Shivani Narayanan, Radiation Therapist and Social Media Manager at PetCure Oncology. "I had a wonderful time speaking to Traci, who made being on the podcast super comfortable and fun."

"I now feel very strongly that Out of the Gray has touched on something meaningful, working to fill a gap in our field that we didn't necessarily know we had; we tend to focus very strongly on the technical education aspect, and while that's important (and discussed on the podcast) there is a growing desire for practitioners of our craft to develop and hone skills involving leadership, outreach and collaboration," said Goss. "This has become a forum for those efforts, and I'm humbled and excited to be a part of that."

Standard Imaging is honoured to share the inspiring stories of many passionate people in our industry. A special thank you to all our guests, listeners, and our host. Listen, download, and subscribe to Out of the Gray (Gy) on Spotify, Apple Podcast, Amazon Music, or Google Podcasts.

Standard Imaging is a leading manufacturer of QA instruments for radiation-based treatments. We've dedicated more than 30 years to developing solutions that save you time while maintaining accurate and precise results. It's your time. Be precise. For more information contact us here!

Ashley Reis is the Marketing Specialist at Standard Imaging, Inc. and has been with the company since 2020.

MEDICAL PHYSICS THESIS

Polymer Dose Gels for Medical Application

Evelina Jaselske recently graduated with a PhD in material sciences at Kaunas University of Technology (KTU), Faculty of Mathematics and Natural Sciences, Department of Physics. Her doctoral dissertation "Formation and functionalization of polymer dose gels using photon and electron beams" was successfully defended at the end of 2021.

In this article she provides a summary of her thesis.

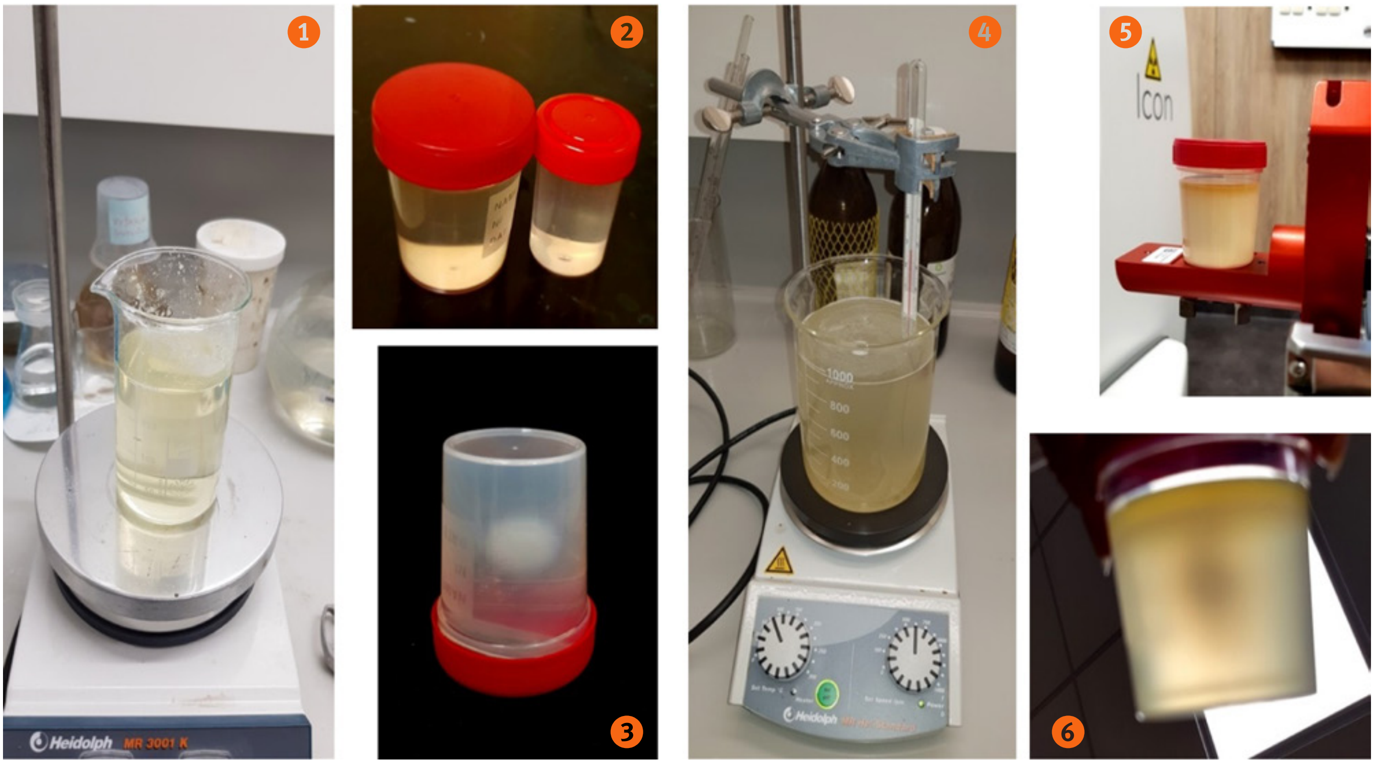


Fig 1: $nPAG^F$ dose gel manufacturing process (1), prepared samples for irradiation (2) and irradiated sample (3); $VIPAR^{nd}$ dose gel manufacturing process (4), preparing for irradiation (5) and irradiated sample (6).

The aim of this study was to develop, analyze and adapt dose gels for small-field high dose radiation treatments (microdosimetry), in terms of a radiation based 3D printed dosimetry concept used for individual treatment plan verification in radiotherapy and radiosurgery.

In this work, many materials were characterised in terms of medical read-out methods such as Raman spectroscopy, X-ray CT, Refractometry, UV-VIS, MR imaging, film dosimetry, etc. in order to explore dosimetric gels features.

Finally, regarding the level of expertise gathered by the scientists of KTU research group of "Radiation and Medical Physics" in this field, two types – nPAG and VIPAR – of dose gels (Fig. 1) were selected for further modification. The decision was based on the fact that they can be produced under normal ambient conditions, the polymerization in both types of gels proceeds via cross-linker BIS acrylamide and both types of gels are sensitive enough to radiation, to be suitable for micro-dosimetry applications [1–3].

Looking for the improvement of polymer sensitivity to ionizing radiation and creating free-standing dose gel structures, which may record polymerized target volume, both initial gels were modified by adjusting their chemical content. Additionally, "free standing polymerization" technique, based on the separation of irradiated and non-irradiated volumes (Fig. 2) with the purpose of comparing theoretically modulated and experimentally irradiated volumetric shapes, was proposed [4, 5].

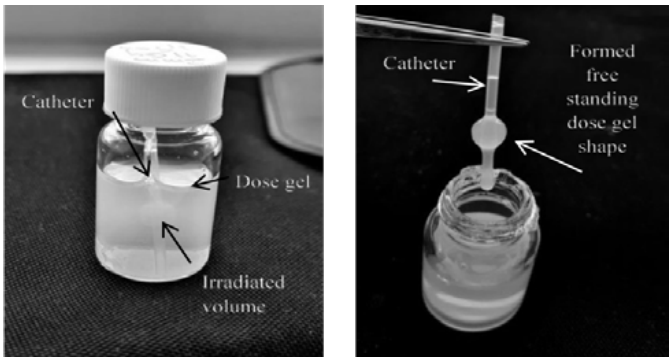


Fig 2: A method for forming free-standing nPAG dose gel/radiation-induced 3D printing

Finally we managed to manufacture and characterize dose gels useful for medical dosimetry applications in broad (0–40 Gy) absorbed dose regions. The performed research has shown that both types of dose gels (nPAG^F and VIPARnd) were sensitive to the irradiation doses up to 10 Gy, with a linear dose dependency. The dose sensitivity, evaluated using UV-VIS spectrophotometry of nPAG^F gel irradiated with 6 MeV electrons was 0.0667 Gy^{-1}, and 0.0516 Gy^{-1} for gamma photons (^{60}Co source). On the other hand, sensitivity of VIPARnd gel irradiated with gamma photons was lower, i.e, 0.0357 Gy^{-1}. However, it should be pointed out that only this gel indicated a detectable sensitivity of 0.0075 Gy^{-1} to gamma photon doses up to 40 Gy. The Raman spectroscopy results indicated a higher and more intensive polymerization of nPAG^F when irradiated with electron beams due to the direct ionization induced processes in gels, compared to the photon irradiation.

In order to evaluate the sensitivity of dose evaluation method in irradiated gels, two evaluation methods, i.e., UV-VIS spectrophotometry and Magnetic Resonance Imaging, were compared. It has been found that MRI evaluated dose sensitivity was dependent on the scanning parameters, with the highest values obtained for the longest echo time (TE) of 145 ms. The estimated R2 related sensitivity values of gels irradiated with gamma photons in Gamma knife facility in the low dose (up to 10 Gy) region were the following: 0.081 Gy^{-1s-1} and 0.121 Gy^{-1}s^{-1} for nPAG^F and VIPARnd, respectively. VIPARnd gels were as well sensitive enough in the high dose region (10 Gy to 40 Gy), indicating 0.035 Gy^{-1}s^{-1} sensitivity, which is a very promising result for dosimetry applications in high dose Gama knife radiosurgery.

The applicability of dose gels for individualized patient dosimetry purposes in brachytherapy (Fig. 3) and gamma knife surgery (Fig. 4) has been assessed and implemented during the pilot projects. Both gels have been shown to be good in the low dose region (0–10 Gy), while VIPARnd gel performed better in the high dose region (10–40 Gy), indicating 0.45 Gy dose resolution and at least 0.2 mm spatial resolution (MRI evaluation). The discrepancies between the treatment planning system (TPS) calculated dose values and measurements were lower than 3.0%, indicating a potential applicability of VIPARnd gel dosimetry in Gamma knife radiosurgery.

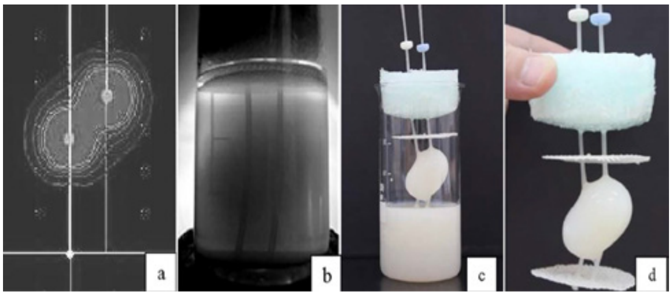


Fig 3: (a) Comparison of brachytherapy treatment planning system proposed treatment volume (2D dose distribution map, transverse view from the TPS) with radiation produced polymerized free standing dose gel volume, (b) image of just irradiated gel filled beaker with a polymerized part in gelatin matrix, (c) separation of polymerized gel part from the gelatin, (d) image of radiation produced 3D free standing polymerized gel shape; notice that the scales are different

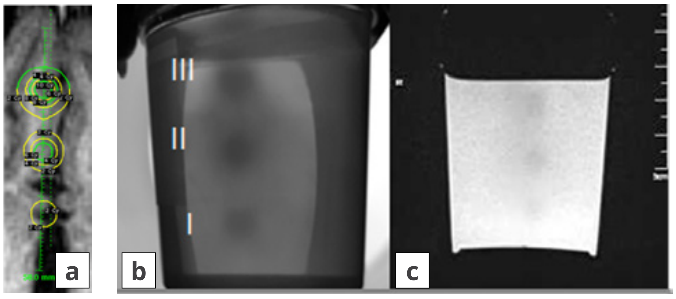


Fig. 4: Application in Gamma knife: (a) distribution of isodoses in three treatment isocenters simulated by the Gammaplan treatment planning system for multiple shot geometry; (b) nPAG^F gel-filled vial after 3-shot irradiation with clearly seen three polymerized 3D shapes at the selected isocenters, indicated as I, II, and III, (3) corresponding MRI DICOM view of the same sample

The main doctoral dissertation results were published in 11 scientific publications: 4 papers related to the dissertation topic are published in journals included in Clarivate Analytics Web of Science database, 5 papers are published in conference proceedings that are included in CAWoS database without impact factor; 2 articles and 2 conference proceedings papers included in the CAWoS database are out of the scope of this dissertation. The main results of the performed research were presented in 15 international and national conferences.

Acknowledgements:

The author was participating in two related research projects supported by the Lithuanian Research Council: P-MIP-17-223, "Development of 3D phantom for individualised dosimetry in radiotherapy," 2017–2019; and Joint LUHS/KTU project under the programme Healthy ageing. P-SEN-20-10 "Development of neurosurgical treatment options for Parkinson`s disease applying molecular markers, gamma knife technology and individualized dosimetry", 2020–2022 and one Association of "Santakos slėnis" joint KTU LUHS project PP34/2101: "Implementation of dosimetry methods in gamma knife radiosurgery for the treatment of cerebral arteriovenous malformations after endovascular embolization", 2021.

1. ADLIENE, D., URBONAVICIUS, B.G., LAURIKAITIENE, J., PUISO, J. New application of polymer gels in medical radiation dosimetry: Plasmonic sensors. *Rad. Phys. Chem. Vol (168),* 2020, https://doi.org/10.1016/j.radphyschem.2019.108609
2. RAHMAN, W.N., WONG, C.J., YAGI, N., DAVIDSON, R., GESO,M. Dosimetry and its enhancement using gold nanoparticles in synchrotron based microbeam and stereotactic radiosurgery. *Conference on Medical Applications of Synchrotron Radiation Proceedings. Vol (1266),* 2010, p.107-110. https://doi.org/10.1063/1.3478186
3. CEBERG, S. 3D Verification of Dynamic and Breathing Adapted Radiotherapy using Polymer Gel Dosimetry. *Monography,* 2010, ISBN: 978-91-7473-041-8;
4. HIROKI, A., YAMASHITA, S., SATO, Y. et al. New polymer gel dosimeters consisting of less toxic monomers with radiation-crosslinked gel matrix. *J. Phys. Conf. Ser. 444* 012028, 2013, https://doi.org/10.1088/1742-6596/444/1/012028
5. VANOSSI, E., GAMBARINI, G., CARRARA, M., MARIANI, M. Polymer gels for in phantom dose imaging in radiotherapy. Applied radiation and Isotopes. Vol (68), 2010, p. 772–775. https://doi.org/10.1088/1742-6596/444/1/012028

Evelina Jaselske is a medical physicist-expert at the radiotherapy and neurosurgery departments of HLUHS Kauno klinos. She recently graduated with a PhD in material sciences at KTU, funded by the Lithuanian Research Council. She is working on the development of new free-standing dose gels for individual patient dosimetry purposes in radiotherapy and radiosurgery. Her main experience is in dose planning, dose verification, and dose reconstruction issues in radiotherapy and radiosurgery. She is also a lecturer at Kaunas College and Kaunas University of Technology and gives lectures for students in the field of biomedical sciences. She participates in scientific projects related to medical physics issues in medicine.

EFOMP COMPANY MEMBER ARTICLE

Sun Nuclear: Improving Accuracy & Efficiency in Dosimetry Data Collection for Commissioning

SUN NUCLEAR corporation

Commissioning and beam scanning are foundational to a strong radiation therapy programme. When designing and developing SunSCAN™ 3D, Sun Nuclear's next-generation cylindrical water scanning system introduced at ESTRO in May, we considered many factors with a focus on workflow efficiencies, ease of use, and hyper-accuracy.

SunSCAN™ 3D: The Next-Generation Cylindrical Water Scanning System from Sun Nuclear

Hyper-Accuracy for Commissioning & Annuals

As stereotactic demands continue to increase, it's important to have a water tank that provides hyper accurate commissioning data to ensure safe and effective delivery of these highly precise treatments. With SunSCAN 3D, a redesigned electrometer with dual-bias control delivers enhanced resolution, with signal-to-noise ratio improved by as much as a factor of two. Plus, a Median Filter, as described in AAPM TG-155, provides glassy smooth scans while maintaining data integrity. **Hyper-accurate scanning of 0.1 mm accuracy throughout the tank, 0.05 mm reproducibility, and 0.02 mm resolution** has been verified by a Coordinate Measuring Machine (CMM) capable of 5-micron accuracy during the development and manufacturing processes.

The unique cylindrical design, carried over from our legacy 3D SCANNER™ water tank, eliminates the need for tank shifts, which can take time and compromise scanning setup. Square 3D water tanks cannot measure a full 40 cm x 40 cm field at 30 cm depth and 100 cm SSD unless the user shifts the water tank twice, taking two measurements of two "halves" of the beam at different tank locations. This technique is time intensive and can introduce errors that compromise data quality.

The cylindrical shape of the SunSCAN 3D enables the most efficient scanning ranges. A 65 cm scan range is possible without a shift, allowing a 40 cm x 40 cm measurement at 30 cm depth and 100 cm SSD, without the inconvenience and potential errors involved in shifting the water tank.

SunSCAN 3D also offers consistent detector orientation, since the smallest part of the detector always measures the beam edge, minimizing stem and cable effects and water movement, providing the sharpest penumbra.

Efficiency & Ease of Use

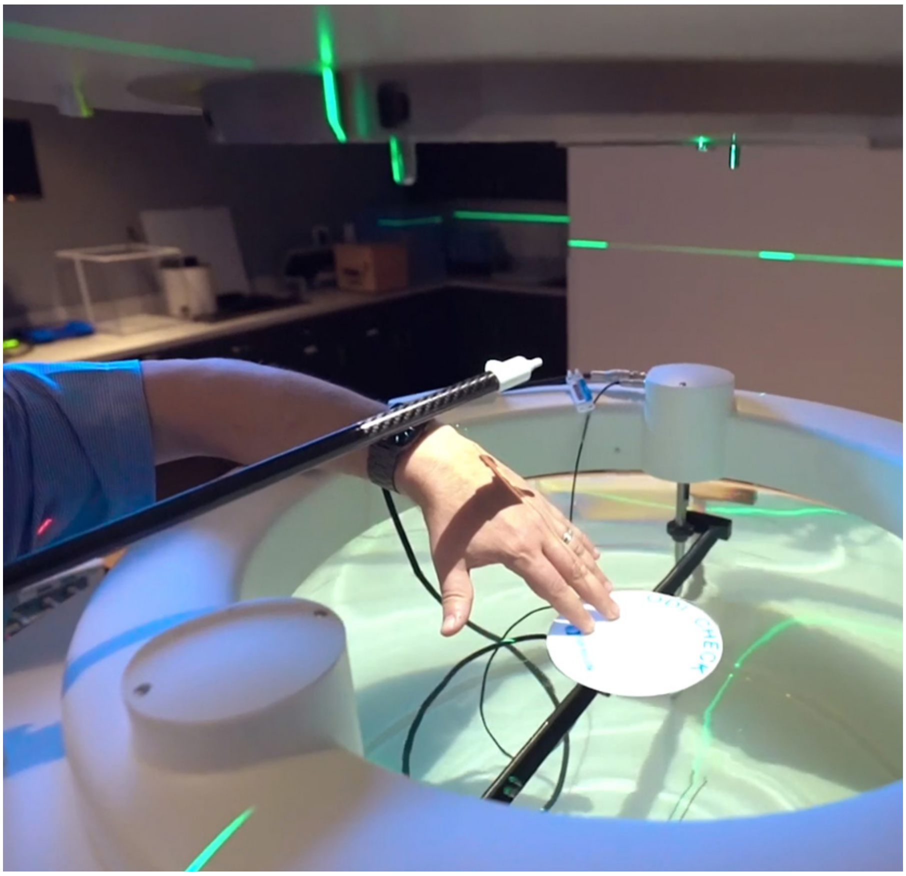
Overly complex water scanning systems present challenges for busy medical physics teams. Some tanks require an individual with specialized expertise to use them. We wanted to create a system that can be used by anyone on your team – from seasoned department leaders to newer medical physicists in the field.

With SunSCAN 3D, you can set up your tank in a third of the time it takes with other water tanks. Simply roll the tank in place, start the filling process (~7 minutes), and run the faster, more accurate AutoSetup™ routine (~7 minutes). Newly redesigned with half the footprint, the SunSCAN Reservoir includes a dripless connector to the tank and a self-enclosed hose to avoid spills.

At three widely set points we measure the water surface to quantify tank levelness, performing an automated physical and true leveling of the water tank by the motorized Automatic Leveling Platform. Using profile measurements, fine adjustments in the X and Y direction align the centre of the SunSCAN 3D with the beam centre. Finally, AutoSetup aligns ring centre and angular orientation to the collimator axis.

Once tank setup is complete, the new, intuitive SunDOSE™ software helps to complete commissioning, queue creation and data management with reduced clicks and enhanced functionalities for an even easier use and workflow. With visualization of all processing layers, users can see the processing applied on each scan in the queue, and batch process groups of similar scan types with one click. Processing layers can be rolled back at any time without losing raw data, for easy correction of over-processing.

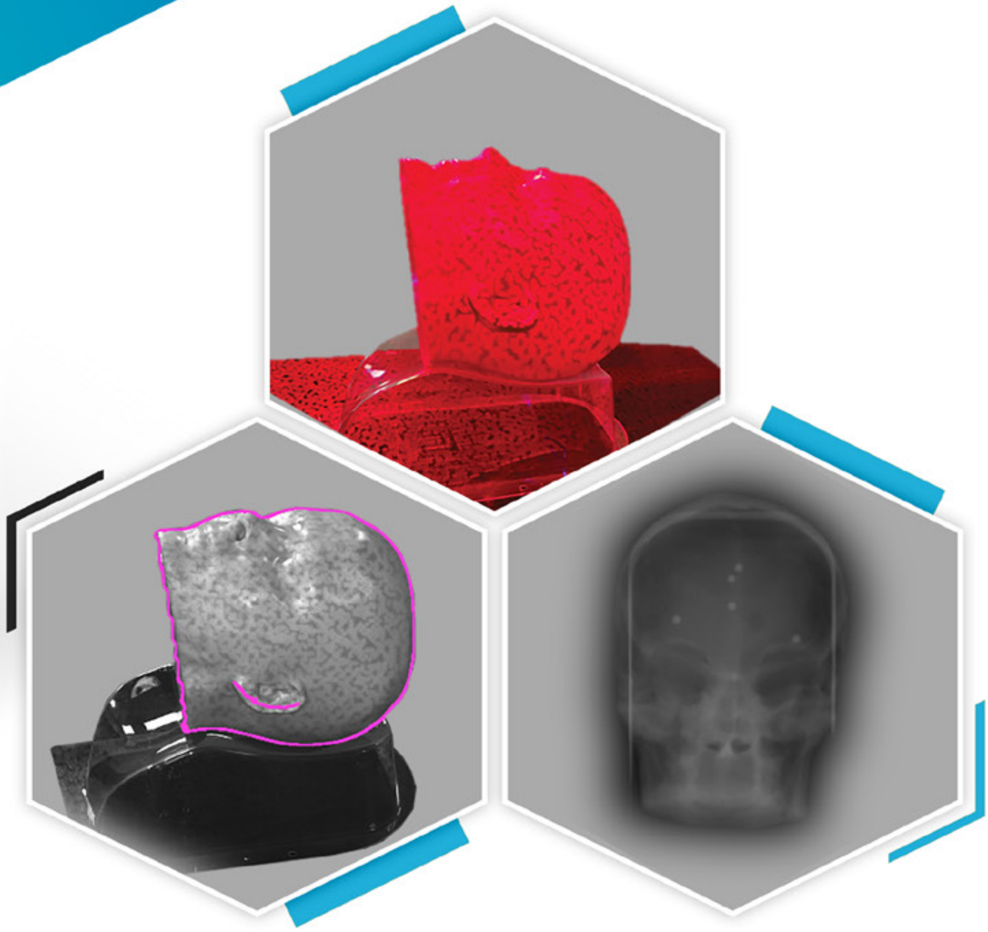
For more information on the SunSCAN 3D system or for a demo request, visit sunnuclear.com.



True leveling is achieved through a proven automatic leveling routine, perfected and optimized over 10+ years. A physically level tank makes leveling confirmation and QA easy.

Julia Kirchhefer, M.Sc. Medical Physics
Julia Kirchhefer is a Medical Applications Physicist at Sun Nuclear, the leader in Quality Management solutions for Radiation Therapy and Diagnostic Imaging. Julia works closely with customers in Germany, Austria, and Switzerland to help guide them through clinical application of Sun Nuclear's solutions, including the new SunSCAN 3D system. Before joining Sun Nuclear, Julia obtained a bachelor's and a master's degree in Medical Physics at the Technical University of Dortmund in collaboration with the Institute for Radiation Protection and Medical Physics at the clinic in Dortmund.

Jesus Fernandez, Bachelor of Engineering
Jesus Fernandez is an Applications Engineer for Sun Nuclear, the leader in Quality Management solutions for Radiation Therapy and Diagnostic Imaging. Jesus has 16+ years' experience installing dosimetry products and training customers worldwide, including installing the first legacy 3D SCANNER tank in 2011, and subsequently supporting install of 200+ water tanks for medical physics teams across five different continents. Prior to joining the applications team, Jesus worked for Sun Nuclear Support Operations, helping customers troubleshoot and go clinical with their Sun Nuclear solutions. Jesus has led many trainings on the new SunSCAN 3D System across the Sun Nuclear organization and with customers.



EFOMP SIG UPDATE

Special Interest Group for Radionuclide Internal Dosimetry (SIG_FRID)

Pablo Mínguez Gabiña from Barakaldo, Spain, provides an update on the activities of this EFOMP Special Interest Group

The SIG_FRID has kept up its work promoting radionuclide internal dosimetry in clinical practice. The number of SIG_FRID members is currently of 111. New applications are always welcome (see below how to become a SIG member).

The Steering Committee (SC) has had monthly meetings (February 25th and April 13th). The next general meeting of the SIGFRID will be held on June 9th, from 15:00 to 17:00 (CEST).

The latest advances in the priorities of the SIG_FRID (listed in previous EMP news) are summarised below. In those priorities that are not mentioned, the situation is similar to that in the previous issue of the EMP news:

Priority 1. Survey on the practice of clinical radionuclide dosimetry
The objective of this priority is to collect up-to-date information on the status of radionuclide internal dosimetry in the EFOMP member countries. The electronic questionnaire is almost ready for distribution to centres that perform radionuclide therapy. A final version of the electronic questionnaire is ready and has been already circulated among representatives of all EFOMP countries. Those representatives will help to distribute the survey within the countries. We hope to receive information from as many centres as possible, so your help in completing the survey for your centre is much appreciated!

Priority 2. Available resources, protocols, tools, bibliography

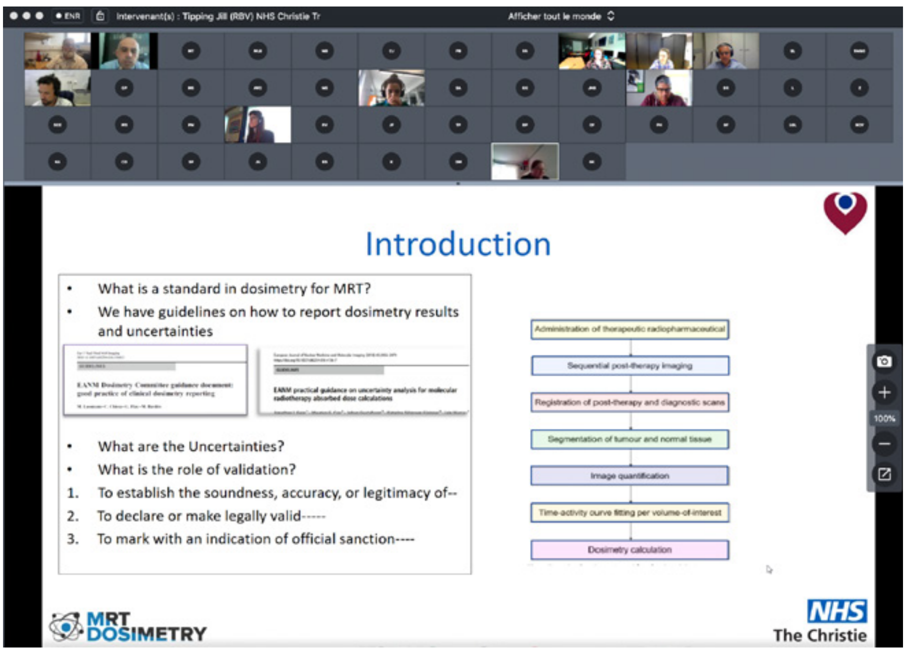
A preliminary template to compile a list of resources useful for nuclear medicine dosimetry is being reviewed by the SC. In the next few weeks the document will be shared with volunteers willing to contribute to compile and add resources to the document, which will include a list of publications, clinical trials in MRT, software tools, and clinical and phantom imaging data amongst others. Special thanks to Pablo Fragoso Costa, Elisa Grassi and Panayiotis Hadjitheodorou for the helpful discussions and feedback so far. We welcome volunteers so please contact the SC if you are interested.

Priority 4. Communication

A monthly newsletter has been issued for SIG_FRID members and quarterly news for EMP news.

Priority 5. Scientific issues

The third scientific meeting of the SIG_FRID was held online on May 3rd, from 15:00 to 16:30 CEST, and was followed by up to 48 SIG_FRID members. A screenshot of the meeting during Jill Tipping's talk is shown opposite.



Screenshot of scientific meeting held on May 3rd 2022

The meeting was chaired by Ernesto Amato and Manuel Bardies. The following three talks were presented, and ample time was allocated for discussion and comments:

- Lidia Strigari. "The new work groups on Targeted radionuclide therapy treatment planning systems comparison and harmonization of their implementation and Dose-effect model development by harmonization of input data: an invitation to participate
- Jill Tipping. "Commissioning and the MRT Dosimetry cross comparison and the questions that it posed"

- Manuel Bardies. "Benchmarking dosimetry software: implementing clinical dosimetry QA"

Priority 6. EU matters

The Innovative Health Initiative (IHI) has announced the draft call texts for the first two calls. Both a one-stage and a two-stage call for proposals are planned.

The following topics are planned and possibly of interest:

- IHI Call 1 (single-stage call).
  - Next generation imaging and image-guided diagnosis and therapy for cancer: https://www.ihi.europa.eu/sites/default/files/uploads/Documents/Calls/FutureTopics/IHI_C1_T2_CancerImaging_vApril2022.pdf
  - Personalised oncology: Innovative people-centred, multi-modal therapies against cancer: https://www.ihi.europa.eu/sites/default/files/uploads/Documents/Calls/FutureTopics/IHI_C1_T3_MultimodalCancer_vApril2022.pdf
- IHI Call 2 (two-stage call)
  - Setting a harmonised methodology to promote uptake of early feasibility studies for clinical and innovation excellence in the European Union: https://www.ihi.europa.eu/sites/default/files/uploads/Documents/Calls/FutureTopics/IHI_C2_T2_FeasibilityStudies_vApril2022.pdf

  Please note:
  Currently, the drafts are being agreed with the Member States (in the States Representatives Group) and the advisory body for science and innovation (Science & Innovation Panel). It is therefore possible that the topics may still change by the time the calls are published, probably in June 2022. The drafts and further background information on the IHI can be found on the IHI website: https://www.ihi.europa.eu/apply-funding/future-opportunities

Priority 7. Regulatory issues

The application coordinated by EIBIR, EANM and EFOMP to answer the EU call *SAMIRA study on the implementation of the EURATOM and the EU legal bases with respect to the therapeutic uses of radiopharmaceuticals* – ENER/D3/2021/253-3 has been successful. This is an important project as it may ultimately participate in wider dissemination of clinical dosimetry. Manuel Bardiès, Steffie Peters and Caroline Stokke are EFOMP representatives, with Caroline Stokke also being EANM Dosimetry Committee member.

Upcoming meetings:

- EANM Multidisciplinary days. (June 28-30). https://www.eanm.org/congresses-events/multidisciplinarydays/
- 4th European Congress of Medical Physics. Dublin. (August 17-20) https://www.ecmp2022.org/
- 35th EANM Annual Congress. Barcelona. (October 15-19). https://www.eanm.org/congresses-events/future-congress/

How to become a SIG member:

The SIG is meant for networking professionals with an interest in radionuclide dosimetry. Membership is open to all EFOMP members. The membership application procedure is explained on the SIG pages of the EFOMP web site: https://www.efomp.org/index.php?r=pages&id=sigs

The application form and a brief CV should be sent to the SIG secretary: sec.sig_frid@efomp.org

Pablo Mínguez Gabiña has been a senior medical physicist at the Gurutzeta/Cruces University Hospital in Barakaldo, Spain, since 2005. He has also been a part-time professor at the faculty of engineering of the University of the Basque Country in Bilbao since 2011. He has been a member of the Dosimetry Committee of the European Association of Nuclear Medicine since 2019. He is also a member of the Steering Committee of SIG_FRID.

UPCOMING MEETING

The UK Imaging and Oncology Congress (UKIO) – the UK's Largest Multidisciplinary Event in the Field – Returns in Person in July 2022

After two years of a virtual congress, held in 2020 and 2021, providing essential and valuable CPD at a time when we couldn't come together, nothing truly replaces the value of networking and face-to-face learning, and we are excited to be back at the ACC in Liverpool, UK on 4-6 July with UKIO 2022: Harnessing disruption – clinical excellence in a time of chaos.

A cutting-edge programme for a multi-disciplinary audience

The congress is a three-day congress and exhibition and the only event in the UK aimed at a multidisciplinary audience in the diverse fields of diagnostic imaging, oncology, and radiological sciences. The UKIO Working Party has spent the last few months putting together a cutting-edge programme that aims to address the medical, scientific, educational, and management issues of the audience's fields of work. The programme provides more than 100 sessions to choose from – there is something for everyone. View the programme at https://www.ukio.org.uk/programme-2022/.

Sessions for medical physicists

The physics and radiation protection stream has been expertly led by Dr Mohamed Metwaly, a lead consultant clinical scientist in the NHS, a registered medical physics expert, and Chair of EFOMP's Communications and Publications Committee. He has put together a diverse and relevant programme with sessions including the latest from the ICRP and IPEM working group on patient dose optimisation and national dose levels, an update on the MPACE accreditation project, and advances in radiology and brachytherapy research.

An exciting plenary programme

Alongside the scientific sessions, we have an exciting plenary programme. This year we're delighted to be welcoming two fascinating speakers. On Monday 4 July, Formula 1's Chief Technical Officer, Pat Symonds, will open the congress by addressing the audience on 'Human factors, data analysis and engineering - keeping the team safe and at the cutting edge of transformations in Formula 1'. After Pat's talk, you can visit the exhibition and see if you could make it as a Formula 1 driver in our full size F1 simulator and leaderboard competition,


Dr Michael Capps, Technologist and CEO, Diveplane


Pat Symonds, Chief Technical Officer, Formula 1

Then on Wednesday 6 July, the congress will be closed by Dr Mike Capps. Mike is a game designer, lead programmer, and research professor, and is best known for his decade as the President of Epic Games, makers of the global gaming phenomenon, Fortnite. Following his time at Epic Games, he co-founded the AI company Diveplane Corporation with the mission to put humanity back into AI. Mike will be giving a talk on pivoting from games to healthcare.

The latest research

We were pleased to receive a large number of abstracts submitted to be considered for presentation. These will be presented in the fully interactive ePoster display and the proffered papers programme, including sessions on imaging technology and AI.

An interactive exhibition

As well as the scientific sessions, you'll also be able to attend the exhibition, which features all the key suppliers under one roof, displaying the latest state-of-the-art equipment, services and technology available in the industry. You can find out more about who you'll meet here - https://www.ukio.org.uk/current-exhibitors/.

The exhibitors also add value to the educational content by running their own sessions – look out for more updates on these shortly. A key initiative new for this year is the **Innovation in action hub** - where our exhibitors will showcase their AI offering in a tangible way for the end user by demonstrating their solution in action within a workflow. The hub is supported by the **NHS AI Lab at the NHS Transformation Directorate**.

A focus on networking

As we return in person for the first time in a while, we're placing an emphasis on networking. Amongst other activities during the congress, our diverse social programme offers the opportunity to meet with other delegates in more informal settings – from pizza-making and walking tours to a silent disco and a night at the iconic Cavern Club, we hope you'll find something you enjoy. Add a ticket to your congress booking.

Dr Rizwan Malik, President, UKIO, is a leading radiologist with an interest in health tech, digital imaging, and the potential of AI to support clinicians and patients.

The Role of the Medical Physics Professional in the Life Cycle Management of Medical Devices

Stephan Klöck explains how placing medical physicists in charge of the life cycle management of medical devices optimises the implementation of real solutions that meet real clinical needs, account for on-site constraints, and provide the most cost-effective service.an unusual scientific angle

Some years ago, the medical devices industry stopped simply selling machines and began to offer health care solutions instead, in a bid to provide for the changing needs of their customer base. After years of increasing complexity in the application of medical devices, the demand for human-centred solutions has become an important factor in business. The promise was to improve quality and versatility at both reduced cost and risk. In the health care community, we began to talk about modalities, plug and play integration and life cycle management… Unfortunately, in reality, not every technical solution can actually be integrated smoothly and seamlessly into every health-care environment. There is always a technical support infrastructure required, where the new device must fit in. Following implementation, a gap can frequently be observed between the solution desired and the solution actually delivered. This can often be a result of failings in the initial analysis or description of the use-case specification for the required solution.

And this is the point in the story where the medical physics professional (MPP) enters the scene.

Possessing a scientific educational background with advanced technical and analytical skills on one hand and a profound understanding of the clinical aspects of the application and their implications on the other, MPPs are well suited to play a leading role in the life cycle management of medical devices and solutions. The MPP is the human link between the clinical requirement for a specific solution, the system to be purchased, and the vendor's ability to provide the solution. Furthermore, the MPP can manage or contribute to each stage of the life cycle, including the establishment of requirements with use-case assessment, investment planning, tendering, procurement of equipment, acceptance testing, especially in regards to safety and physical properties, quality management, effective and safe use and maintenance, user training, interfacing with IT systems, and safe decommissioning and removal of the equipment.

During the EFOMP Council meeting in October 2019 in Warsaw, a proposal from the Maltese delegation was accepted to develop a policy statement concerning the involvement of MPPs in the procurement process and in the other stages of the life cycle of medical equipment. In November 2020, EFMOP assembled a working group consisting of 10 delegates from their national member organisations (NMOs): Erato Styliano Markidou (Cyprus), Christian Gromoll (Germany), George Gourzoulidis (Greece), Susan Maguire (Ireland), Gabriele Guidi (Italy), Eric Pace (Malta), Wim van Asten and Hugo Spruyt (Netherlands), Jaime Martinez (Spain) and Stephan Klöck (Switzerland). Wim van Asten from the Zuyderland hospital group in the Netherlands was announced as the chairperson of the working group.

Since 2020, the working group has met several times. Unfortunately, due to COVID restrictions, never in person. To begin the process of developing the document, a descriptive comparison of the current situations in the countries of the working group members was carried out. Finally, a responsibility assignment matrix for a project or business process was derived, describing the participation of MPPs playing various complementary roles in completing tasks or deliverables. The draft of the policy statement will be presented during the 4th European Congress of Medical Physics (ECMP) in August 2022 in Dublin and submitted for approval by the EFOMP council in the autumn of 2022.

The working group believes that the institutional involvement of MPPs in the life cycle management of medical devices is a crucial step in implementing true solutions, addressing the actual clinical needs while taking account of on-site constraints and maintaining the highest quality and most cost-efficient service. According to the final document, institutions will be invited to review their processes and adapt the complete system as described, or elements thereof as relevant, giving MPPs a stronger position in healthcare organisations throughout Europe.

Stephan Klöck is the Swiss delegate in the working group on "EFOMP Policy Statement 17: Involvement of MPPs in the Different Stages of the Medical Device Life Cycle". He is a medical physicist in radiation therapy at the Lindenhof Hospital, a private facility in Berne, CH. Before, he was working at different sites eg for almost 10 years as a head of medical physics in radiation therapy at the University Hospital Zurich. He started his training in 1994, and his fields of expertise are image-guided stereotactic treatments and motion management. Currently, he chairs the exam committee of SSRMP for board certification.

Upcoming Conferences and Educational Activities

This list was correct at the time of going to press.
For a complete, up-to-date list, please visit our **EVENTS WEB PAGE**

Jun 24th, 2022 - Jun 26th, 2022

6th Theranostics World Congress
Wiesbaden, Germany

Jul 1st, 2022 - Jul 22nd, 2022

SCMPCR E-learning Program (ELP- 06): Clinical Medical Physics in Modern Radiotherapy
Online

Jul 4th, 2022 - Jul 6th, 2022

The UK Imaging and Oncology Congress (UKIO) 2022
Liverpool, UK

Jul 25th, 2022 - Jul 29th, 2022

Jubilee RAD 2022 Conference – Summer Edition
Herceg Novi, Montenegro

Aug 17th, 2022 - Aug 20th, 2022

4th European Congress of Medical Physics (ECMP 2022)
Dublin, Ireland

Sep 4th, 2022 - Sep 9th, 2022

RAPTOR SCHOOL - LOOP REQUIREMENTS
Ljubljana, Slovenia

Sep 5th, 2022 - Sep 30th, 2022

4th Summer School in Medical Physics 2022: Radiobiology and Radiobiological Modelling for Radiotherapy
Online or hybrid (online and on-site) in Heidelberg / Germany

Sep 19th, 2022 - Sep 23rd, 2022

Erasmus Basic MRI Physics 2022 - Dundee, UK
NHS Tayside Medical Physics (University of Dundee), Scotland, UK

Sep 21st, 2022 - Sep 24th, 2022

German Conference on Medical Physics
Aachen, Germany

Sep 22nd, 2022 - Sep 23rd, 2022

BIR Annual Congress 2022
London, UK

Oct 13th, 2022 - Oct 15th, 2022

EFOMP School - Statistics in Medical Physics
Athens, Greece

Oct 14th, 2022 - Oct 15th, 2022

EuSoMII Annual Meeting 2022
Valencia, Spain

Oct 15th, 2022 - Oct 19th, 2022

EANM'22 – 35th Annual Congress of the European Association of Nuclear Medicine
Barcelona, Spain

Oct 17th, 2022 - Oct 25th, 2022

Courses in the field of Particle Therapy 2022
Online

Oct 24th, 2022 - Oct 26th, 2022

Fourth Geant4 International User Conference at the physics-medicine-biology frontier
Napoli, Italy

Nov 13th, 2022 - Nov 16th, 2022

EPSM22: Engineering & Physical Sciences in Medicine Conference
Adelaide, Australia

Dec 13th, 2022 - Dec 16th, 2022

International Conference on Integrated Medical Imaging in Cardiovascular Diseases (IMIC-2022)
Vienna, Austria

EFOMP Structure

EFOMP Governing Committee

President

Paddy Gilligan

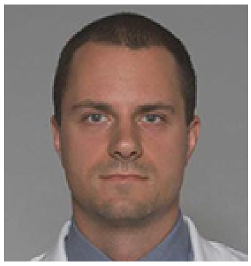
Past President

Marco Brambilla

Secretary General

Efi Koutsouveli

Treasurer



Jaroslav Ptáček

Communications & Publications Committee

Chairperson

Mohamed Metwaly

Past Chairperson

David Lurie

Internet Manager

Jurgita Laurikaitiené

European Matters Committee

Chairperson

Loredana Marcu

Vice Chairperson

Michele Stasi

Education & Training Committee

Chairperson

Christoph Bert

Vise Chairperson

Veronica Rossetti

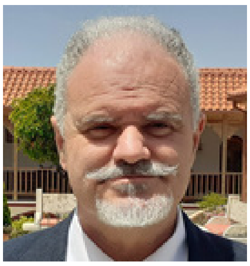
Professional Matters

Chairperson

Brenda Byrne

Projects Committee

Chairperson



Constantinos Koutsojannis

Scientific Committee

Chairperson

Brendan McClean

Vice Chairperson

Eeva Boman

EFOMP Company Members

EFOMP
P.O. Box 8003
3503 RA Utrecht
The Netherlands
www.efomp.org

EFOMP

EUROPEAN FEDERATION
OF ORGANIZATIONS
FOR MEDICAL PHYSICS

The European Federation of Organisations in Medical Physics (EFOMP) was founded in May 1980 in London to serve as an umbrella organisation for medical physics societies in Europe. The current membership covers 36 national organisations which together represent more than 9000 medical physicists and clinical engineers working in the field of medical physics. The motto developed and used by EFOMP to underline the important work of medical physics societies in healthcare is "Applying physics to healthcare for the benefit of patients, staff and public".

For more news and information about EFOMP activities please follow us on social networks or visit our website

www.linkedin.com/company/efomp
@EFOMP_org
www.efomp.org
/efompweb
/EFOMP.org