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The European Federation of Organizations for Medical Physics Bulletin

European Medical Physics News
Autumn 2019

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Editorial

Dear Readers,

This issue of European Medical Physics News starts with a very important news from EFOMP President, regarding the foreseen possibility of individual membership association to EFOMP, a proposal discussed and approved in the last EFOMP Board and to be discussed and approved in the next EFOMP Council meeting in Warsaw, in October 2019 (see p. 4).

The cover page of this issue honors Prof. Wolfgang Schlegel, with a farewell symposium held on 31st May 2019 (p. 16).

This year the scientific meeting of the French Society for Medical Physics took place in Angers, France: you can find a report on p. 6.

The ninth Alpe-Adria Medical Physics Meeting and the Annual Meeting of the Austrian Society for Medical Physics took place in May 2019 in Graz, Austria (see the report on p. 15).

An analysis based on "facts separated from fiction" of the last Medical Device Regulation (MDR) is set forth in the very detailed article on p. 8: a very useful reading, indeed.

The Winter EFOMP School (ESMPE) in Nuclear Medicine, and the Summer EFOMP School "State of the art and new trends of angiographic equipment: Image quality, Patient and Staff dosimetry" held in Prague, continues the ESMPE tradition of well attended, well prepared and educationally efficient events (pp. 19, 21)

EUTEMPE educational event news are reported on pp. 23 and 25, on radiation protection issues.

If you want to know about the experience of being an Associate Editor of EFOMP official scientific journal, Physica Medica, please see the short article by P. Mancosu on p. 29.

The section on "Medical Physics research news" from experienced as well as from young medical physicists starts on p. 31 with an article on "Future perspective in NTCP modelling", then it continues on: p. 34 on "Virtual clinical trials in 2D and 3D X-ray breast imaging"; p. 41, with an article on "A Dynamic Eye Phantom for Proton Therapy of Uveal Melanoma"; p. 43 with the article on the new imaging technique "Orthogonal Ray Imaging" and finally on p. 45 with a new technique of real-time radiochromic film dosimetry.

The section "EFOMP Company member news" contains articles from Qaelum (p. 36) and from RTsafe (p. 38).

The new section on "Medical Physics Leadership" is presented in the article on p. 47 and contains an interesting article related to "Clinical MRI Safety Performance and Quality Improvement project" on p. 49.

What medical physicists do in their free time? This section contains articles on Medical Physics and Cycling (p. 52), Medical Physics

and Martial Arts (p. 53), Medical Physics and "Maker" (p. 54).

Finally, the section on "Book Reviews" contains an article on "Image Processing and Acquisition using Python" (p. 56).

We remind you our important meeting for 2020, the next 3rd European Conference of Medical Physics, Turin, Italy, 24-26 September 2019, as announced also in this issue: the Scientific Committee has been nominated (see p. 5).

The Editorial Board of EMP News thanks all contributors of the articles of this Autumn 2019 issue!

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Paolo Russo, Editor-in-Chief & Your editorial team (pubcommittee@efomp.org).

European Medical Physics News, 2 September 2019.


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Individual Associate Membership

When elected as President of EFOMP, I promised to introduce a new category of membership in EFOMP to allow individuals to become associate members without weakening the character of EFOMP as a Federation of National Member Organisations.

After more than one year of intense and fruitful discussion, the Board unanimously approved this in the Officer's meeting held on the 5th and 6th of April 2019 in Woudschoten, The Netherlands, the proposal for introducing the new category of Individual Associate Membership as follows:

1. Individual associate members will have access to the EFOMP e-learning platform.
2. Additional privileges could be discounts on fees for attending ESMPE schools, ECMP, or to stand for EEB examinations. The discounts for EFOMP activities will be established by the Board.
3. Individual associate members cannot attend or vote in Council meetings nor join EFOMP committees, based on their individual membership. NMO delegates and EFOMP committee members are nominated by NMOs only. Therefore, individual members don`t need to prove to be a member of an NMO, a Medical Physicist or to be European.
4. The registration of individual associate membership will be completed upon completion of a simple form and payment online, straightforward and without any additional burden from the administrative point of view.
5. The fee for becoming an individual member will be proposed by the Board and established by the Council.

This way there will be no interference of individual associate membership with the current rules of EFOMP as a federation. At the same time, we will solve the problem of how to grant access to the e-learning platform of EFOMP, which is one of the strategic activities of EFOMP in the field of education and training in the coming years and needs resources to be expanded and fully implemented.

This proposal will be submitted for discussion and eventually approval to the next EFOMP Council meeting to be held in Warsaw on the 12th of October.

Dr. Marco Brambilla

President of EFOMP

Head of medical Physics Department

University Hospital of Novara

EFOMP

Quality control in cone-beam computed tomography (CBCT)

EFOMP-ESTRO-IAEA protocol

ESTRO

IAEA

Third European Congress of Medical Physics in 2020

While approaching the Autumn period, we will follow the ECMP congress planning through this EMP newsletter. Since the last newsletter in June, the congress Scientific Committee has been established, including 30 experts from different parts of Europe, complemented by two international members. It was considered important to have a balanced representation of EFOMP National Member Organisations and also gender balance in the committee, while also having an appropriate representation of medical physics main subspecialities. You may find the names and home countries of the Scientific Committee members on the ECMP web page.

Fig. 1: A night view of Piazza Castello, the Royal Castle square in the city centre in Torino. © City of Torino - Enrico Aretini

At this stage, the Scientific Committee will work together with the Congress Planning Committee to build the programme for refresher courses, special focus sessions and invited talks. As the welcome nation, the Spanish society SEFM is also contributing to build three sessions to the ECMP.

The ECMP 2020 programme will include four parallel sessions during the congress. Each subspeciality - radiotherapy, nuclear medicine and radiology – will have their own line, while the cross-over topics and special focus and professional sessions will occupy the fourth line of sessions. We hope to inspire fresh topics and forward-looking discussions with fast developing areas in medical physics in this fourth parallel, inspired by the congress slogan "Embracing change and sharing knowledge". As one example of specific topics selected for the conference, we have a proposal for a professional session concerning mentoring of young medical physicists during their training - an issue which certainly has big impact on the future success in our professional field. We seek to have this and many other influential topics in the congress programme.

While working for the programme, the congress timeline has also been finalised and recently published on the ECMP web page. Following the timeline, the next important steps are the opening of the congress registration and abstract submission.

The registration and abstract submission for ECMP 2020 will open on 24th September 2019. We wish to welcome all European colleagues to submit their recent scientific findings to the congress. We are also happy to reach all major vendor companies in order to have their representation in the ECMP exhibition.

The third ECMP will be held in Torino, Italy, 24-26 September 2020. You may find further information on the congress web page (www.ecmp2020.org) and the EFOMP web page (www.efomp.org) as well as social media (LinkedIn, Facebook, Twitter, Instagram) for constant updates.

We wish you a pleasant Autumn period.

Dr Mika Kortesniemi

Chief Physicist and Adjunct Professor in the HUS Medical Imaging Center, University of Helsinki, Finland

Dr Mika Kortesniemi works as the Chief Physicist and Adjunct Professor in the HUS Medical Imaging Center, University of Helsinki, Finland. His professional focus is on the quality assurance, dosimetry, optimisation and radiation protection in x-ray modalities, especially the evolving CT technology. The research work is primarily related on radiological optimisation, utilizing anthropomorphic phantoms and Monte Carlo simulations. Dr Kortesniemi is the past chair of EFOMP Science Committee. In addition to his primary position in HUS Medical Imaging Center, Dr Kortesniemi is also involved in IAEA, ICRP and ESR collaboration, and quality audits in radiology.

58th scientific meeting of the French Society for Medical Physics

Fig. 1: announcement of the 58th scientific meeting of the SFPM © M. Brémaud

This year the scientific meeting of the French Society for Medical Physics ("Société Française de Physique Médicale"– SFPM) took place in Angers, France (Fig 1). This annual meeting is a key moment for the SFPM because it provides the opportunity for medical physicists to exchange on various topics and to discuss the past, present and future developments of the Society during the general assembly. The 58th edition was held in a recently-renovated conference centre (Fig 2). During three days, more than 250 medical physicists from France, Belgium, Switzerland and even Lebanon, United Kingdom and Canada attended the conferences. 32 manufacturers in healthcare also participated in the industrial exhibition.

The 86 abstracts selected by the scientific committee for the radiotherapy track were organised in sessions on adaptative radiotherapy, machine learning, complexity indexes or stereotaxy. A specific session jointly organised with the French Society for Oncology and Radiotherapy ("Société Française de Radiothérapie Oncologique" - SFRO) was held on the intensity modulation for breast. Presidents of both societies and invited speakers from the Curie Institute debated on the growing importance of this technique in clinical practice. The imaging track was structured around a teaching course on spectral imaging – what modality is this?. In nuclear medicine, a seminar on targeted radionuclide therapy was organised.

A social dinner was held in a botanical park on Thursday evening. Attendees enjoyed a short drink outside and could discover some of the attractions of the park. A dinner with local specialties was then followed by dancing.

The last day of the meeting was dedicated to artificial intelligence, gathering all participants. Researchers from the University of Angers presented in detail the principles of machine learning, deep learning and artificial neural networks while medical physicists illustrated applications of artificial intelligence in radiotherapy, nuclear medicine and imaging.

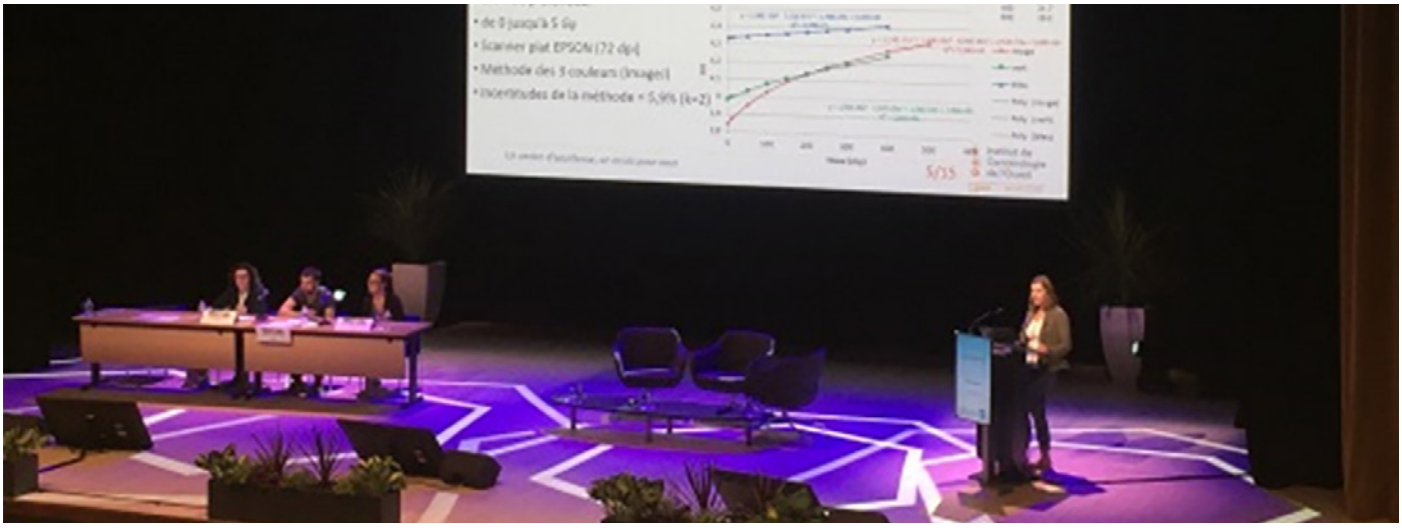

Fig. 2: the congress centre was entirely renovated just before the meeting © D. Autret

All abstracts will soon be published in a special issue of Physica Medica. Three prizes were also awarded:

- Best oral presentation: Antoine Wagner (Université Libre de Bruxelles, Belgique / Centre Oscar Lambret, Lille, France), "Integration of the Cyberknife M6 in the Monte Carlo platform Moderato and prediction of the beam parameters by machine learning"
- Best oral presentation – young physicist: Anaïs Barateau (Université de Rennes, CLCC Eugène Marquis, INSERM, LTSI - UMR 1099, Rennes, France), "Comparison of a deep learning method with three other methods to perform dose calculation from CBCT images in head-and-neck radiotherapy"
- Best e-poster – young physicist: Salima Briand Maroubi (Centre Léon Bérard, Lyon, France) "Dosimetric impact of the manual reconstruction errors for an interstitial brachytherapy Venezia applicator"

Next year, the 59th scientific meeting of the SFPM will take place in Avignon, from the 3rd to the 5th of June 2020. All details will be available at https://sfpm-js2020.sciencesconf.org/ and abstracts in English from all countries are warmly welcome!

Department of Medical Physics, ICO - Integrated Center for Oncology, Angers

Damien Autret

Maxime Brémaud

Christelle Di Bartolo

Stéphane Dufreneix

Camille Guillerminet

Christophe Legrand

Jérôme Mesgouez

Medical Device Regulation (MDR) – facts and fiction

In May 2017, the new Medical Device Regulation (MDR) was published and three years later, in May 2020, it should be fully implemented in all countries within the EU. Since the MDR is a regulation it is legally binding. Hospitals need to prepare for the new regulation. The lack of practical experience with the MDR has led to various interpretations of the new rules. Not all of these statements are correct and some are unnecessarily alarming. We have tried to bring some clarity by separating facts from fiction.

Devices already on the EU market

A large part of the medical apps will be categorized in a higher risk class
Fact

The MDR has a separate classification rule for medical software (annex VIII, rule 11). It states that software intended to provide information which is used to take decisions with diagnosis or therapeutic purposes will be classified as class IIa or higher. Many medical apps that provide doctors with a suggestion for a diagnosis are currently classified as class I, but that will change.

Manufacturers of such apps will need to certify their product through a notified body. Since these apps now lack a certificate of a notified body (a declaration of conformity by the manufacturer currently suffices), their conformity has to be assessed in time in order to remain available on the market. Manufacturers will also have to make efforts to gather clinical evidence for the safety and efficacy of their product.

In other categories of medical devices products will be subject to reclassification (typically up), forcing manufacturers to invest time in keeping their products on the market.

Maintenance of medical equipment will be restricted to manufacturer personnel
Fiction

A medical device may only be put into service when duly supplied and properly installed, maintained and used in accordance with its intended purpose (article 5.1). Proper maintenance is a requirement, however, it is not specified who must or may execute these activities.

The manufacturer has the liberty to formulate additional requirements in the manual regarding the required expertise or education of the person who performs the maintenance (annex I.23.4). This provides the manufacturer with the opportunity to set the bar high, either in terms of qualification or costs, up to the point that a hospital is not able to comply. At the same time, a manufacturer risks overpricing his product by doing so. Also, it is to the manufacturer's advantage that small malfunctions can be dealt with quickly; a service that only trained hospital technicians can provide within a short time frame (and at a reasonable cost).

The manufacturer can also provide instructions on the nature and frequency of the preventive maintenance. The performance and safety of a device during its expected lifetime are the manufacturer's responsibility to guarantee, provided that the device is maintained according to the instructions (annex 1.6). Deviations from protocol will affect the liability of the manufacturer regarding its device, but the law does not say that it is prohibited. It is the hospital's responsibility to provide good and safe care to its patients. Modifying the maintenance protocol at least needs justification and a risk assessment.

When a hospital donates medical devices after they have been used or makes them available on the second-hand market, it must comply with the rules set out in the MDR.

Fiction

The MDR is aimed at the protection of patients and consumers, mainly by regulating market access. When devices that already have been put into service are further made available on the market, this does not fall under the rules of the MDR ("Whereas" section, point 3). This does not imply that a hospital in this case does not carry any responsibility for the devices to be sold or donated.

Market access for manufacturers

A manufacturer is obliged to consider alternative treatment options while evaluating its own device.

Fact

Looking at alternative treatment options is a compulsory part of a clinical evaluation (article 61.3). This stimulates a critical evaluation of the new device with for instance current practice, thereby ensuring that new devices will have a higher benefit-risk ratio than devices that are already on the market.

Every new medical device will require a clinical investigation

Fiction

In order to bring a device to the market, a manufacturer has to provide sufficient clinical evidence to prove that its device complies with the general safety and performance requirements. The amount of evidence has to be appropriate for the device and its intended purpose (article 61.1). A clinical evaluation is to be carried out to collect the clinical evidence, comprising of three parts: 1) a critical evaluation of the relevant scientific literature currently available on existing, equivalent devices, 2) a critical evaluation of all the clinical investigations of the device itself and 3) a consideration of currently available alternative treatment options (article 61.3). If part 2 does not yield any results and part 1 and 3 provide sufficient clinical evidence, a clinical investigation is not mandatory. This principle also applies to class III devices and implantable devices. However, demonstrating equivalence for such devices is more difficult. The notified body must confirm the equivalence of the new and current device and will check whether the post-market clinical follow-up studies are appropriate to demonstrate the safety and performance of the new device (article 61.4).

Furthermore, carrying out a clinical investigation may not be appropriate for certain devices (article 61.10). In those cases, conformity can also be demonstrated with non-clinical testing methods, substantiated with arguments by the manufacturer. Validation of diagnostic software can just as well be performed with offline patient data, raising the question whether a clinical investigation is even ethical in such an instance. The same holds for investigating proven technologies such as band aids.

Nevertheless, the MDR does not allow for 'grandfathering'. Devices placed on the market after May 2020 will not simply be permitted based on equivalence with a device carrying CE-marking under the MDD.

The manufacturer of a high-risk medical device can consult an expert panel before the clinical investigation.

Fact

The manufacturer of a class III medical device or a class IIb product with an integrated drug can consult an expert panel to have the intended strategy for the clinical investigation assessed (article 61.2). The manufacturer must take the panel's opinion into account. Currently, the European Commission and the Medical Devices Coordination Group are preparing the installment of the panels and recently announced that the call for experts will be published later on in 2019. The panels are also designed to contribute to the development of guidance documents, such as common specifications.

A manufacturer can still apply CE-marking for a class I medical device

Fact

When the manufacturer of a class I medical device has prepared the corresponding technical documentation (annexes II and III), he can declare that his product complies with the MDR (article 52.7). However, if the class I device has a measuring function, is delivered sterile or is a reusable surgical instrument, then a conformity assessment by a notified body is required. This assessment is then limited to one of the aforementioned aspects.

A manufacturer who has placed a medical device on the market under the MDD does not have to comply with the MDR during the period in which the corresponding CE certificate is valid

Fiction

A device with a valid CE marking according to the MDD (93/42/EEC) or AIMDD (90/385/EEC) may continue to be sold after May 2020. A number of MDR rules must already be applied by the manufacturer, such as post-market surveillance and registration of the device in EUDAMED (article 120.3).

A notified body can force a manufacturer to perform additional clinical investigations after a device has been placed on the market

Fact

When assessing the manufacturer's file, the notified body may conclude that the clinical evidence is insufficient to allow the device to be used for its intended purpose. It can then decide to limit the intended purpose to a specific patient group or prescribe specific post-market studies (article 56.3).

The effectiveness of a medical device must be demonstrated every 5 years through a randomized controlled trial

Fiction

The MDR requires manufacturers to take into account the current state-of-the-art applicable to their device in their clinical evaluation plan. In addition, the post-market surveillance plan must be suitable for keeping the device up-to-date, partly by carrying out post-market studies. As long as results from existing research are applicable, there is no obligation to conduct a new clinical study.

Medical equipment may only be sold to a trained user

Fiction

The MDR includes only a few words on user training. It is certainly not a condition for sale. The competence of the users is not addressed in the MDR either. At the design stage, the manufacturer must take into account the education and training of the intended user of his medical device (annex I.5) and may specify in the instructions for use what specific training or expertise is required (annex I.23.4). As many medical devices are used by patients themselves, it would be a considerable task for a manufacturer or supplier to verify that the user is trained for every device sold. Obviously, a user must be competent when using a device in order to provide good and safe care.

Use and development within hospitals

The clinical evaluation of a medical device intended for home use can be used for the conformity assessment procedure of a new version intended for use in the hospital

Fiction

A device is equivalent if the technical, biological and clinical characteristics are similar to such an extent that there is no clinically significant difference in safety and clinical performance (annex XIV.A.3). The user of the device is a characteristic that must be taken into account when claiming equivalence. When equivalence is not demonstrated, the existing clinical evaluation cannot be used for the new device.

From 2020, hospitals must register all UDIs of the devices supplied to them

Fiction

The obligation to register and store the UDI's of the devices supplied to them is limited to class III implantable devices (article 27.9). Member States may extend this obligation to other groups of medical devices in the future.

Every medical device that is used in the treatment of the patient must be registered in the Electronic Patient Records

Fiction

The MDR prescribes healthcare institutions to store the UDI for class III implantable devices (article 27.9) and this obligation can be extended by Member States to other devices. The registration of all medical equipment used in a patient is not mentioned in the MDR. The use of device registers and databanks is encouraged by the European Commission (article 108). A doctor does not, however, have to inform the patient about every patch, infusion pump, monitor, ventilator, operating table, heating mattress, anesthesia device or other material used during an operation.

A device that is tailor-made for an individual patient with a 3D printer is a custom-made medical device

Undecided

So-called computer aided manufacturing techniques, such as 3D printing, laser sintering or stereolithography, are standardized production processes to which quality management is applicable and for which certification is therefore possible. If a medical device can be tailor-made for an individual patient by changing a number of parameters from a standard model, this is not considered to be custom-made (article 2.3). There is still plenty of discussion about this subject within Europe. A special task force is working on this subject and therefore it is still too early to make a conclusive statement about this.

When third-party replacement parts are used, the CE certificate is no longer valid

Fiction

The use of third-party replacement parts is permitted, provided that the manufacturer of these parts ensures that the replacement part does not affect the safety or performance of the device (article 23).

When a medical device is developed in-house by a hospital, the hospital becomes a manufacturer

Fiction

The development of a medical device is not sufficient to qualify as a manufacturer. To become a manufacturer, the device must also be marketed (article 2.30), whether for a fee or free of charge. If the device is not transferred to another legal person, the hospital is not a manufacturer according to the MDR. However, the hospital must then meet the conditions and requirements from article 5.5 and must, among other things, demonstrate that the product meets the general safety and performance requirements.

The instructions for use of an in-house developed medical device must meet the same requirements as the instructions for use of a device available on the market

Fact

The MDR sets rules for healthcare institutions that manufacture a medical device for use within their own institution (article 5.5). One of the requirements is that the device meets the general safety and performance requirements. The instructions for use are part of these requirements and must therefore be drawn up by the healthcare institution according to the same rules set out for manufacturers (annex I.23.4).

Documentation and transparency

In the annual safety report for class IIb and class III medical devices, manufacturers also estimate the extent of the use of the device

Fact

In the context of post-market surveillance, manufacturers must prepare a periodic safety update report (PSUR) for class IIb and III devices annually. Part of this is an indication of the sales volume and an estimate of the size of the population that uses the device (article 86.1 and articles 87, 88 and 89).

A manufacturer does not have to report on non-serious incidents in EUDAMED

Fiction

A manufacturer does not have to report a non-serious incident directly to the competent authority or his notified body, but for class II and III devices, the manufacturer must report trends in the periodic safety update report (PSUR) as part of their plan for post-market surveillance (article 88.1). This involves any statistically significant increase in frequency or severity of incidents. The reports on trends and PSUR are processed in EUDAMED (article 92.1), so information on non-serious incidents is also reported by manufacturers in EUDAMED. It is not yet clear which (part of that) information will be made available to the public (article 92.3).

Post market surveillance will cost hospitals a lot of time

Fiction

The MDR sets stricter requirements for manufacturers to monitor their product after it has been placed on the market. To this end, manufacturers will want to gather more information about the experiences with their products. A manufacturer must prepare a post-market surveillance plan, which specifies which resources are used and how the data is collected (annex III). This includes a continuous review of the benefit-risk ratio and the risk management of the device. In this plan, the manufacturer also determines whether post market clinical follow-up is required.

Professional users and hospitals have a lot of information that could be relevant to PMS, but they have no obligation to provide data to the manufacturer in the context of PMS. Of course, hospitals and professional users have an interest in ensuring that the effectiveness and safety of medical devices is guaranteed. Therefore, they could make agreements with certain manufacturers about the information to be exchanged.

If the UDI-DI of a device is included in the UDI database of EUDAMED, this means that the product carries a CE marking

Fiction

The UDI-DI, the unique code to identify a type of medical device, must be registered by the manufacturer in the UDI database of EUDAMED. The allocation of the UDI-DI takes place before the device is placed on the market (article 29.1), and therefore the availability of the UDI-DI in the database does not mean that the CE certificate has been issued by the notified body (annex VI.C.5). The FDA uses the same identification system, so a device available in the United States may already have a UDI-DI.

All EU citizens will be able to consult a summary of the safety and performance of each medical device online

Fiction

EUDAMED is the European database where all relevant information about medical devices will be stored. Part of that information will also be made available to the public, such as a summary of safety and clinical performance (article 32). However, only implantable devices and class III devices must be provided with such a summary. For other resources, the basic data elements from annex VI, Part B, will be publicly available through EUDAMED. This includes, for example, the risk class, contraindications, sterility, basic UDI-DI and the manufacturer's name and address.

A patient information leaflet is mandatory for every medical device

Fiction

Patients with an implanted device receive information from the healthcare institution about the device, including the implant card, prepared by the manufacturer (article 18). This implant card is not applicable for devices such as plates, screws, fillings, stitches, etc.

In the instructions for use, the manufacturer can state information such as residual risks or contraindications that must be communicated to the patient (annex I.23.4.g) and alert the user and / or patient that all serious events with the device must be reported to the manufacturer and the competent authority (annex I.23.4.z).

E.C. Gelderblom, MSc PhD MPE

Erik Gelderblom is a Medical Physics Expert at the Radboud University Medical Center in Nijmegen, The Netherlands. Positioned within the Med. Tech. department he has a broad scope of interest and experience with various fields of Physics within the hospital, including regulatory affairs such as the MDR. Currently, his focus is on the safe implementation of computer aided manufacturing techniques and other innovative (non CE-marked) techniques.medical physics professional matters.

R. Wientjes, MSc MPE

Is a medical physicist expert working in the University Medical Center Utrecht, the Netherlands. His main interests are hospital physics, hospital safety, quality systems, operating room and intensive care.medical physics professional matters.

J.M. den Harder, MSc PhD MPE

Since 2016, Chiel den Harder works for Amsterdam UMC, location AMC in the Netherlands as a medical physicist at the department of Radiology and Nuclear Medicine. His main focus areas are safety and quality of imaging technologies, research into quantitative imaging biomarkers, and implementation of imaging innovations into patient care. He is a member of the Institutional Review Board. Before joining the Amsterdam UMC, he worked in several other hospitals as well as in industry focusing on development of imaging technologies.

J.B. van de Kamer, MSc PhD MPE

Jeroen van de Kamer is a Medical Physics Expert, working at the department of radiation oncology of the Netherlands Cancer Institute, NKI-AvL, in Amsterdam, the Netherlands. One of his interests is the quality control of the linear accelerators and patient-specific quality assurance in radiation therapy. The NKI-AvL continuously strives to improve treatment techniques, either by home-made developments or acquisition of new technologies. Hence his interest in the ins and outs of the Medical Device Regulations. Jeroen is a member of the board of the Society for Medical Physics of the Netherlands with a focus on radiation safety and European affairs.medical physics professional matters.

B. Damink, MSc MBA MPE

Bunna Damink is a Medical Physics Expert with diverse professional experience in medical equipment safety training, electrotechnical engineering, radiation protection and management. For the past 14 years, she has worked as medical physicist and manager of the biomedical engineering department for Bravis Hospital in The Netherlands. She is a member of the Quality Improvement Committee of the Dutch Society for Medical Physics.

AAMPM Alpe Adria Medical Physicists Network Meeting 2019

Fig. 1: Alpe Adria Medical Physics Group: Mario de Denaro, Renata Longo, Renato Padovani, Hrvoje Hrsak, Borislava Petrovic, Brigitte Zurl, Bozidar Casar, Slaven Jurkovic, Uwe Wolff, Werner Schmidt, Csilla Pesznyak, Dushko Lukarski, Stipe Galic

An Alpe Adria Medical Physics Group meeting took place in the Medical University of Graz in Austria on 15 May 2019. Medical Physicists from 8 different countries (Italy, Croatia, Serbia, Austria, Slovenia, Hungary, North Macedonia and Bosnia Herzegovina) were present. This article provides a summary of the Board Meeting which took place at that time.

Two new countries (North Macedonia, about 35 members, 15 of them Medical Physics Experts and Bosnia Herzegovina, about 30 members) asked to join the Alpe Adria Medical Physicists group. The representative from North Macedonia presented a handout on the situation of Medical Physicists in the country and an official letter of intent to join the AAMP Group. Both societies were heartily welcomed without a dissenting vote. Now the AAMP Group consists of nine member societies.

Werner Schmidt (Austria) informed the group that he will retire soon and that his substitute for the future in AAMP tasks will be Uwe Wolff, representing the Austrian Medical Physics Society.

Hrvoje Hrsak (Croatia) informed the participants that Croatian professionals have formed a new Medical Physicists Society (segregated from the Biomedical Engineering Society). The Croatian Medical Physics Society was described in the Summer edition of EMPnews.

During the meeting there was a discussion on the status of the profession for Medical Physicists: In Italy, Croatia and Hungary Medical Physicists are recognised as Health Care Professionals, while in Hungary Medical Physics Experts are members of the Medical Doctors Chamber. In North Macedonia MPs are stated as healthcare professional Co-workers (Cat. D); their intention is to get MPE´s recognised as healthcare professionals (Cat. A equates to medical doctors).

There was also a discussion on the status of EFOMP and the EFOMP Examination Board (EEB) for MP and MPE. Renato Padovani gave a presentation about EEB and informed colleagues that EFOMP EEB does not provide certification but a certificate that states that the competences are at the level of MP or MPE. The recognition and certification or registration depends on national regulations.

The next AAMP Group meeting will be in 2021 and Slovenia will be the host country.

The Annual Meeting of the Austrian Society for Medical Physics

The ninth Alpe-Adria Medical Physics Meeting and the Annual Meeting of the Austrian Society for Medical Physics took place in May 2019 in the lovely location of Graz, Austria. The local organizers, PD Dr. Brigitte Zurl and Dr. Peter Winkler, were overall attentive hosts.

The meeting offered scientific sessions on aspects of nuclear medicine, diagnostics, radiotherapy, dosimetry and radiation protection. Each session included a keynote lecture and a proffered papers session. An interesting feature presented this year was a pre-meeting teaching course on Volumetric Modulated Arc Therapy, where participants had plenty of hands-on training using treatment planning systems such as Eclipse, Monaco and Pinnacle. Moreover, aspects of quality assurance of VMAT were also discussed and most importantly, there were actual measurements performed on Varian machines.

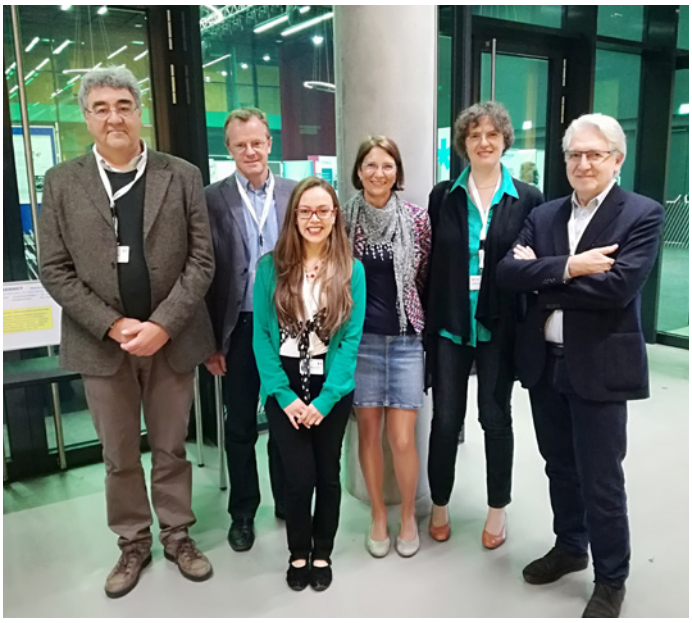

Fig. 1: Congress Presidents Dr. Peter Winkler, Dr. Brigitte Zurl, Italian members of the Scientific Committee: Dr. Mario de Denaro, Prof. Renata Longo, and Dr. Renato Padovani, MAS. Lucia Arana (author) © LM. Arana Peña

The sessions reminded us as professionals that there are still many challenges to face and to always keep in mind clinical feasibility when implementing new techniques and protocols.

Medical physicists play a leading role in the implementation of risk management systems, yet we need to work as a team with other professionals in the practice in order to keep a radiation protection culture.

During the proffered papers sessions, young medical physicists also had the opportunity to present the results of their research projects to other professionals. The discussions that followed the presentations were valuable as more experienced medical physicists offered their knowledge and expertise to the younger ones; this was much appreciated.

Throughout the conference dinner we enjoyed a beautiful view and delicious Austrian cuisine at the Castle of Graz. Additionally, we were also guests of the mayor of the city at the Town Hall, where his representative greeted us personally, shared some history of its notable citizens such as Erwin Schrödinger and even let us step outside on the balcony.

Altogether, this biennial meeting generated a lot of enthusiasm among its participants. Moreover, it brought together seven countries from the Alpe Adria region and it welcomed two additional countries to the organisation: North Macedonia and Bosnia-Herzegovina.

— Save the date in two years for the 10th edition to be held in Slovenia. Looking forward to meeting you there!

MAS. Lucía Mariel Arana Peña

Medical Physicist, PhD Student , University of Trieste, Italy

Lucía Mariel Arana Peña studied a Physics degree in Guatemala. She was a lecturer at the national university, Universidad de San Carlos de Guatemala and at a high school, which has allowed her to support and inspire other students to follow STEM careers, specially for young women. She worked as a medical physicist at one of the four radiotherapy centers in Guatemala, providing services for the low-income population. She participated in the international program of the Master of Advanced Studies in Medical Physics from ICTP-UNITS in Trieste, Italy and collaborated at Istituto Oncologico Veneto using 3DCRT, IMRT, VMAT, TBI techniques as well as knowledge-based planning solutions. She is currently a PhD student at the University of Trieste, and she will be developing her research inside the working group of BreastCT with Synchrotron Radiation in the SYRMEP beamline at Elettra Synchrotron Facilities.

Farewell symposium for Wolfgang Schlegel

Fig. 1: DKFZ auditorium at the Farewell symposium for Prof. Wolfgang Schlegel. © DKFZ/Kircher

On the 31st May 2019, the German Cancer Research Center (DKFZ) organized a farewell symposium for Prof. Dr. Wolfgang Schlegel, a German pioneer of Medical Physics in radiotherapy, as well as EFOMP president 2006-2008 and EFOMP Honorary Member since 2018. The symposium was chaired by Prof. Oliver Jäckel, DKFZ, one of his former PhD students and now the leader of the department of Medical Physics for radiotherapy of the DKFZ. The initial welcome address was given by Prof. Michael Baumann, chairman of the board of the DKFZ, who characterized Prof. Schlegel as one of the best examples for bringing research in physics from its basics to the patients in medicine and Prof. Gerhad van Kaick, MD, DKFZ. This was further extended in the talk by Prof. Stephanie Combs, MD, medical director of the clinic for radiooncology and radiotherapy at the TU Munich, who described him as one of the truely central people in Medical Physics, who pushed forward not only the development of stereotactic techniques but also the development of the multi-leaf-collimator as well as treatment planning software to realize intensity modulated radiotherapy for the benefit of patients. PD Christian Thieke, MD, further explained the history of multi-criteria optimization employing Pareto solutions in IMRT treatment planning, that was developed by the group of Prof. Schlegel in cooperation with the Group of Prof. Küfer at the Fraunhofer Institut for industrial mathematics at Kaiserslautern, Germany. Another of his PhD students, Prof. Thomas Bortfeld, now chief of the Physics Division of the Massachusetts General Hospital at Harvard University described the historic development by different generations in Medical Physics: The "baby boomers" (1945-1965) brought the LINAC into clinical cancer treatment, the "generation X" (1965-1980) the CT, MRI and PET for improved diagnostics, the "millennials" (1980-1995) the 3D-treatment techniques and the "generation Z" (1995-2010) the IMRT and IGRT. As one of the key items that he took from his time at the DKFZ with Wolfgang Schlegel he mentioned the capability to have visions and to further illustrate it, he cited from Angela Merkel's speech at Harvard just a few days before the symposium, that we should not do things because they are possible but because they are important and right to do. So one of his personal visions is to bring proton therapy, which up to now requires large extra facilities, downsize it and have it installed at his department in the same level as the conventional linacs. Furthermore, he characterized Wolfgang Schlegel as a family man having now 11 grand-children and being a role model in personality besides his scientific skills. Wolfgang Schlegel's support for Medical Physics in developing countries in south Asia was the topic of Prof. Golam Abu Zakaria's talk. Prof. Jürgen Debus' laudation summarized Wolfgang Schlegel's scientific outcome. 68 finished

Fig. 2: Speakers an the symposium. From left: Prof. Michael Baumann, DKFZ; Prof. Thomas Bortfeld, Havard, USA; Prof. Jürgen Debus, MD, Univ. clinic Heidelberg and HIT center; Wolfgang Schlegel and wife, Prof. Gerhard von Kaick, MD, DKFZ; Prof. Stephanie Combs, MD, Unv. clinic TU Munich; Prof. Oliver Jäkel, DKFZ; Prof. Golam Abu Zakaria, Hospital Oberberg Gummersbach; Prof. Steve Webb, Royal Marsden, UK. © DKFZ/Kircher

Fig. 3: Standing ovations for Prof. Wolfgang Schlegel at the end of the symposium. © DKFZ/Kircher

PhDs (and one more still to come), 7 habilitations, more than 350 publications in journals as well as books, organizing the DEGRO academy as well as 11 Heidelberg IMRT courses. Setting up an international online master course for advanced physical methods in radio-oncology that originated from a summer school on medical physics that Wolfgang Schlegel organized with his group in Chile. The talks were rounded up by closing words by a close friend of his, Prof. Steve Webb (Royal Marsden, UK), who emphasised their scientific but also personal friendship for many years. In his own closing remarks, Prof. Schlegel summarized his scientific career looking back at three "coincidences": first coincidence was a TV report in 1973 on the DKFZ at Heidelberg that showed a small nuclear reactor and cyclotron for nuclear medics isotope production and diagnostics that showed the application of nuclear physics for the benefit of patients and not only for science. Despite having a job offer by the German railway for applying nuclear techniques to measure the gravel thickness below railway tracks (which would have entitled him to have a train of his own including a jeep on board!), he went to the group of Prof. Lorenz and started working there on the 1st of April 1973. The second coincidence were the Beatles who earned the record company EMI so much money that they allowed Hounsfield to develop the CT. It was at the DKFZ, where the first whole-body CT scanner in Germany was installed, that he later used to develop radiotherapy treatment planning based on CT data. The third and last coincidence was his origin from the German region of Saxony, where people are known as great coffee lovers. So he often met the physician and neurosurgeon Volker Sturm at the coffee place. They exchanged ideas on improving treatment of brain tumours including the promise to each other, that Wolfgang Schlegel would not perform surgery while Volker Sturm would not try to calculate. Wolfgang Schlegel mentioned explicitly the help of the ingenious mechanical engineer Otto Pastyr, who realized many sophisticated technical constructions, that improved stereotactic as well a conformal radiotherapy treatment. Overall it needed not only people with good ideas but also a good working atmosphere to realize them. Success goes hand in hand with failures, therefore it needs sufficient free space for that, too. The overall aim of Wolfgang Schlegel was and still is to improve the cancer treatment for patients. Prof. Schlegel spoke to this point frankly about his own diagnosis of a brain tumour two years ago. He had now seen also as a patient the view of radiotherapy treatments that he and his group developed. He ended with a quotation: Life is like being on the Titanic: one knows, that she will sink. The symposium ended with long standing ovations for him.

Fig. 4: Markus Buchgeister expressing best wishes to Wolfgang Schlegel also on behalf of EFOMP. © DKFZ/Kircher

Prof. Dr. Markus Buchgeister

Beuth Hochschule für Technik Berlin, Germany

Markus Buchgeister entered the field of medical physics in radiation therapy at the university clinic of Tübingen in 1995. In 2010, he received a call for a position as professor for medical radiation physics at the Beuth University for applied sciences at Berlin. Since 2003, he is engaged as co-opted DGMP board member for public relations and communications of the German Society for Medical Physics. Parallel, he served as chairman of the EFOMP Communication and Publications Committee 2003-2009 and from 2009-2015 as German EFOMP delegate. In 2017-2018 he was chairman of the EFOMP Education and Training Committee, being now its past-chairman in 2019 and German EFOMP delegate for a second round.

Prof. Wolfgang Schlegel's council address on behalf of being awarded the EFOMP Honorary Membership in 2018, read on his behalf by Markus Buchgeister during the EFOMP Annual General Meeting in Copenhagen, Denmark.

Prof. Wolfgang Schlegel (Photo: DKFZ/Schwerdt)

Dear EFOMP board members, dear EFOMP delegates

I would like to thank you for the great honour of having been elected as an honorary member of EFOMP. Due to reasons of health, I am unfortunately not able to come to this council meeting myself. Let me address a few sentences to you, concerning my professional track and my relation to EFOMP.

I started my professional career in Medical Physics as a physics-postgraduate in 1973, when I decided to change from basic Nuclear Physics to Medical Physics. I soon recognized that Medical Physics was a much more fulfilling discipline and retrospectively this change was one of the wisest decisions in my life. As a postdoc at the German Cancer Research center DKFZ in Heidelberg I worked in computer processing of Nuclear medicine and CT-images. I participated in the development of 2D- and 3D- planning of radiotherapy and later extended my working field to the development of collimators for radiotherapy, stereotactic radiosurgery, 3D conformal radiotherapy with computer controlled multi-leaf collimators and intensity modulated radiotherapy IMRT. The next steps were image guided radiotherapy and finally radiotherapy with protons and carbon-nuclei. Concluding I can say, that I had the great luck and privilege of having been involved in Medical Physics of ground-breaking innovations of the last 40 years in radiology and radiation oncology, during the last 2 years I experienced these recent developments myself as a patient, and I could convince myself how important and beneficial Medical Physics is in the frame of health care.

EFOMP has always played an important role in my professional life. For many years I have been a lecturer at the European School of Medical Physics (ESMP) in Archamps, teaching stereotactic radiotherapy, 3D treatment planning, IMRT and image-guided radiotherapy. Furthermore I had a very close relation to EFOMP during my time as vice president and president of EFOMP in the years 2006-2010, and as president of the World Conference of Medical Physics in 2009.

I once more would like to emphasize, how delighted I am to become an honorary member of EFOMP, which I consider to be the home of all Medical Physicists in Europe, the organization which has the wonderful and challenging task to foster European Medical Physics, with respect to education and training, science, research and health care. I wish you a successful council meeting, Thank you very much again, Good luck to EFOMP and to all of you!

Wolfgang Schlegel

EFOMP Winter School "Nuclear Medicine Dosimetry, Practical approach"

Let's put some Gy (Grey) in our Nuclear Medicine life…..

The weather is cold, I have a big building in front of me, when I try to get in they ask for the password; "Gy" I say…. "Where?", they respond, "in Nuclear Medicine Therapy", I reply and the door opens.

More than 2.5 Billion euros from some radiopharmaceutical companies will be invested in order to develop new radiopharmaceuticals for therapy in Nuclear Medicine. With that in mind and with the new era of Theranostics upon us, the need for a dosimetry approach is necessary.

For me it was the first time attending an EFOMP School. 40 Medical Physicists dedicated to Nuclear Medicine were all together under the same roof. (Figure 1). The atmosphere was very friendly and a wide range of topics were covered with excellent lectures. The most important thing was the discussions that took part in every lesson which gave us the opportunity to exchange ideas about any kind of problem we have at work, helping us to see it from different perspectives. We got to know each other well and for sure we are going to communicate in the future, helping each other. All of this together made this event a great opportunity to undertake as continuous professional development, which would be to our advantage.

Fig. 1: EFOMP school participants © Jaroslav Ptácek

The course lasted for 3 days in Prague, January 2019, and had as its main topic dosimetry in Nuclear Medicine Therapy. Carlo Chiesa explained to us all the theoretical values that are very important for dosimetry. Diagnostic vs. Therapeutic Nuclear Medicine – Nomenclature (TRT, MRT, SIRT, RIT, etc.) - Aims of dosimetry – Main steps of patient-specific dosimetry were the main aspects that were covered during the first lectures.

Glenn Flux gave us a great opportunity to know each other and tried to light the flame for dosimetry needed in Nuclear Medicine Therapy.

Alex Gil Vergara and Ludovic Ferrer showed us practical computing aspects, on freely available software (Slicer 3D). They travelled a lot of kilometres running around the lecture hall trying to resolve any problems we had during the course. The course involved:

- Input/output Dicom Visualization & RTstruct , Dicom (RT) Segmentation,
- Presentation of a clinical case Definition of the dosimetry workflow Data Input & Visualisation,
- Advanced processing Segmentation CT-CT co-registration Result output,
- Advanced Visualisation Dicom (RT),
- Segmentation and image registration Time activity curve Absorbed dose calculation,
- Presentation of a clinical case Definition of the dosimetry workflow Data Input Visualisation, TAC Fitting
- Absorbed dose calculation
- Post processing and presentation of results
- Presentation of tools that allow increasing traceability of dosimetric calculations (Electronic notebooks)

The school had a great timetable; to be more specific it was divided into 4 sessions on Thursday and Friday: 2 morning parts and 2 afternoon ones with lunch and coffee breaks between them, Saturday had 2 morning sessions. That means that we had time to chat with each other and exchange questions, experiences since we shared the same challenges.

Special thanks are needed to Jaroslav Ptácek, Tereza Hanušová the organizing team for making everything perfect from coffee and tea to managing all needs in the lecture hall.

Konstantinos Dalianis

Medical Physicist, PhD, Medical Physics Department, Hygeia Hospital, Healthcare group, Athens, Greece

Clinical & Research Interest: Medical workers dosimetry for PET/CT & Nuclear Medicine, patient dosimetry and pediatric doses from hybrid SPECT/CT, radiation protection for PET/CT department.

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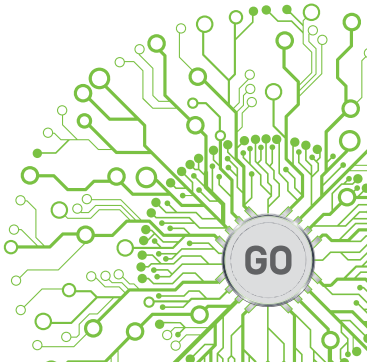

EFOMP Summer School "State of the art and new trends of angiographic equipment: Image quality, Patient and Staff dosimetry"

The beautiful and vibrant city of Prague has already welcomed EFOMP Schools multiple times. But this was the first time that the school was dedicated to the topic of Interventional Radiology. Our radiation protection team (5 people) was particularly interested in this topic, and after checking the detailed program, we had no doubts about our attendance. In retrospect, we are certainly very happy about our participation.

This school entitled "State of the art and new trends of angiographic equipment: Image quality, Patient and Staff dosimetry" aimed to cover a wide range of topics including the main aspects of angiographic equipment and technology, new legislation, and patient and staff dosimetry. The theoretical and practical information was very well balanced in the high-quality lectures. Although the entire atmosphere was nice and relaxed, the programme was quite packed (Fig. 1,2).

The first day started with two presentations from the interventionalists Werner Jaschke (Germany) and Flavio Ribichini (Italy), who gave us an overview of the most common procedures in the interventional and cardiologic fields. The information provided in these talks was extremely interesting and beyond the usual. Unlike all sections performed by a medical physicist to a medical physicist, these lectures provided us with a unique opportunity to see our routine from a different angle. We were able to see our objectives from the clinician's point of view and to understand their requirements and constraints.

Additional attention should be given to the sessions jointly organized with the Committee of the Radiological, Electromedical and Healthcare IT Industry (COCIR). The lecturers from four main vendors of fluoroscopic equipment (Siemens, General Electric, Philips and Canon) presented the newest trends in the field of angiographic equipment, and gave us inside-information on their recent technical developments and dose optimization algorithms. We were eager to hear about the new X-ray tubes employing flat filaments and crystalline silicon detectors presented by Markus Landl (Siemens). It was especially interesting to see real clinical examples showing the advantages (i.e. better image quality or possible dose savings) of the new systems. Andreas Patz (Cannon) presented the two new technologies in fluoroscopic collimation "Fluoro Spot" and Fluoro ROI. The first one allows for dicentric, non-symmetric selection of the region of interest, while the second one provides lesion-focused exposure, while surrounding tissues are imaged through additional filtration, resulting in significant dose savings for both the patient and the operator. We were eager to hear about the new X-ray tubes employing flat filaments and crystalline silicon detectors presented by Markus Landl

— The second day was dedicated to image quality and radiation-dose assessment and ended with a round table where all participants were able to ask the lecturers and the other participants about their vision and experience in solving technical and even ethical problems at work.

This turned out to be a lively discussion which continued during the social dinner in a nice Czech restaurant (Fig. 3).

Fig. 1: EFOMP school participants in Prague, July 2019 © Jaroslav Ptácek

Fig. 2: EFOMP school participants in Prague, July 2019 © Jaroslav Ptácek

Fig. 3: Round table discussions

Saturday was fully dedicated to dosimetry and started with presentations by Annalisa Triani (Italy) and Jenia Vassileva (IAEA) on patient-dosimetry, followed by presentations on staff-dosimetry by Marco Brambilla (Italy) and Filip Vanhavere (Belgium). Honestly, every single presentation in this session would deserve a separate paragraph in this small review, but personally we would like to highlight Filip Vanhavere's presentation "The role of active dosimeters". In 30 minutes, he gave an extensive overview of existing personal dosimeters for real-time dose measurements, explained their advantages and drawbacks for interventional procedures and even was able to provide answers which we had been searching for a while.

Overall, the school significantly expanded our knowledge and gave us the opportunity to share our experience and problems with colleagues from other countries.

It was really great that we were able to participate in this course all together as a group. Besides the possibility to discuss the received information with colleagues, we made use of the time in Prague for team-building and really enjoyed it.

Natalia Saltybaeva

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EUTEMPE-RX Module MPE12
Occupational dosimetry in diagnostic and interventional radiology: Personal dosimetry and competences for MPE with RPE responsibilities

Do you know how to assess the dose to the eye lens? Do you know about the pros and cons of different types of dosimeter? Can you state the typical measurement uncertainties in practical occupational dosimetry? These and other questions will be answered in the EUTEMPE-RX module MPE12, which deals with the technical, practical and legal aspects of occupational dosimetry, with a focus on high dose rate workplaces and their special properties. EUTEMPE-RX is a series of international high-end courses for medical physicists working in hospitals, medical device companies or universities as well as for scientists in related disciplines.

Fig. 1: Hands-On experience in small groups during the session © Markus Borowski

Why should you spend time on occupational dosimetry?

Dealing with occupational exposure and occupational dosimetry are common tasks for most of us. We all know about detrimental effects of ionizing radiation. Thus, in order to quantify the exposure and to limit associated risks, all persons exposed to ionising radiation (non-patients) are under mandatory surveillance. In many hospitals, Medical Physics Experts are involved with this dosimetry and in particular the dosimetry of occupationally exposed personnel. They have to select and assign dosimeters, guarantee their correct usage, evaluate the results and advise clinicians and other exposed staff.

In order to fulfil this task with a high level of expertise, a broad theoretical background on legal, technical and epidemiological aspects is mandatory. However, even more relevant is the practical competence to evaluate different clinical exposure situations, assess features of new dosimeter types and not at last communicate relevant aspects to staff from other clinical disciplines. There are a number of different approaches to implementing personnel dosimetry e.g. depending on prospected dose rates and exposure situations, requirements for additional extremity or eye lens dosimetry or if time resolved dosimetry is required. As medical physicist in charge, you are expected to advise on the appropriate use of dosimeters, and how to interpret the measurement results.

The course MPE12 is designed to address these challenges on a high international level and will enable you to deal with situations where personnel dosimetry is concerned, as well as to help you in training radiation protection staff.

The course starts with a prior e-learning phase, providing a comprehensive insight into the different personnel dosimetry techniques and all the information you need to make sound decisions regarding personnel dosimetry in a clinical setting.

The theoretical part will cover in particular the following topics:

- Radiobiological and epidemiological basics
- Detection principles of passive and active dosimeter systems and their practical consequences
- Assessment of uncertainty budgets within dosimetry measurements
- Legal regulations on the European level and within different member states
- Motivation and communication strategies to promote personnel dosimetry

What really makes this course unique, however, is the on-site phase in Braunschweig, Germany, where we focus specifically on practicals, expert discussions and excursions.

We spend two full days providing hands-on experience in groups of three to four using clinical equipment and assessing real clinical exposure situations.

One day is assigned to study characteristics of active & passive dosimeters under lab conditions. The results will provide the

crucial feeling for device specific applicability, limitations and measurement uncertainty. Guided by expert tutors, you will develop scientific questions and measurement protocols and experimentally answer them. The small working groups enable you to raise your specific ideas, questions and solution suggestions. You are welcome to analyse thoroughly equipment used in your clinic as well. You will leave with the competence to assess other equipment following you specific needs.

The second day will take you to real life operating theatres and intervention sites, like a hybrid operation room, a cath lab or an angio suite. You will have the opportunity to closely observe and quantify exposure situations at these workplaces, to experience clinical routine and limitations of real life conditions. In addition, you may liaise with clinicians to discuss clinical impact and context . Repeating that exercise at your home site will definitely improve the situation for the observed group as well as their appreciation for your work.

Further highlights are two excursions. One trip takes you to the Dosimetry Service in Berlin. You get to look behind the scenes of such an institution, providing legal dosimetry services for thousands of professionals per month and gain a deeper understanding of their processes and quality assurance tasks. At the excursion to the national metrological institution of Germany (PTB), you will visit the world's first reference source for pulsed radiation, needed to test active personal dosimeters. The PTB is strongly engaged in occupational dosimetry and corresponding new developments for years. You will get first-hand information and will have the opportunity to discuss basic metrological challenges with their internationally renowned experts.

The vivid exchange at numerous occasions quickly became the heart of all EUTEMPE courses and very much appreciated by all recent participants. As part of the MPE12 course you benefit from sharing your opinions, experiences and approaches with other like-minded that likely face similar challenges as you.

You will leave the on-site phase in Braunschweig with a bucket full of impressions, a comprehensive knowledge and practical experience on personnel dosimetry and many new contacts that will help you solving future challenges.

– Leaders: Dr. M. Borowski, Klinikum Braunschweig and Prof. Dr. M. Fiebich, University of Applied Sciences, Giessen.

Photo: COPYRIGHT holder Klinikum Braunschweig - P. Sierigk

Dr. Markus Borowski,

Institute of Diagnostic Radiology and Nuclear Medicine, Klinikum Braunschweig / Germany.

Dr. Markus Borowski is head of the medical physics division at the Institute of Diagnostic Radiology and Nuclear Medicine at the Klinikum Braunschweig. He is a member of several competent medical authorities and strongly engaged in the German standardization system. For many years, he has been a regular organizer and teacher in medical physics and radiation protection in particular. He was project leader in several scientific projects of the German federal ministry of the environment, inter alia dealing with topics of personnel dosimetry and quality assurance in radiation diagnostics.

Prof. Dr. Martin Fiebich

University of Applied Sciences, Giessen / Germany

Prof. Martin Fiebich is professor for medical imaging at the University of Applied Sciences in Giessen. He is convenor of the working group "Image Acquisition Systems" of the DIN Standards Committee "Radiology". He is member of the Competent Medical Authority in Hesse. In the German Commission on Radiological Protection he works in the committees "Technical Radiation Protection" and "Organ-equivalent doses". He is member of the board of the German Society for Medical Physics (DGMP). Research interests in image quality analysis, quality assurance, Monte Carlo simulations in medical imaging

EUTEMPE-RX Module MPE11 - Dose management of pregnant patients, pregnant staff and pediatric patients in radiology

Radiation Protection for Bumps, Babies and Beyond

This is the second time Module 11: Dose management of pregnant patients, pregnant staff and ''pediatric patients in radiology has been delivered as part of the EUTEMPE training scheme. This course started on the 01st of April this year and finished on the 25th of May. There was a wide mix of nationalities represented in the participants including: Ireland, UK, Sweden, Belgium, The Netherlands, Serbia, Italy, Surinam, and America. I applied quite last minute for this one, but was glad I did and that they could accommodate me!

The course is headed by Professor John Damilakis, who many people will be familiar with through his extensive research publications on radiation protection and dosimetry, and recent presidency of EFOMP among a multitude of other medical physics commitments and interests. He is joined in the delivery of the course by a number of his local colleagues from the Medical Physics department in Heraklion, as well as guest lecturer Virginia Tsapaki – another well-known international Medical Physicist.

Fig. 1: Module 11 Participants - Heraklion, Greece May 2018

Similar to the previous module I completed, this one is also based on the Moodle platform with a total of 21 "Chapters" for participants to cover over the month of April. Following the completion of the online content, a very concise literature review was submitted on one of the chosen topics by the 20th of May – this accounted for 20% of the course marks. The the face-to face section, lasting a week, was in Heraklion in Greece from the 21st to 25th of May. At the face-to-face section there was both an exercise and an exam which accounted for the remainder of the course marks.

Having done another course previously, I knew I had to put my head down and get reading to get through the online content. Whenever I put a query on the forum at the end of a chapter, the teaching staff were always prompt and helpful in their response. Chapter length varied depending on topic being covered, and in each area being addressed had a separate chapter for conceptus/pregnant patient and paediatrics. The course did start at the very beginning for areas such as Biological effects, which I felt that most Medical Physicist should already know if they are aiming towards MPE status. But if you have not worked much in the paediatrics radiology field, starting at the very beginning was necessary to deliver all the relevant background information. The amount of detail for each side was wide ranging, but in general there was plenty of information on the topic being covered. In instances where participants were to do their own reading on a topic, guidance for relevant articles for Medical Physicists would have been appreciated. Some chapters, such as those covering Mathematical phantoms and Monte Carlo codes, made more sense when covered in the face-to-face section as we got a chance to trial the software or watch demonstrations of it in action. Perhaps one of the most useful aspects of the course was the chapters covering absorbed dose via critical review of the literature. This provided plenty of research articles from which dose calculations for various situations could be based. Another useful tool introduced in this section was the CODE software – an EU project on conceptus dose and risks from imaging with ionising radiation. But more on that later.

Content sufficiently covered, I chose my literature review topic, and found that there was plenty of time to complete the assignment in advance of the face-to-face section. The only difficulty I found was the succinct nature of the assignment – but it managed to focus my attention to provide the most relevant information in a summarising fashion! Then it was time to

pack the suitcase for some guaranteed sunshine in Heraklion. I had met one of the other participants at a meeting in the UK so we had both arranged to stay in the same hotel, in order to share the adventure of travelling to the course each day. As it turns out, there were two other participants also in this hotel, so for the rest of the week all four of us travelled to the course together and shared our experiences as medical physicists in our respective countries.

Fig. 2: Day 3 Practical session on CT optimisation using a Paediatric phantom

The face-to-face section was a more practical application of the knowledge we had gained through the online course, including a recap of some of the more important aspects. The day usually involved some presentations on theory followed a practical session. This allowed participants to debate ideas and share experiences from local / national approaches in the area of pregnant patients and paediatrics. It was a good mix, which meant participants weren't overwhelmed by a day taking in theory, and conversations surrounding method of radiation protection continued over breaks and lunch.

In particular, I felt the session where we were performing dose calculations and comparing results from different methods in literature highly useful, as it is a cost effective way to provide a dose estimate if you have no access to software. The other session that was especially useful was the demonstration of the CODE software for calculation of conceptus dose following a variety of different examinations. This software also allows calculations of occupational dose for fluoroscopically guided interventional procedures. For more information see http://embryodose.med.uoc.gr/code/about.php

The evenings were nice and balmy encouraging exploration of the city, and a well-deserved ice-ream (there was a multitude of good ice-cream shops!). The tutors had provided us with a suggested list of places to see and eat – I always like to get a local recommendation to try out when I visit somewhere new.

Fig. 3: The Hosts and Attendees at Erganos Restaurant, Heraklion

We had a group dinner on the Thursday evening in the lovely traditional restaurant, Erganos, in Heraklion, which again provided a time to learn more about others experiences of Medical Physics in other countries over a banquet of food – tasty morsels never stopped coming from the kitchen!

There was a short exam on the Friday afternoon, after which almost half of us decided to do some sightseeing as a reward for completion of the course. So it was off to the local Minoan Palace ruins at Knossos, followed by another tasty dinner, this time in "Peskesi".I would highly recommend this gastronomical delight!

Overall, I found this course very beneficial and would recommend it to others. Again, undertaking an external course such as this accounts for plenty of CPD credits towards the Category 1 points and also provides you with a recognised European MPE qualification – useful in the context of the BSS and new Irish Legislation due soon! For more information please see http://eutempe-net.eu/

Naomi Mc Elroy

Senior Medical Physicist, Tallaght University Hospital, Ireland

Naomi Mc Elroy B.Eng. M.Sc., has been working in the field of Medical Physics for the past 16 years. She works as a Senior Medical Physicist in Tallaght University Hospital, Dublin. Her work focuses on diagnostic imaging and nuclear medicine services for both adult and paediatric patients. She has been the Honorary Treasurer for the Irish Association of Physicists in Medicine (IAPM) for almost two years and is registered as an MPE with the Irish College of Physicists in Medicine (ICPM).

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European Journal of Medical Physics - Being an associate editor

Professor Paolo Russo, editor-in-chief of Physica Medica: European Journal of Medical Physics (EJMP), asked me to recount my experience as associate editor of our journal. I am grateful for this request as I am honoured to be part of the EJMP family.

My history with EJMP started in 2010 when I submitted a paper reporting the application of a thermoluminescent dosimeter in nuclear medicine. At that time, the impact factor of Physica Medica was less than 0.5 and, thus, it was not my first choice. Radiotherapy & Oncology and IJROBP journals were my first choices, with 8 and 7 papers published respectively in these journals.

In 2015 I joined EJMP as part of the editorial board and in 2016 I was appointed associate editor. At that time I was associate editor of the Journal Applied Clinical Medical Physics, thus I had a previous experience on how to manage an article from the editorial point of view. However, it was clear to me that EJMP had a strong desire to became a leading journal in physics applied to medicine.

I usually spend more than 2 hours per week in managing the papers. To date, I have acted as associate editor for 83 submitted papers. Of these, 30 were accepted for publication; 48 were rejected (61%, in line with the journal rejection rate); and 5 are currently under review or awaiting resubmission. I also acted as an invited editor, together with Professor Andrew Nisbet from the University of Surrey and Nuria Jornet from Hospital Sant Pau-Barcelona, for the first virtual issue of the journal on lung SBRT (https://www.physicamedica.com/content/LungSBRT).

Now EJMP is my reference journal for publishing my best research. Meanwhile, I take every opportunity to increase the visibility of our journal. Since 2016, I have published 16 papers in EJMP. As a matter of fact, my submitted paper on total marrow irradiation, that was part of my PhD dissertation, was rejected by our journal. Of course, I am not happy at this result, but nevertheless it is an indication that the level of our journal is high and that, also for an associate editor, it is difficult to have a paper accepted by EJMP.

I take this opportunity to recommend you to submit your best research to our journal!

Pietro Mancosu

Pietro Mancosu obtained his PhD in medical physics from Aarhus University, Denmark. Author of >100 papers (>50 as first or last author with H-index=29), he is senior Medical Physics deputy to research at the Humanitas Cancer Center in Milan (Rozzano), Italy. His main scientific activities included physics of SBRT; motion management for RT target definition and compensation during the delivery; total marrow irradiation; comparison between RT techniques, IGRT with non ionization methods. In particular, his research interest on physics aspects of SBRT gave him the opportunity to lead the working group of the Italian association of medical physics regarding SBRT that published >20 papers in the last 5 years.

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Ion Beam Tracking: Pin-pointing the location of the Bragg peak real-time in Patients

Contribution from EFOMP Scientific Committee members

The main argument for the use of ion beams (protons or carbon ions) in radiotherapy is their ability to lower the deposited dose to surrounding healthy organs, because of the Bragg peak. However, due to the steep dose gradient at the distal edge of the Bragg peak, uncertainties in the determination of ion range can have a profound impact on organs adjacent to the tumor. Incorrect range predictions may cause an overshoot or undershoot of the Bragg peak respectively lowering the tumor dose or increasing the delivered dose to adjacent organ.

Clinically the uncertainty in the range predictions is accounted for by adding a margin around the tumor to address all possible shifts of the Bragg peak. We thus voluntarily irradiate nearby healthy organs to guarantee that the cancer gets full dose, which can lead to severe side effects for the patient. In addition, ion beam treatment directions are often selected that avoid placing the sharp falloff of the Bragg peak near or directly on the edge of an adjacent healthy organ that is sensitive to radiation.

In order to maximize the benefit of ion beam therapy, it would be desirable to verify real-time the range in patients. The state-of-the-art for in-vivo range verification methods was reviewed by Knopf [1], where technologies such as implantable markers, radiography, prompt gamma imaging, positron emission tomography (PET) and MRI were presented and discussed. Prompt gamma imaging (PGI) has become the most promising technique for real-time in-vivo range verification, offering an instantaneous snap-shot of the location of the Bragg peak in the patient and not being affected by biological washout or organ motion. PGI was initially proposed in 2003 by Stichelbaut [2] at the PTCOG meeting, for online verification of the ion range. The first experimental evaluation of PGI was performed on a 38 MeV proton beam in 2007 [3], using CsI(Tl) scintillator as the primary detector of the prompt gammas. Since 2007, several research groups have tried to develop PGI technology for use with 1) proton beams using cyclotrons [4-8] and 2) ion beams using synchrotrons [9-10]. The critical aspect for a successful application of PGI in patients is the efficient detection of the secondary prompt gamma radiation leaving the body relative to the large background signal coming from scattered photons and neutron activated gammas. Most PGI systems are photon counting systems that integrate the photon signal arriving at the detector [5], while others use energy (prompt gamma spectroscopy, PGS [4]) or timing (prompt gamma timing, PGT [7]) to separate the prompt gammas from the background.

Ongoing radiation oncology medical physics research in Heidelberg focuses on developing novel PGS imaging technologies to allow real-time Bragg peak verification in patients for protons, Helium, Carbon and Oxygen ion beams available at the Heidelberg Ion Therapy (HIT) facility. The HIT facility uses a synchrotron to accelerate ions for therapy, which generates approximately continuous radiation. In order develop PGS for the HIT facility a dedicated trigger was developed to time-stamp each ion entering the room, with timing resolution of less than 1 ns. The PGS system being developed in Heidelberg, will be composed of a 1) trigger to time stamp each ion entering the room, 2) a primary detector composed CeBr3 scintillator with approximately 1.5-3.0% energy resolution in the MeV range of the emitted prompt gammas and 3) a BGO Compton suppression system to reduce the background continuum. The goal of the novel PGS being developed at the HIT facility for ions is to allow real-time verification of the Bragg peak location in the patient.

References are shown on page 80

Professor Joao Seco

Division of Biomedical Physics in Radiation Oncology, DKFZ, Germany

Prof. Seco graduated with a PhD from the University of London, at the Institute of Cancer Research (ICR) and Royal Marsden Hospital in London, UK. He then went on to become an Assistant Professor of Radiation Oncology at Harvard Medical School in Boston, working at the Massachusetts General Hospital (MGH). He then returned to Europe to work at the German Cancer Research Center, DKFZ in Heidelberg, heading up a new group dedicated to ion beam research and with the focus on 1) novel imaging technologies to reduce Bragg peak positioning errors in patients and 2) on investigating the mechanism of radiation triggered DNA damage via reactive oxygen species. He is also presently the Chair of Medical Physics at the Department of Physics and Astronomy, Heidelberg University and is a member of the EFOMP Scientific Committee, representing the DGMP, German Society for Medical Physics.

Future perspective in NTCP modelling

Since the late '80s the radiation oncology community has recognized the importance of estimating the response of normal tissue to radiation therapy (RT) to better evaluate the clinical cost/benefit ratio of a proposed therapeutic strategy [1]. NTCP models able to robustly predict radiation-induced morbidities (RIM) play an essential role in the identification of a personalized optimal plan, and represent the key to maximizing the benefits of technological advances in RT. The most modern RT techniques pose new challenges for NTCP modelling. The conformality rush of the last decade revealed the existence of radiobiological phenomena that were either concealed or disregarded in the classical RT treatment strategy. On the one hand, the progressive sparing of healthy tissue permits to focus on toxicity outcomes that would have been neglected in the economy of past RT modalities. On the other hand, the increasing heterogeneity of dose distribution to healthy tissue highlights unprecedented dose-response patterns and, as a result, emphasizes the limit of the traditional Dose Volume Histogram(DVH)-based toxicity analysis and NTCP modelling philosophy. At the same time, the high sparing capability of modern techniques demands for more and more accurate insights of possible avoidance regions within a specific OAR for a knowledge-based plan optimization.

Against this background, recently, our research group, which is made up of research scientists with a background in medical physics, theoretical physics and biomedical engineering, focuses its research activity on the understanding of the mechanisms underlying RIM by the analysis of local dose response patterns.

With this in mind, we embraced the philosophy of voxel-based (VB) schemes, which have been recently introduced in the context of radiation oncology, following the excellent example set by the neuroimaging community.

Our typical VB analysis consists of two main processes (see Figure). In a first phase, the planning CT scans of the patient cohort are spatially normalized to a common anatomical reference, and the associated doses are consistently warped. In a second phase, the statistical analysis of regional dose differences among patients with different outcomes is performed, according to a permutation test designed to counteract the multiple comparison problem that arises when the null hypothesis is simultaneously tested on a large number of voxels. At the same time, the statistical analysis is expressly designed in order to adjust the dosimetric findings for confounding factors (i.e. non-dosimetric covariates).

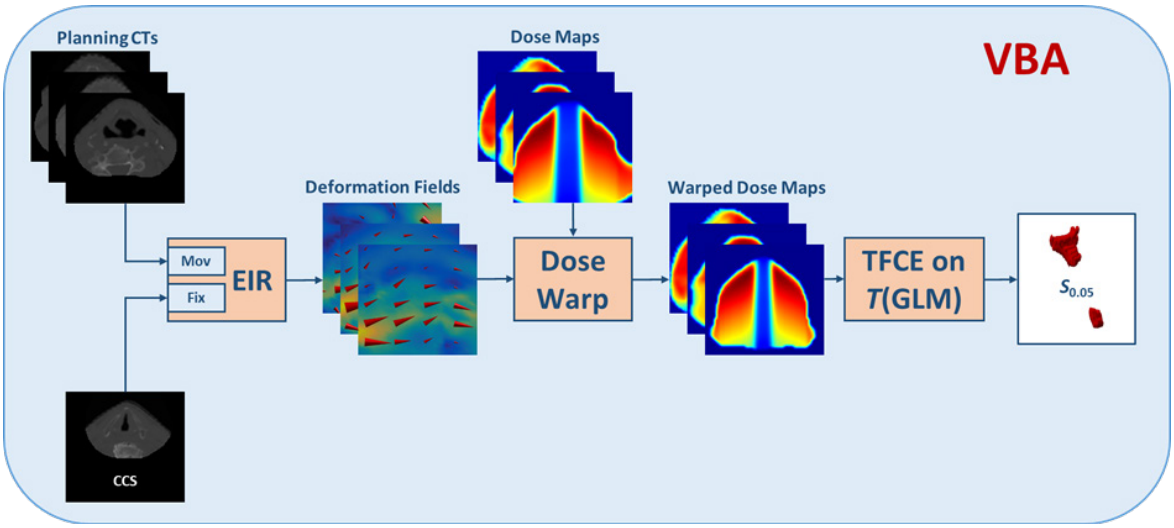

Fig. 1: Schematic flowchart of the voxel-based (VB) analysis: the planning CTs are registered to the common coordinate system (CCS) by an elastic image registration (EIR) tool. The obtained deformation fields are used to warp the dose maps into the CCS. A statistical mapping scheme (TFCE) is applied to extract the clusters of voxels (S0.05) significantly associated with higher doses released in patients developing the radiation induced toxicity.

Exploiting different expertise within our VARIATION (Voxel bAsed RadIATIon ONcology) Lab, we have successfully applied the VB analysis to different cohorts of patients to investigate different endpoints. In particular, the VB strategy applied to head and neck tumour patients treated with RT successfully allowed us to identify correlations between radiation-induced dysphagia and local dose release, thus providing a new insight into the spatial signature of radiation sensitivity in a highly composite region like the head and neck [2]. A large part of our activity has been devoted to probe the regional radiation response within the lungs. To this end, cohorts of thoracic cancer patients (supradiaphragmatic Hodgkin Lymphoma and lung cancer) treated with diverse RT modalities (conformal RT, IMRT, SBRT or protons) were VB-analyzed [3-5]. All these studies highlighted that the dose to the parenchymal region in the middle and lower lungs is correlated with radiation-induced lung damage. Interestingly, the significance patterns also showed the involvement of the heart in radiation-induced lung damage [4, 5]. Furthermore, analyzing a randomized trial of IMRT vs proton therapy for non-small cell lung cancer [4], the VB analysis not only substantiated previously reported hypotheses on the prominent role of the lower parts of the lungs in the development of radiation pneumonitis, but, most importantly, when applied to treatment modality, showed that the regions significantly spared by protons were those apparently not strongly sensitive for radiation-induced lung damage, thus shading light on the inconsistency between dose differences between protons and IMRT and the similar incidence of radiation pneumonitis in the studied trial. This finding represents an example of organ regional radio-sensitivity that should be considered in clinical practice for the effective design of future clinical trials comparing RT modalities.

The on-going developments focus on a modern NTCP approach that could include the recent voxel-based evidence on organ radiobiology. We recently devised a mathematical solution, named Probabilistic Atlas for normal tissue Complication Estimation (PACE), for the statistical modelling of NTCP that allows to deal with inhomogeneous organs susceptibility [6].

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Laura Cella

Laura Cella is Research Scientist @ IBB-CNR, Consultant Medical Physicist and Adjunct Professor @University of Naples. Her research activities have constantly been focused on the Physics of Radiation Oncology. Her activity within the VARIATION Lab is dedicated to image based modelling approaches, incorporating machine-learning methods, for clinical radiobiological studies and for radiation therapy optimization.

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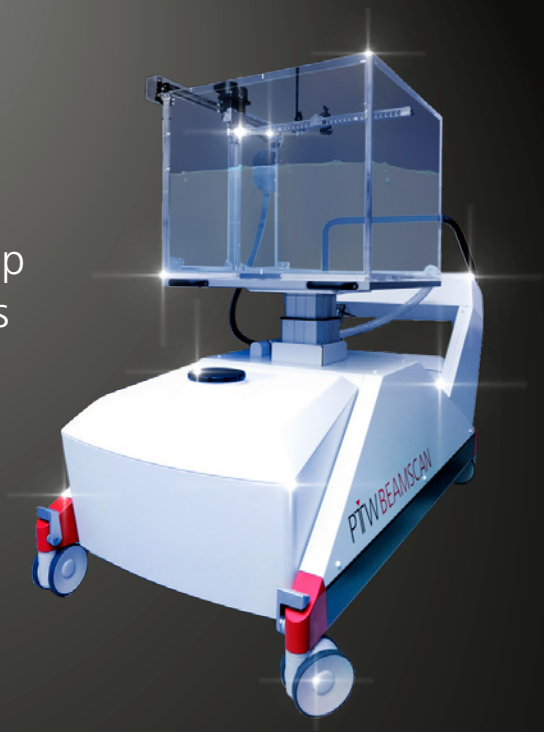

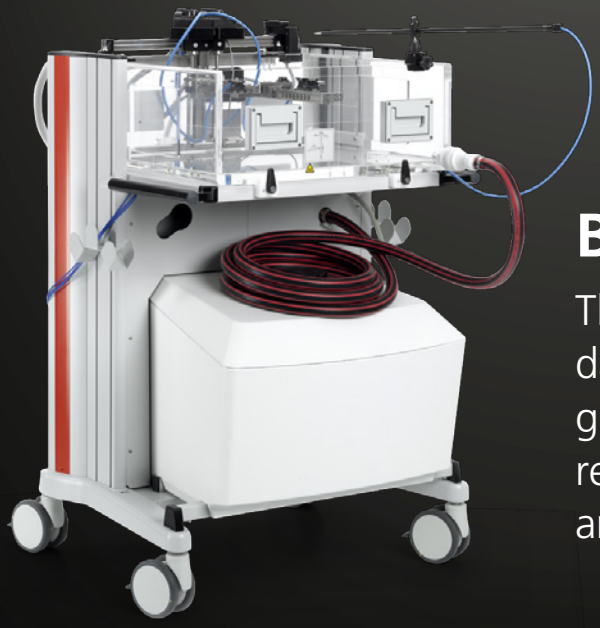

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Virtual clinical trials in 2D and 3D X-ray breast imaging

The current gold standard technique for breast cancer screening and diagnosis is 2D full-field digital mammography (FFDM). However, its two-dimensional nature limits its performance. Indeed, FFDM produces 2D projections of the 3D breasts, causing tissue overlapping in the final images which may hinder the detection of massive lesions, in the radiological interpretation. Pseudo-3D (digital breast tomosynthesis – DBT) and 3D (computed tomography dedicated to the breast – BCT) breast imaging techniques entered the clinical practices in the last years. The former produces 3D images of compressed breast with non-isotropic resolution, with reconstructed voxel sizes in the order of 1 mm x $(0.1\ mm)^2$; DBT is undergoing extensive clinical trials also for evaluating the possibility of its use in screening exams as a substitute to FFDM. BCT scans the uncompressed breast and it permits avoidance of the discomfort caused by the firm breast compression adopted in FFDM and DBT. BCT produces 3D images of the breast with isotropic resolution in the order of $(0.25\ mm)^3$.

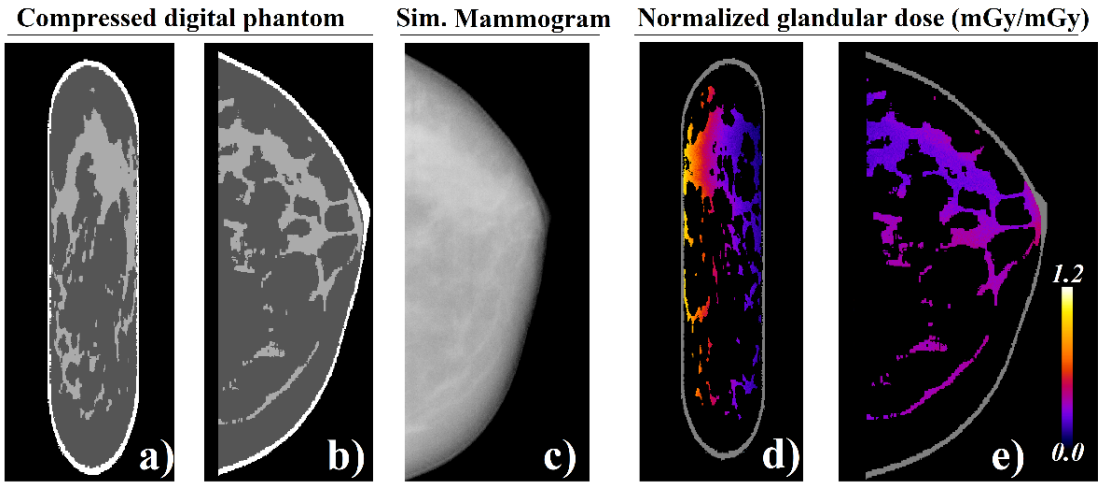

Fig. 1: a) coronal and b) axial slices of one compressed breast digital phantom; c) simulated mammogram of such a digital phantom at 28 kV (W/Al), MGD = 0.01 mGy; d) coronal and) mid plane axial view of the normalized (to the incident air kerma at the breast surface) glandular dose map.

DBT and BCT techniques are compared to FFDM in clinical trials in order to show their merits for screening or diagnostic breast imaging. However, clinical trials present several ethical issues, huge costs, long realization times and the need to recruit large patient cohorts for relevant statistical significance. In addition, comparing the different technologies and scanner optimizations requires multiple patient exposures with an increase of absorbed radiation dose and an increase in the risk for radio-induced diseases.

Virtual clinical trials (VCT) represent a novel approach to the above issues. VCTs are in-silico reproductions of medical examinations with simulated devices, digital model of patients and automatic analysis systems. VCTs are largely adopted in pharmacology and cosmetic testing and in treatment outcome predictions; lately they entered the field of medical device development and represent an emerging approach in testing and developing apparatuses in radiology.

A project for VCT in X-ray breast imaging has just started, involving the medical physics groups of University Federico II & INFN, University of California Davis (Prof. J. Boone) and Medical University of Varna, Bulgaria (Prof. K. Bliznakova). We are developing a platform based of Monte Carlo simulations and patient-like digital phantoms for VCTs in 2D and 3D breast imaging. Digital breast phantoms are produced by means of tissue classification of high-resolution 3D breast images acquired via the BCT scanner at UC Davis. These are digitally compressed via software developed at Univ. Varna in order to reflect the shape of the breasts undergoing FFDM and DBT.

A Monte Carlo software, based on Geant4 toolkit, permits calculation of X-ray projections of the pendant breast (for 3D imaging) and of the compressed breast (for FFDM and DBT in-silico studies), as well as glandular dose distribution within the organs. As examples, figure 1 shows a compressed digital breast phantom (fig. 1a,b), the Monte Carlo simulated mammogram (fig. 1c) and the calculated glandular dose distribution (fig 1d,e) (normalized to unit air kerma). Figure 2 shows the real 3D breast image (fig. 2a) as well as the relate digital breast phantom (fig. 2b) and the simulated 3D image (fig. 2c).

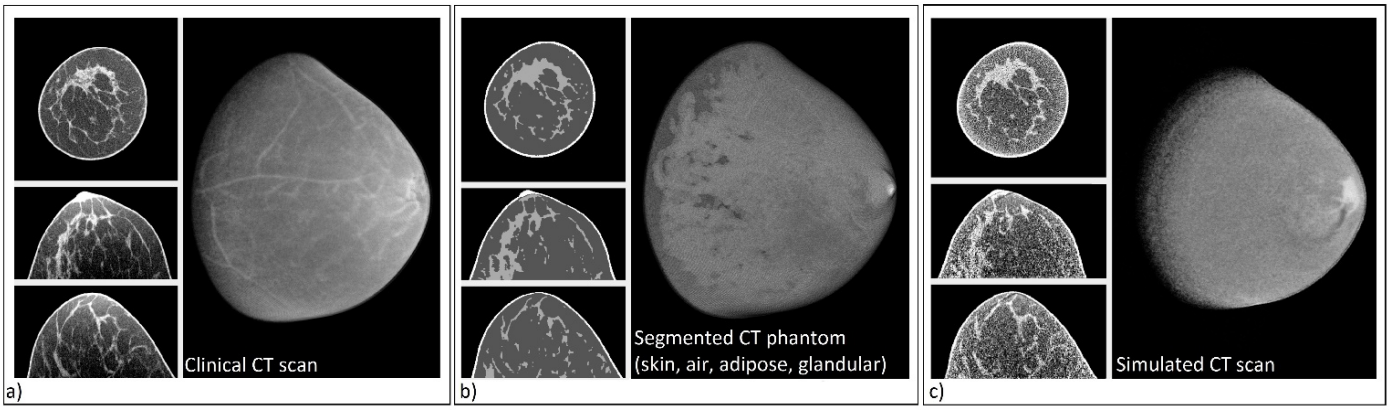

Fig. 2: a) Slices from a clinical BCT scan at UC Davis (80 kV, ~5 mGy of MGD); b) digital breast phantoms produced by tissue classification of real scan; c) simulated BCT (49 kV, ~0.5 mGy).

As a post-doc working in the group of medical physics at Univ. Napoli Federico II, recently I have submitted a proposal, as principal investigator, in the framework of a young-investigator's call for research funding by an Italian national research Institute (INFN). It is a two-year research project aiming at contributing to the realization of the first platform for virtual clinical trials in X-ray breast imaging and dosimetry. This project joins groups of medical physicists at INFN branches of Napoli, Pisa and Ferrara (Italy) to specifically develop i) the population of digital breast phantoms needed for the international VCT trial in DBT imaging, ii) machine learning approaches for image segmentation necessary for tissue classification (glandular, adipose, skin), iii) specific digital phantoms of the compressed breast for simulating contrast-enhanced spectral mammography.

The evaluation of this proposal is expected after summer 2019: fingers crossed, I will have more news in the near future!

Antonio Sarno, PhD

Universita' di Napoli Federico II Dipartimento di Fisica "Ettore Pancini", Napoli, Italy, sarno@na.infn.it

Antonio Sarno received his PhD at the University of Naples "Federico II" in 2017, where he is now a post-doc researcher. His work focuses on the development of Monte Carlo codes for dose estimates and image quality optimization in X-ray breast imaging. He is also involved in INFN projects on frontier applications for diagnosis and treatment of breast cancer.

QAELUM: Can CT Image truncation cause false dose alerts?

EFOMP Company member news

One of the main benefits of a radiation dose management system is the possibility to automatically generate alerts when the dose exceeds certain thresholds. These dose thresholds are mainly based on national Diagnostic Reference Levels (DRLs) which are defined for a standard-sized patient. An advanced dose management system offers the possibility to automatically select the group of patients by defining a patient size range in terms of weight, effective diameter or Water Equivalent Diameter (WED). As weight is not always filled in, WED, an attenuation-based metric, has become the favourite parameter to indicate patient size. But how accurately is WED calculated? Are we sure that our group of standard-sized patients does not include patients with wrong size calculation? Especially when everything happens automatically, how can we prevent that a high dose alert does not indicate a bigger patient for whom the size was not correctly calculated?

Automatic calculation of WED by a dose management system can be performed from the CT localizer image or the reconstructed axial images. The difficulty in using the localizer lies mainly in the different calibration of pixel values in terms of water attenuation between vendors/scanner models/software versions, the inclusion of table attenuation, the use of edge-enhancement filters and the wrong positioning that can magnify or minify the patient's image. The reconstructed axial CT image is presented as an accurate way to measure the WED of the patient on the condition that the full patient tissue is included in the image[1,2].

But what happens if the axial image is truncated? Can it still be used to estimate the WED?

Our research team performed a study to investigate the effect of image truncation on the calculation of water equivalent diameter for chest and abdomen CT scans. We used a set of CT examinations (286 thorax and 222 abdomen CTs) for which the middle slice was not truncated and then we intentionally truncated the images up to 50% (Figure 1). Non-truncated WED values were compared to truncated values. The results indicated that for truncation percentages below 20%, the underestimation of the WED was rather small and no correction was needed. For larger truncation percentages, the difference between the non-truncated and truncated WED became larger and correction factors3 could improve the calculation of WED. The results were presented at the European Congress of Medical Physics (ECMP 2018)[4].

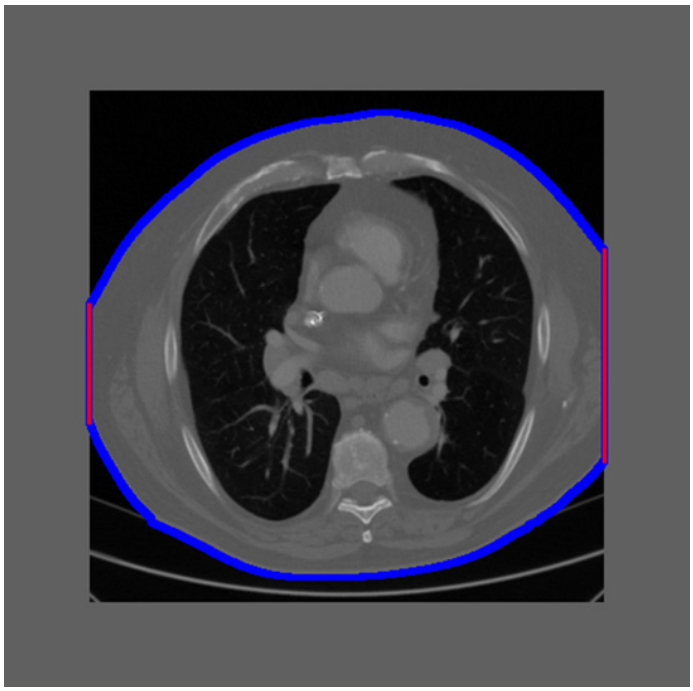

Fig. 1: Example of an intentionally truncated CT image. The truncation percentage was calculated as the ratio of the patient border touching the field of view to the total patient border $\left(\frac{red}{red+blue}\right)$.

The study was then broadened to evaluate the effect of truncation on the Size Specific Dose Estimates (SSDE) calculation (Figure 2). Improvement of SSDE calculation and reduction of false notifications was observed for truncation percentages up to 40% when correction factors were applied to WED. The results were presented at AAPM 2019.

Although defining the Diagnostic Reference Levels for a specific patient size range allows to exclude overweight and obese patients, the truncation of the image could lead to a bigger patient being falsely identified as "standard-sized" and generate a dose alert. Knowing the effects of truncation on the calculation can assist in excluding dose alerts from the daily workload.

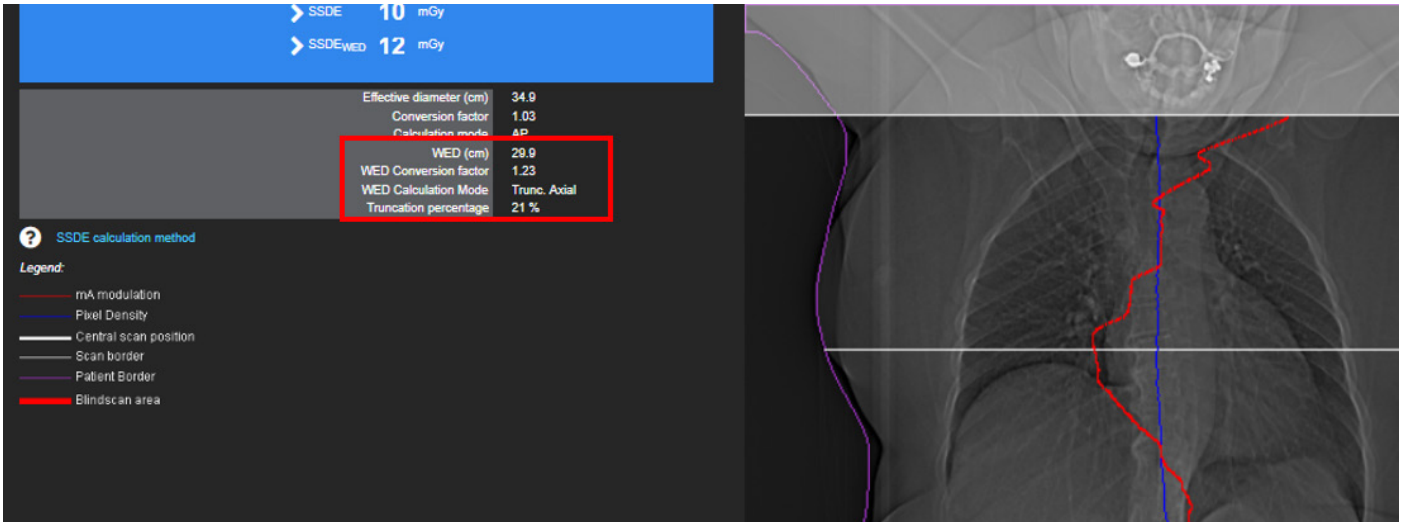

Fig. 2: Example calculation from truncated images. A message indicates that WED and SSDE should be evaluated with care, as the calculation may not be accurate (screenshot from DOSE, Qaelum).

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Niki Fitousi,Ph.D

Niki Fitousi, PhD, is a certified medical physicist from Greece, currently working in Belgium. She is a member of the Hellenic Association of Medical Physicists (member of EFOMP). Her professional experience includes work in all fields of Medical Physics (Radiation Therapy, Diagnostic Radiology and Nuclear Medicine). She is now the Head of Research in Qaelum, focusing mostly in the field of dosimetry and image quality in medical imaging

An Dedulle

An Dedulle has a master degree in Medical Radiation Physics (University of Leuven, Belgium). She is currently employed at Qaelum NV (Belgium) as a PhD researcher. Her PhD project is titled "Personalized patient dosimetry and risk assessment in radiology" and is conducted in cooperation with Qaelum NV and the University of Leuven (unit of Medical Physics & Quality Assessment). The PhD project is funded by the Flanders Innovation & Entrepreneurship agency [grant number HBC.2016.0233].

RTSAFE: Patient-specific dose verification in advanced radiotherapy applications: A clinical case study using the Personalized PseudoPatientTM technology

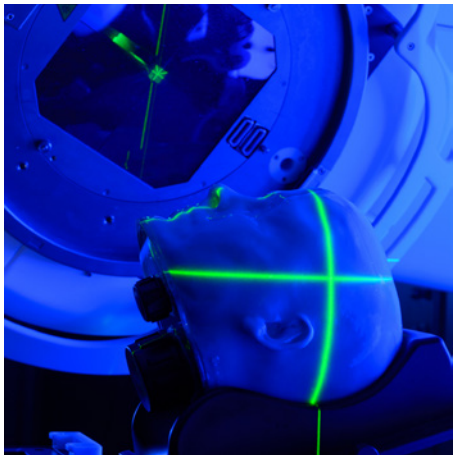
EFOMP Company member news

The wide use of stereotactic radiosurgery (SRS), intensity modulated radiation therapy (IMRT) and volumetric modulated radiation therapy (VMAT) treatment approaches for the management of a variety of brain lesions, has resulted in safer treatments and a better quality of life for patients than ever before. Contemporary single-isocenter linac-based SRS is an effective first-line treatment for patients with brain metastases, compared to whole brain radiotherapy. At the same time, treatment planning and dose delivery are becoming ever more customizable to individual patients. Plans characterized by high levels of conformity and steep dose gradients from the periphery of the target to surrounding tissue are created, using a single isocenter and non-coplanar arcs.

Such complex treatments and the consequences of errors when delivering high-dose fractions of radiation just millimeters beyond their intended site, can have a far-reaching physiological impact. Therefore, the need for pre-treatment dose verification in the actual patient's anatomy in order to minimize the possibility of unintended exposure, either of overdose or underdose, is never more critical.

Patient-specific end-to-end quality assurance procedure

Patient-specific quality assurance (QA) procedures for cutting-edge therapies of the brain must be performed in an End-to-End manner so that measurements of the geometric and dosimetric accuracy can verify the effectiveness and safety of the treatment. In order to achieve this goal, phantoms dedicated for patient-specific QA purposes should meet certain specific requirements: to replicate the shape and dimensions of the patient's head, not to perturbate the dose in non-coplanar fields, to be suitable for off-axis dose measurements, to provide a realistic contrast in MR and CT imaging and to be compatible with MR/CT/CBCT/MV imaging, as well as, patient immobilization and set-up equipment.



To meet these prerequisites, RTsafe has developed the 510(k) FDA cleared Personalized PseudoPatient™ technology. This patient-specific QA approach combines 3D-printing technology using bone and soft tissue mimicking materials, along with the latest developments in dosimetry. Personalized PseudoPatient phantoms comprise a patient-specific End-to-End QA tool with an excellent level of dosimetric and anatomic equivalency between the actual patient and the phantom. Moreover, the realistic bone and soft tissue contrast in both MR and CT imaging enables the direct fusion of the phantom images with the real patient's during image guidance.

Clinical Case Study using RTsafe's Personalized PseudoPatient™

In this study, the Personalized PseudoPatient approach was implemented for the patient-specific QA of 11 VMAT cases, including either stereotactic or re-irradiation cases of primary or recurrent brain or head and neck tumors. Direct measurements of the dose that was actually deposited within the patient planning target volume (PTV) and selected organs-at-risk (OARs) were performed by treating each Personalized PseudoPatient phantom as if it was the real patient and delivering the exact same plan intended for the patient.

Dose verification was performed by using ion chamber dosimetry and directly comparing the acquired results with the treatment planning system (TPS) calculations. For this purpose, special inserts for point dosimetry were positioned within the PTV and/or OARs of each Personalized PseudoPatientTM phantom according to the corresponding DICOM RT Structure set file of the specific patient. The phantoms were then filled with water that served as the soft tissue equivalent. Each phantom was irradiated using the specific patient's irradiation protocol including image guidance. TPS calculated mean values of the ion chamber's sensitive volume were compared with corresponding measurements.

Overall 16 PTVs and 21 OARs were evaluated. Regarding the PTVs, an overall excellent agreement between measurements

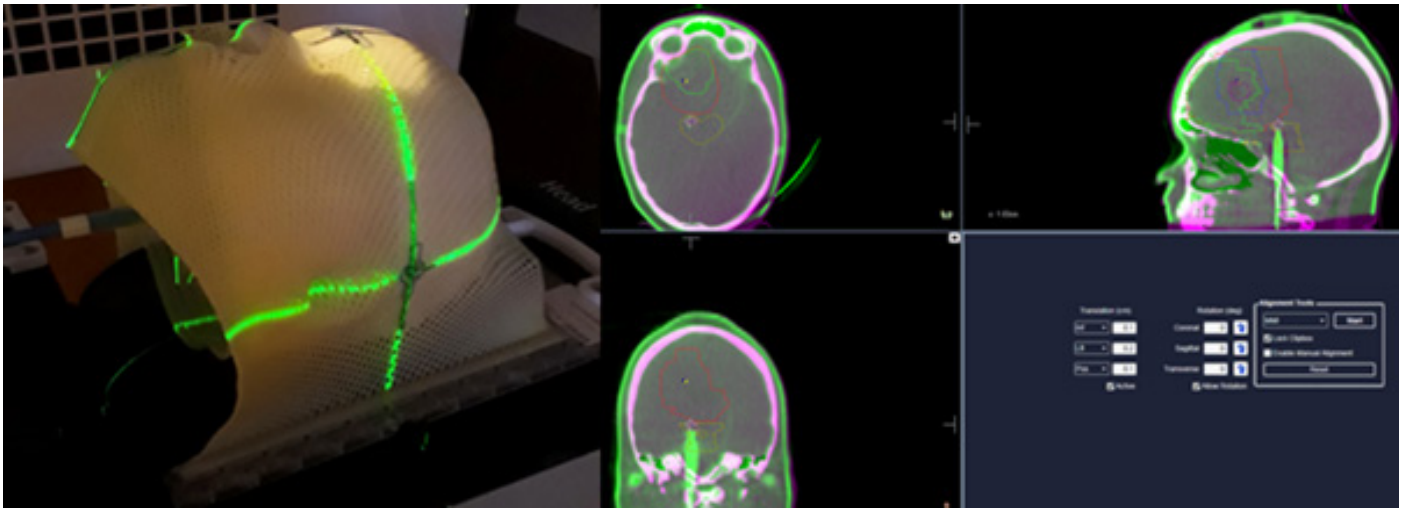


Fig. 1: . (Left) Phantom set-up on the treatment couch using the actual patient's thermoplastic mask on the SRS base plate. (Right) Cone-beam CT scan of the Personalized PseudoPatientTM phantom registered on the real patient's CT dataset.

and calculations was achieved with median percentage difference between measurements and TPS calculations of the order of -2.7% ± 2.0%, complying with the recommendations of ± 5% of the prescription dose regarding the overall accuracy in the irradiation dose delivered to the patient dose specification point. In the OARs regions, ion chamber measurements showed a median overestimation of the order of 2.9% ± 10.9% complying with the failure modes and effects analysis (FMEA) proposed by TG-100 regarding the failure in the delivery accuracy of the dose distribution. In any case, all dose measurements indicated a dose deposited in the OARs lower than the accepted dose limit for the specific OAR with respect to the fractionation scheme used.

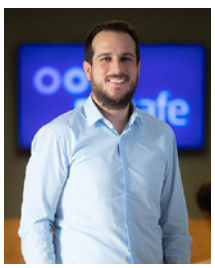
Using the Personalized PseudoPatient, dose measurements are performed directly within selected PTVs and OARs of the real patient's replicated anatomy, using the department's ion chambers or films, enabling the confirmation that the TPS calculated dose is actually delivered with dosimetric and geometric accuracy in an absolutely personalized way. More specifically, the overall results of this work suggest that the implemented methodology based on 3D-printing technology is capable to verify the dose in clinically significant regions within the patient, by delivering the exact same plan intended for the patient, without the need of plan recalculation in the phantom anatomy.

For more information, visit www.RT-safe.com or email info@rt-safe.com.

Kyveli Zourari

Project Manager

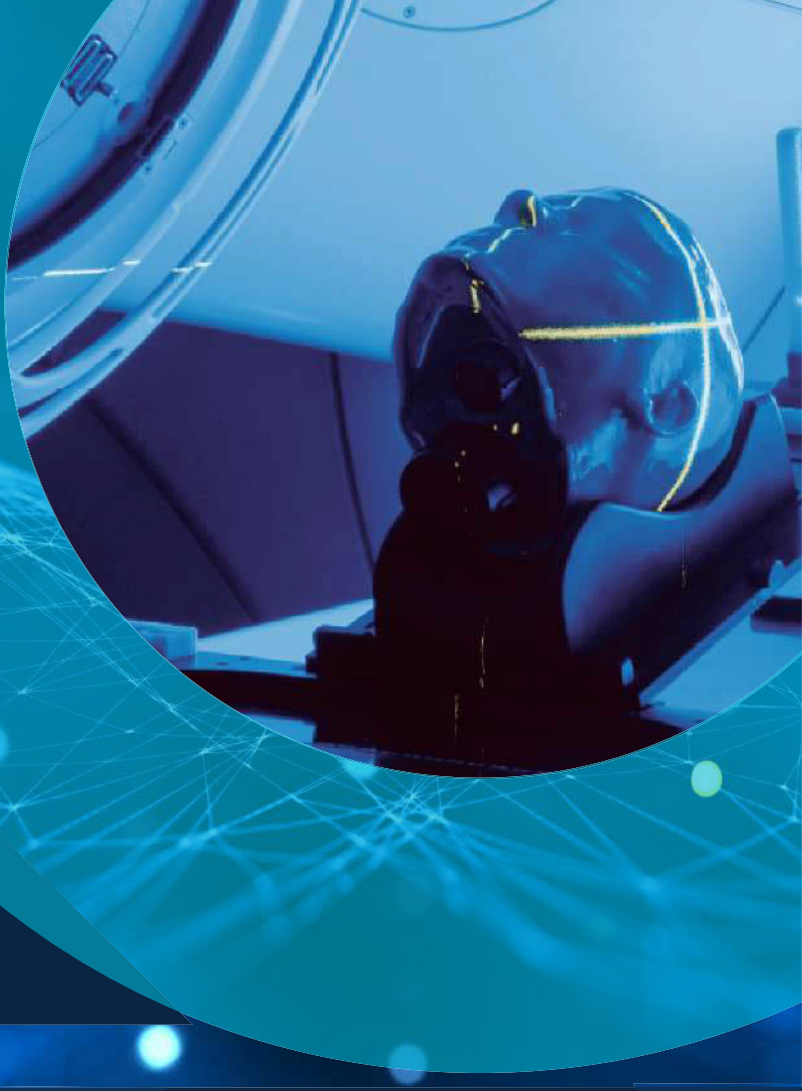
Kyveli is focused on developing a comprehensive QA certification program dedicated for SRS & SBRT applications at RTsafe. Previously, she gained experience in computational & experimental dosimetry, as well as, dosimetry audits in radiotherapy as a scientific associate at the Medical Physics Laboratory of 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

Project Manager

Emmanouil is responsible for data analysis, project management, and film dosimetry at RTsafe. He has a Diploma in Applied Mathematics & Physics from the National Technical University of Athens, a Master of Science in Medical Physics/Radiation Physics from the National and Kapodistrian University of Athens and a Ph.D. in Medical Physics from the Medical School of Athens. Prior to RTsafe, he worked in "Evaggelismos" General Hospital of Athens and "Attikon" University Hospital. He is works at Herlev Hospital close to Copenhagen as a medical physicist in radiation therapy and is currently affiliate associated professor at the Niels Bohr Institute, University of Copenhagen.



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A Dynamic Eye Phantom for Proton Therapy of Uveal Melanoma

The change in technology is very rapid and we also see the reflection of this on medical devices. With the development of medical devices, new concepts also enter the medical physics world. One of the latest concepts is particle therapy, which becomes more and more common every day. There are 82 proton therapy centers all around the world and 24 of them are in Europe[1].

Proton therapy has advantages, such as good segmentation of healthy and tumor tissues, lower entrance dose, homogeneous local dose delivery to the tumor. All these aspects increase the appetite of medical physics researchers to make the technique even better.

The Protons4Vision project, in which I am working as a PostDoc researcher at Delft University of Technology (TU Delft) in collaboration with the University of Leiden and HollandPTC, had exactly this effect on me. The overall goal of the Protons-4vision project is to maximize the potential of Proton Therapy of Uveal Melanomas (UMs) by developing novel technologies to improve tumor localization, therapy planning, and image-guided tumor destruction. The project aims to develop an MRI-based planning method linked with an optical eye-tracking system that has the potential to image and track the tumor in 3D, allowing accurate radiation therapy without the need for invasive tantalum clips. Developing such a technique requires end-to-end testing. My project aims to develop a dynamic eye phantom including a gel dosimeter, which will mimic the (involuntary) motions of the normal eye.

During my Ph.D., I worked on designing and developing a breast tissue-equivalent phantom with epoxy and paraffin based novel material mixtures, which would lower the need for being dependent on commercial phantoms. My idea was to develop a non-commercial material with affordable components which has a modifiable mixing ratio and can be changed according to the need of the user. I characterized different material mixtures with x-ray spectroscopy techniques and Monte Carlo simulations.

During my first postdoc at the University of Trento (Italy), I expanded these skills to design and develop an IOERT protection disc.

In my current project, I had the chance to combine my background on phantom design and development and material characterization with 3D dosimetry and Proton Therapy.

The first year of the project was focused on studying gel dosimetry and obtaining different gel dosimeters, performing characterization studies with Monte Carlo simulations and conducting validation experiments. Gel dosimeters are well-characterized materials when used with X-rays, but they display some limitations when used with protons, as they are LET-dependent.

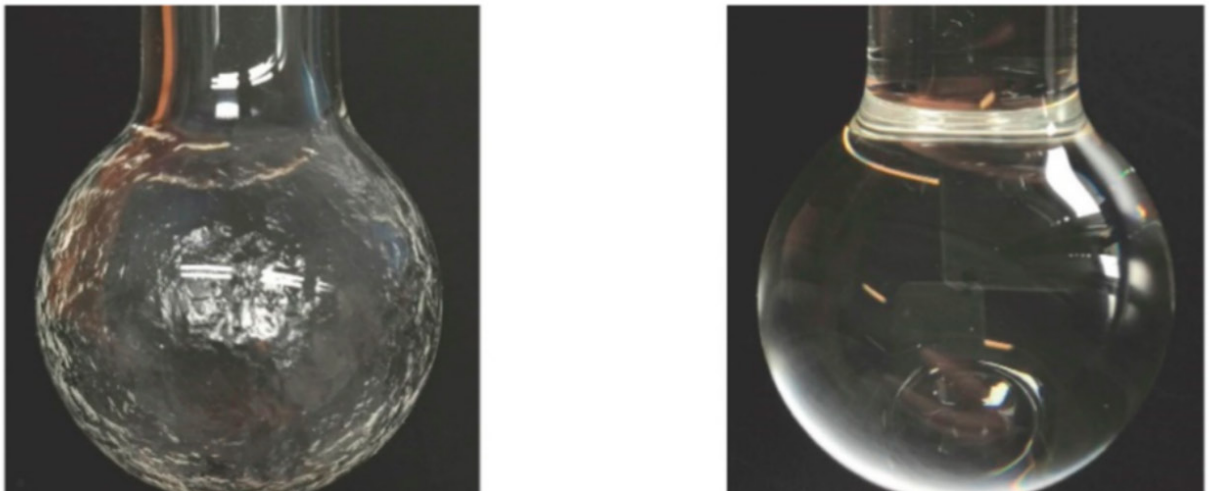

Fig. 1: The eye phantom with RFG gel dosimeter.

So far three different gel dosimeters have been used, two commercial (Presage→, and RTgel-100) and one produced in-house (RFG gel). The final phantom will consist of a sphere having the dimensions of the human eye and it will display movement and vibrations of a normal human eye. In figure one, it is possible to see the image of the first trials of the eye phantom with the RFG gel[2].

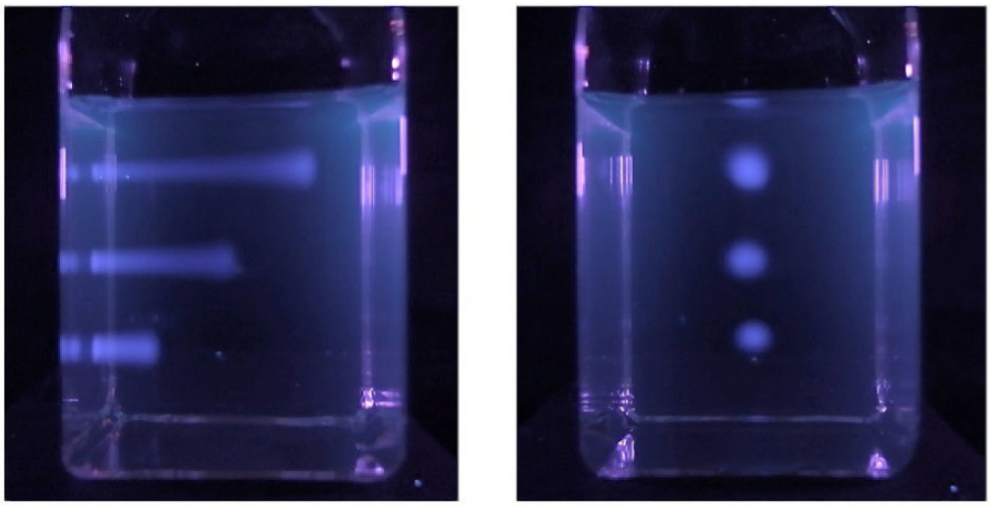

Fig. 2: 80 MeV proton beam tracks imaged in RFG gel; attenuated, from top to bottom, by polystyrene sheets 22, 32 and 42 mm thick.

The first experiments were performed in July, 2019 with RFG gel at HollandPTC. Results are still under evaluation. However, in Figure 2, from the previous work of Warman et.al., images of proton beam tracks in RFG gel with can be seen[3].

The second year of my postdoc will focus on producing the eye phantom and building the dynamic construction of the moving eye.

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3. Warman J.M. et.al. Polymers 2018, 10, 685.

Şölen Yüksel

Şölen Yüksel (Ph.D.) Postdoctoral Researcher at Radiation Science and Technology Dept. Delft University of Technology.
Şölen Yüksel graduated in Physics Engineering Department and did her MSc and Ph.D. degree on Medical Physics at Ankara University, Institute of Nuclear Sciences. She did her first PostDoc at University of Trento and nowadays she is doing her second postdoc at TU Delft as part of the Protons4Vision Project.

Orthogonal Ray Imaging

During my master studies in medical physics I decided to attend an Erasmus+ traineeship to improve and practice my knowledge and skills. I was so fascinated by an innovative imaging technique, Orthogonal Ray Imaging (OR-imaging), so I chose it both as thesis and as traineeship subject.

OR-imaging is a technique developed to assist megavoltage external beam radiotherapy (EBRT) proposed by the Laboratório de Instrumentação e Física Experimental de Partículas, LIP, at Coimbra University in Portugal.

It is able to visualize the anatomy of the diseased region in real-time, in order to monitor the correct irradiation of the malignance. Moreover, 100 ms are enough to execute the imaging. Thus, soon after the radiotherapy begins, it is possible to search for morphological tumor changes able to compromise the treatment plan effectiveness and then take the appropriate action.

The most common image-guided techniques for EBRT use cone beam CT or portal imaging. They are affected by two problems: the former technique rotates an X-ray the source around the body and thus it adds dose in addition to the dose delivered by the treatment itself; the latter is not usable for real-time visualization.

OR-imaging is performed by acquiring scatter radiation from the patient, orthogonal to the therapeutic beam. The idea is to select a slice of tissue, to divide it in columns, to scan them one by one and to reconstruct the image of the entire slice. In order to perform this the primary beam must be parallel and have a small square cross section, 5 mm x 5 mm. The source moves in correspondence to the first column of tissue, where it stops and irradiates the column (parallel to the beam). The scattered radiation emitted at 90° with respect to the beam direction is collected on a gadolinium orthosilicate scintillation detector, GSO. Each detector slice represents a position among the depth explored by the pencil beam in the tissue column.

At this point the process is repeated for the next column. The scattered radiation is correlated with the morphological and tissue density, because the scattering happened with more intensity in denser material.

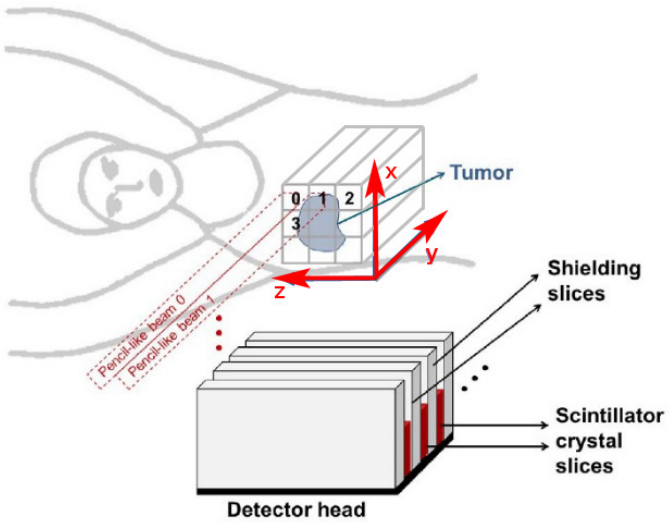

Fig. 1: OR-Imaging concept [1]. A pencil-like megavoltage X-ray beam scans one tissue column at a time in the region of interest. The scattered radiation escaping from the patient at 90°± 1.4° to the primary beam direction is selected by a parallel hole lead collimator and then, it is acquired by a GSO multislice scintillator detector. The final image of each tissue slab is obtained as justapposition of more adjacent coloumns images. Scrolling the stack of images related to slab of tissue, 5 mm thick, one onto the other, it is possible to visualize the entire volume of interest with pixel of 5 mm x 5 mm.

I performed my thesis in the Medical Physics Research Laboratory at Federico II University, Napoli, Italy within the MC-INFN project. I developed Monte Carlo simulations via Geant4 code for OR-Imaging in order to determine the bi-dimensional photon distribution and energy spectra on a flat detection surface orthogonal to the primary beam. I showed that at typical EBRT beam dose, in time acquisition about 100 ms (enough for 100 Hz dynamic frame rate) there is sufficient statistics to visualize a spherical tumor with 2 cm radius on 0.5 cm x 0.5 cm pixel dimensions.

Currently my studies continue in an Erasmus+ traineeship at LIP, Coimbra University. The purpose of the project is to

investigate new GSO detector configurations for OR-Imaging via Monte Carlo simulation: monolithic scintillator and multislice aluminium wrapped scintillator.

The first step consisted of an image acquisition of an anthropomorphic phantom, NCAT [2], in a tumor lung scenario using a monolithic GSO scintillator behind the collimator slice. The image is represented by a histogram of the energy deposited in the scintillator. The second step is the implementation of the GSO scintillation properties, waveguide, photomultiplier. The same procedure will be repeated for the multislice aluminium-wrapped scintillator.

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Michele Sannino

Michele Sannino graduated in biomedical physics at Federico II University of Naples (IT) in June 2019, with a thesis about Orthogonal Ray Imaging technique. Currently he is intern at University of Coimbra (PT) by an Earasmus+ founded project.

Real-time radiochromic film dosimetry

Radiochromic film (RCF) dosimetry is widespread in medical physics applications. RCFs are mainly used for quality control checks of diagnostic instrumentation and for the determination of Percentage Depth Dose (PDD) curves in external beam therapy, with photon and ion beams.

In practice, the RCF is exposed to radiation and the level of darkening is evaluated after its withdrawal from the radiation site. To evaluate the darkening, flat-bed scanners and densitometers are commonly used. These instruments don't allow measurements of the RCFs' dose trend, but only measurements of doses integrated over the time and wavelength.

To overcome this limitation, we have recently designed, developed and patented a new methodology for the real-time determination of the spectral response of RCFs [1]. This methodology is based on opto-electronic instrumentation conprising in a bundle of seven optical fibres, a light source, a spectrometer, a reflector and the RCF [2]; the schematic of these elements is shown in Fig. 1.

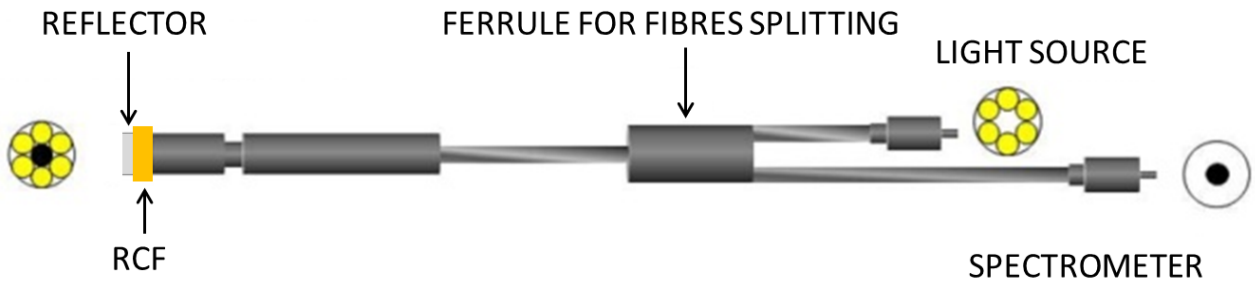

Fig. 1: : Schematic of key elements of the new radiochromic film real-time dosimeter.

Six optical fibres transport the light from a halogen light source up to the RCF. The light passing through the RCF is back-scattered by the reflector and then collected by the central seventh fibre, which delivers it to the spectrometer. This last fibre acquires RCF spectra in the wavelength range 200 - 1200 nm. The acquisition rate is fixed by the integration time, which in turn is determined by the reflector's material; 1mm plastic (ABS or Teflon) layers and 1.5 μm Al-mylar foils have been found to be the most efficient materials, allowing integration times of a few seconds, and hundreds of ms, respectively.

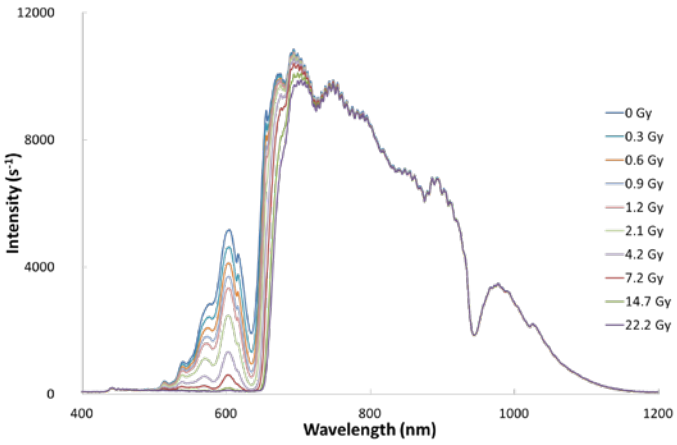

Fig. 2: Real-time spectral response of an EBT3 Gafchromic film to 60Co gamma rays.

Figure 2 shows the spectra resulting from the exposure of an EBT3 Gafchromic film to 60Co gamma rays from a 2.6 Gy/min Gammacell.

The integration time for this exposure was set to 1.3 s. The curves of Fig. 2 represent the trend of the spectral response of the film. In particular, the curve with highest intensity corresponds to 0 Gy; those with lower intensity correspond to increasing doses up to 22.2 Gy. Regarding this dose range, the maximum sensitivity of EBT3 Gafchromic film is in the range 500 - 700 nm. The dose calibration can be performed by several analytic methods, including the evaluation of the intensity at fixed wavelengths or the absorbance in a defined wavelength range. Overall, uncertainties within 4% were obtained for EBT3 and XR-QA2 Gafchromic films for different dose ranges.

Since the sensitivity of the RCFs' spectral response is dependent on the wavelength, this method allows, by means of a careful choice of the observable for the calibration, the extension of the dynamic range of some RCFs types by more than one order of magnitude [1]. Moreover, this methodology can be applied to many RCFs types, by covering a dose range from a few mGy to hundreds of kGy. Other advantages are the use of optical fibres, such as the micrometric thickness, no interaction with electromagnetic fields and remote real-time dosimetry.

The team who collaborated on the development and patenting of this invention involves researchers from the University of Naples Federico II, INFN Section of Naples and University of Sannio. We are currently working on the optimization of the new RCF real-time dosimeter for some specific applications.

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Pierluigi Casolaro

Pierluigi Casolaro is a postdoctoral research fellow at INFN-Napoli and qualified expert in radiation protection. His research interests are in the dosimetry and neutron detection. Currently he's responsible for the INFN Technology Transfer "Optorad" project, which aims to increase the Technology Readiness Level (TRL) of the recently patented real-time dosimeter.

Real-World Experiences of Medical Physics Interventions - let's show the world what we do!

A call for book contributions

There is an expression saying that a medical physicist is "a person that solves problems you didn't know you had in a way you can't possibly understand". It made me smile when I first heard it but I do find it to be quite true.

Medical physics is a wonderful profession but, let's be honest, most of the time it is hidden in the shadows of healthcare. As medical physicists, we contribute, amongst many other things, to the struggle against cancer, we help ensure the diagnostic quality of medical images and that all those minimally-invasive interventional procedures are done with the least risk for developing deterministic effects. We also help protect auxiliary staff and patients from the effects of ionizing radiation, mechanical waves in sonography and electromagnetic fields in MRI. We teach, train, help deepen the medical research and, occasionally, even solve problems that go beyond the medical field (anyone ever asked you to fix the printer or a software bug lately?). By the same token, we are used to getting strange looks from people when introducing ourselves as "the physicist working in the hospital" and many times we get mistaken for a physician or physiologist.

I believe we all have our ways of explaining to the general public in a simplified manner what we do. After all, physics has been a part of medicine long before William Roentgen discovered X-rays. But what happens when we get the same looks and questions from the people we're supposed to work in the same team with? Isn't it surprising when your very colleagues (Radiation Oncology and Radiology medical doctors, managers, administrators, radiographers or even some of the radiation safety officers and service engineers), who are supposed to cooperate with us, are 'convinced' that medical physicists are not necessary and that we are only in their way? Sometimes their attitude is somewhat on the side of ignorance: "if I don't understand it then it's not important!"

These questions and problems are similar all over the world. I had the privilege of talking to many medical physicists with different backgrounds, from different hospitals, countries and, although our equipment, staffing level and way of managing the quality and safety might not be the same, we all have something in common and that is the constant need to justify on a daily basis why our presence is crucial to the healthcare ecosystem. In many countries, we are still not recognized as a scientific and healthcare profession which is just a reflection of the same problem but at the national level.

It is nothing new and it is something we like to talk about during social dinners after our training meetings or conferences, giggle about it and compare experiences. These are also an excellent way of learning new things and getting ideas about how to solve problems in our department or hospital - seeing how other people dealt with them in theirs. Those abilities can be sharpened even more if one attends a leadership-focused course such as EUTEMPE Module MPE01 'Leadership in Medical Physics, development of the profession and challenges for the medical physics expert' (www.eutempe-net.eu/mpe01). I attended it myself this year and I can already see its significant contribution in my daily practice with special emphasis on the fact that this course also helped my motivation and determination to stand up for myself as a medical physics professional. Sometimes, we get stuck in our problems and difficulties and this course showed me a practical way in which I can start solving multidisciplinary-team related problems step by step. It showed me that everything can be done with the right means, approach and reasoning and helped me get a better grasp of my profession while encouraging me to look beyond just my guild, to expand my horizons. That expanded way of thinking is the reason why I am writing this article.

Together with a few wonderful colleagues I met during this course (Andreea Dohatcu (US) - as co-editor, Brenda Byrne (IE), Nathan Dickinson (UK) and Henrik Sundstrȍm (SE) - as specialty peer-reviewers), I decided to start a book project about showing in a useful, usable and non-assuming manner to a wide audience, how medical physicists are making a difference in our working environment. We want to present situations (quick cases, short stories, anecdotes...) where the presence of a medical physicist had an impact and made a change in patients' or non-MP colleagues' lives.

But, for this, we need your help in collecting them directly from the frontline. This book would focus on items (findings, processes, pieces of advice, etc.) that you helped your clinics with and that show in a direct practical manner our usefulness as medical physics professionals. We want all of the stories that you are willing to share whether it is something "small", like finding out, when you were doing your regular quality checks, that the filter was missing from an X-ray machine

(and that the machine had been used like that for months or even years without anyone else noticing) or something "more serious" like discovering set-up errors for the radiation oncology patients. This collection targets an extended readers' community made of public, patients, friends, families, science lovers, future MP students as well as non-MP clinical colleagues, and we hope to contribute with it to our Medical Physics branding.

To put this idea in motion we host a Google form, a template (link: https://forms.gle/4w2LCo6Kmyb18oKZA), designed together with Prof. Carmel Caruana, for collecting your thoughts, but you are also welcome to e-mail your free-style stories to the following address: medphy.experiences@gmail.com. The language should not be academic, but one accessible to all. The stories will be published without any information about your hospital's name or location. We will include the author's name only if requested by the author.

We are looking forward to your kind assistance and future contribution to this project that is committed to the benefit of all of our profession and patients.

Ana Buinac

Ana is a Medical Physicist at the Department of Medical Physics, University Hospital Centre Zagreb, Zagreb, Croatia. She started her career as a Medical Physicist in Radiation Oncology. Since 2017 she has been working in the field of Diagnostic and Interventional Radiology. Her primary interests are radiation protection and quality assurance.

Reporting on the backstage experience acquired during a clinical MRI Safety Performance and Quality Improvement project involving participation from institutions worldwide

It all started small, on a peaceful day, when my Radiology Department's Administrative Director at the time came into my office and told me about a new commercially available decision-making app from a leading MR safety advocate that she heard of. She was very excited about it, this method appearing to be the solution to some of our clinical problems. More exactly, it consisted of an efficient decision-helping procedure for performing risk assessments on patients with foreign bodies/implants/devices who are prescribed to undergo MRI investigations. She wanted it to be implemented by our MRI technologists ASAP within the patient examination workflow.

Being as analytical, problem-solving oriented and inquisitive as any other clinical medical physicist is by nature, I started to document myself about all the implications this change might bring with it, to proactively prepare my due help as an active member of the Interdisciplinary Departmental Magnetic Resonance Imaging (MRI) Safety Team.

During this part, which included a 4-day seminar offered by the method's author, I started to realize that there was a gap between the way this method was designed by the owner to be rolled out to the clinical practices, the background knowledge it relied on and the supporting materials it needed, on one hand, and the way my Director envisioned launching it at our sites, on the other hand. She assumed that our MRI techs would be ready to apply it on a daily basis if they were presented with an executive summary about the benefits, were walked through this MRI Implant Risk Assessment Decision Tree and were given a laminated copy of this workflow to have handy for reference, at their MRI scanners' control booths.

I told the Director my concerns about not having any data about the level of MRI physics safety-related didactic knowledge within our team of MRI technologists, on which this Decision Tree relies. I also mentioned my concerns around the fact that any expectations or blind assumptions about the level of knowledge being enough (while it might not be) could bring to our institution: increasing the liability due to risk of performing MRI exams on a category of patients with foreign objects in the body that were not handled before. As a result, she was more than happy to allow me to develop a Quality Management Tool to inform or confirm my worries before rolling this new Method into our practice. Hence, I designed a quick „pulse-taking" survey covering the "basic must-have" knowledge an MRI Technologist/Radiographer is expected to have in order to be able to adopt the above-mentioned Method. The result was puzzling, enough to prompt the need to assess other practices, the comparative study results potentially being of worldwide interest since this Decision Tree Method has useful international applicability.

However, with an international data collection, I found myself in front of many obstacles I did not experience before: first I struggled with reaching to and building peer medical physics reliable connections due to the lack of availability of a database of names of medical physicists internationally. Besides, I did not know if there was a professional interest into such project from the very few persons I could find, neither did I know them well enough to know how to approach them successfully from the first attempt. Then I realised my own communication skill-set shortcomings for a project of such a span and for dealing further with non-medical physics survey takers and their managers.

It proved fortuitous, then, that I heard about the EFOMP-EUTEMPE Medical Physics LEADERSHIP MODULE MPE01: "**Leadership in Medical Physics - Development of the profession and the challenges for the Medical Physics Expert** "; a comprehensive mini-MBA that was held on-line over a 3-months period and face-to-face in Prague, in February 2019. This brought together in a comfortable professional atmosphere about 30 worldwide medical physicists peer-participants, helping us to build bridges, assisting us to network and give feedback and advice to each other based on individual and explicit experiences, as well as bringing all of us on the same page in terms of attitudes, skills, competences and vocabulary necessary to such collaborations as my project needed. At the end of the program, once I made it public at the suggestion of Dr. Carmel Caruana – one of the module's leaders – my project's Call for Volunteers received an overwhelming answer of participation.

Once collaborators were found, the next challenge that surfaced from the interactions was the variety of requests from each potential participant site: some wished to develop a project idea organiser to share with the possible interested colleagues,

some had their ethics committees asking specific questions or requesting adjustment to their own needs such as ensuring anonymity of participants and confidentiality of their workplaces. We also discovered the necessity to design an internationally applicable, generic and yet specific enough verbiage to ensure copyright protection of project idea, survey subject and questions, as well as final data, that all had to abide to.

Subsequently, we all hit another wall: the survey questions needed to be translated into the language of each country, demanding more time and patience, and we also realised that the educational professional path of the MRI operators can vary widely, as well as the quality and frequency of their on-the-job training. This prompted adding two more questions to the survey. Oversight, then, to ensure integrity of data, had to be provided by each of us. Sometimes, the survey takers, that had to be staggered at different time slots in order not to disturb their clinical cycle, talked about the questions with the next ones, hence disqualifying them. This reduced the already small MRI operators pool we found available, but, in the end, we managed to have a good sample.

The timeline for completion of the project extended from a couple of months initially, to about a year. Yet, our study is now in the final phase, so if you are interested about results and conclusions, please stay tuned!

I can't end this report about our project's backstage experience without a big THANK YOU to all – Christina Brunnquell (United States of America), Ana Buinac (Croatia), Brenda Byrne (Ireland), Carmel Caruana (Malta), Marek Chmelik (Slovakia), SeungRyong Cho (South Korea), Nathan Dickinson (United Kingdom), Mariana Hernández-Bojórquez (Mexico), Richard Mittasch (Austria), Johan Sjöberg/Tomas Jonsson (Sweden) – who made it possible, took it further, started a chain-reaction support at your institutions, engaged colleagues, managers, technologists, convinced ethics committees, oversaw, collected, organised and returned the data. Each of you is an example of a reliable leader in action!

Andreea Dohatcu, PhD

Andreea Dohatcu, PhD is a Qualified Medical Physicist and Assistant Professor in Radiology Department, School of Medicine, University of Texas Medical Branch- Radiology Department, USA. Graduated from SUNY Buffalo and completed clinical training in the Imaging Physics Residency Program at UT- MD Anderson Cancer Center. She is board-certified by American Board of Radiology (ABR) and licensed by Texas Medical Board for practicing diagnostic medical physics. She is also certified by American Board of Magnetic Resonance Safety (ABMRS) as MRSO and by American Board of Medical Quality (ABMQ) as CMQ. She is currently providing imaging physics support for all aspects related to Radiology's clinical operations: compliance (Quality Assurance and Control) for Mammography, US, MRI, CT, Fluoroscopy, Radiography; Radiation and MRI safety; and Quality Management. She is actively involved in clinical PQIs in MRI safety, CT protocols and Fluoroscopy dose reduction and optimizations, as well as in teaching medical students and residents. She is from Bucharest, Romania.

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Mark Tooley, United Kingdom: Cycling from John O'Groats to Land's End ("JOGLE").

I used to cycle a lot in the 1980s when I lived in South London, commuting to St Bartholomew's hospital, and I always cycled the annual London to Brighton ride. During this period, I went on a week's trip from Barnstable in North Devon to Land's End at the bottom of Cornwall with my great friend Dave. We stayed in Youth Hostels and cycled leisurely. At the end of this, Dave said when we both had retired, we should cycle the full length of the country, top to bottom. I heartily agreed and thought no more. I then left London, moved to Bristol, got married, had children, scrapped my old bike, and stopped cycling.

Fig. 1: Mark Tooley cycling up Shap Fell in Cumbria, England, on the way from John O'Groats to Land's End.

Then, at the beginning of 2018, Dave rang me and said he was retiring and wanted to fulfil our 30 year old promise to each other and cycle JOGLE. As I had already just retired, I felt I could not say no, but panicked slightly – I did not even have a bike! So I did my research, and in February, I bought a steel-framed Genesis Equilibrium, which could carry paniers and a tent. Although I was a long-distance runner, I was not cycle-fit, so I had to start cycling in earnest. I went out long training trips as often as I could. We spent many hours planning the trip and route. We decided to go in the same direction as before, from North to South, and follow the just-published SUSTRANS Land's End to John O'Groats cycle route using their national cycle network. We were doing the published route back to front, which had its challenges! At 1200 miles, the distance was longer than the direct route, but it avoided busy roads and was much more scenic. We realised that weather-wise it was better to go south, as the summer progressed. We decided to do it over 3 weeks, which meant nearly 60 miles a day, every day, no room for error and no days off. We were going to be carrying our luggage and small tents. We planned our route meticulously, and booked all the camp sites and B+B accommodation in the larger towns and cities; we aimed to stay with friends and family wherever the route passed near them. We camped for 10 nights, B+B for 5, and family and friends for 5. The journey started on 12th August. We flew to Inverness, then a bike company took us and our bikes to John O'Groats. On the first morning, a strong easterly wind was blowing, which was good for our spirits, as we were initially going west. However, it was the only time the wind was in our favour! At the start, I loaded up my bike with my paniers and tent and panicked as I could not even lift my bike, it was so heavy! As I set off, I seemed very wobbly. We spent the next 10 days working our way through Scotland, soon realising how vast the country is. The lovely weather of the hottest recent summer seemed to stop as soon as we started our trip! Most of the Scottish days had some rain, and some of the high passes had lots of rain and strong winds. After the long route in Scotland, Northern England seemed to go quite quickly. We had our wettest day in the Midlands where the whole country was engulfed in heavy rain. Bizarrely, I also experienced many punctures that day. Although the hills in Scotland were long and sometimes very hard, the hills in Devon and Cornwall seemed much harder. I always felt very tired towards the end of each day, but seemed always to be OK the next morning. Our penultimate day was spent in Redruth, saying with an old friend. It was lovely having a bath there! We left our tents and panniers with her, and left the next morning for the final 37 miles to Land's End. This was a lovely morning, and our bikes felt so light! A small welcome party met us at the end, consisting of our wives and families. We had a lovely picnic and a bottle of champagne on the grass around Land's End, rounding off an exhausting but amazing journey. We ate loads of food (but I still lost 4 kg in weight), saw some amazing countryside, as well as experiencing harsh cities and many lovely towns and villages, the full length of our country.

Professor Mark Tooley

FREng, President of IPEM

Professor Tooley is currently President of the Institute of Physics and Engineering in Medicine. He is also a senior scientific advisor to the Chief Scientific Officer of the NHS. He was the Head of the Department of Medical Physics and Bioengineering and Director of Research and Development at the Royal United Hospitals in Bath, until he retired in 2017. He has academic appointments with the University of Bath and the University of the West of England. Mark has a BSc in Electronic Engineering from the University of Bath, a MSc and PhD in Medical Physics from the University of London. Mark's interests include: innovations in medicine, physics applications in anaesthesia, simulation and modelling in medicine, physiological measurement, biological signal processing, blood pressure measurement, novel patient monitoring solutions, and mentoring. He is a Fellow of IPEM, IOP, IET, RCP and the Royal Academy of Engineering.

Nathan Dickinson, United Kingdom: Kicking it as a medical physicist and martial artist

Fig. 1: Nathan Dickinson at his training sessions

I first started martial arts training at the beginning of my second year of university in Leicester, in 2005. I was trying to find a way of spending more time with a good friend, who had a black belt, and I wanted to start taking fitness seriously. He suggested trying a Tae Kwon Do club in the city and I've trained in one form or another ever since, picking up a black belt wife along the way!

Tae kwon do started as a Korean version of Shotokan karate in the 1950s, and has subsequently developed into two styles, one a more traditional martial art, and the other a kicking-orientated Olympic sport. Training in the former gave me a sense of focus and discipline, the ability to create and actualise a longterm vision, delaying gratification and sticking it out when it hurts and gets tough.

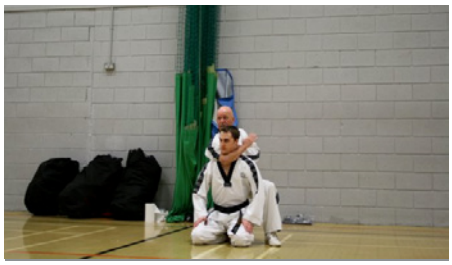


Fig. 2: Nathan Dickinson at his training sessions

On my first lesson I was worried that I wouldn't be able to do any press-ups and that I wasn't very fit, but I was reassured that I'd be eased into things gently. On the first class we did lots of running and press-ups (that I actually managed), but on the second class things were kicked up a notch, I started seeing stars, and then saw nothing. The next thing I remember, I was propped up in the corner being handed some water. It was all a bit embarrassing, and at the start of the next class three guys, who were in great shape and were good fighters, condescendingly remarked how surprised they were that I bothered to come back. That made me determined to work hard and succeed at this challenge. I started to enter competitions, and over the years have won over 30 medals and trophies at local, national and international competitions, including a bronze medal at the 2007 World Championships. Of those people in the changing room that night I went back after falling down early on, I was the only one to make it to black belt, much less progress through dan grades. These character-forming experiences have served me well, particularly during my professionally, academically and personally intense experience as a medical physics trainee with a young family.

Martial arts also provide a great stress release, not only from the high intensity work out and adrenaline-release from hitting things, but from the concentration and mindfulness required. You cannot spar at the absolute limits of your fitness when distracted; you lose and you can get hurt. The significant stretching routines require absolute concentration and focus to get further into a position that is in no way comfortable, and self-control to stay there. This helps greatly at work, when pressure can sometimes build and you have to stop and concentrate at the task at hand without getting bogged down with competing demands.

The strategic nature and long term commitment of competing regularly and achieving my dan grades has also served me well outside the training hall. Visualising a far off goal, taking small steps to get there, reflecting when you don't win, putting aside discomfort and self-doubt and making the most of opportunities with humility have been important. Though I no longer complete and have much less time to train having a young family, I still look after myself, hit some pads at a kickboxing club occasionally and push myself to seek out new challenges. When you're outside your comfort zone the most exciting things happen, you make new discoveries and you grow, be it with hobbies, sports, at home or at work.

Nathan Dickinson

Principal Clinical Scientist, Nottingham University Hospitals

Nathan initially studied Physics with Astrophysics at the University of Leicester, gaining an MPhys degree in 2008 and then a PhD in Astronomy in 2012. After working as a postdoctoral researcher and a short spell in the IT sector, he became a Trainee Clinical Scientist in 2014 at Nottingham University Hospitals, specialising in Imaging with Ionising Radiation (or diagnostic radiology and nuclear medicine physics). He obtained state registration and an MSc in Clinical Science from Newcastle University in 2017, before holding a joint position in the Radiation Physics and Nuclear Medicine Physics sections as a Clinical Scientist in Nottingham. In late 2018 Nathan moved fully into nuclear medicine as a Principal Clinical Scientist, with a focus on molecular radionuclide therapies.

Johan Sjöberg, Sweden – Medical Physicist and "Maker"

I've always had a fascination for how things are made. My mother once told me that when I was a young boy, I could just stop right in the middle of the sidewalk, or wherever we were, and just stare intensely at some object or detail that caught my eye. I can imagine the thoughts that went through my mind during these episodes of intense focus: "Why is the texture of this surface like this? What material is this made of? How was it made?".

Today, these feelings of fascination are channeled into creative work. In my personal 'maker space' and electronics workshop is where all the magic – sorry, science and engineering – takes place. I design, code and assemble circuit boards with micro-controllers to perform various computational tasks. I work with computer-aided design (CAD) to design and 3D-print encasings and other parts for them. I experiment with carbon fibre for creating strong and yet light weight parts. As an example of a project of mine, I replaced the instrumentation of one of my cars to a completely different one and got it to work perfectly by programming an interface between the car and the new instrumentation. I now run a small business on the side for this, with customers in USA, Canada, UK, Hong Kong, Australia and several other places. Exciting and fun! It's certainly a very profound confirmation of your work when people are willing to pay you for your creations.

I enjoy interior design as well. I used CAD to design our living room table and had it manufactured at a local workshop. Truly unique (and expensive!). I designed a cat wall according to drawings by my partner and manufactured and painted it myself. It covers the entirety of the largest wall in our living room. Complete with shelves covered with sisal mat for extra grip, stair-cases, small beds, a cat-sized hammock and a climbing pole. The cats love it, as do we. A 3D-printer is quite handy for interior design hacks as well. We couldn't find nice hooks for the towels in one of our bathrooms, so I designed and 3D-printed some. Looks good and works perfectly. We also wanted to replace our old, frail and dusty lamp shades at our country house but couldn't find that vintage look that we wanted. So, I downloaded a lamp shade design that another person had made from a place called "Thingiverse" (http://www.thinkiverse.com), which is a file sharing site for 3D-printable objects. I 3D-printed a couple of them and it turned out really good. All our ceiling-mounted lamps in the kitchen and living room, as well as the reading-lamps in all the bedrooms in our country house now have brand new lamp shades that were downloaded from the internet.

Many people enjoy this type of creative work, using tech such as 3D-printers and microcontrollers as the foundation of their art and science projects. They're generally referred to as Makers, and there are dedicated "Maker spaces" – workshops where people come together to share equipment and ideas. Everyone can be a Maker today – it's relatively easy and straight

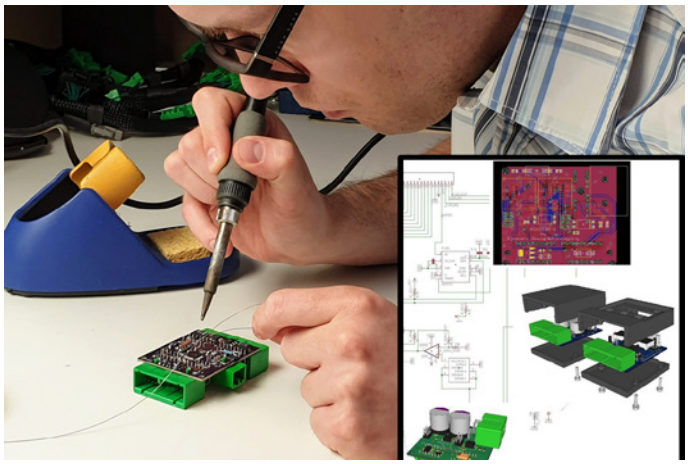


Fig. 1: Johan Sjöberg working on the instrumentation for cars

Fig. 2: Johan Sjöberg with his cats

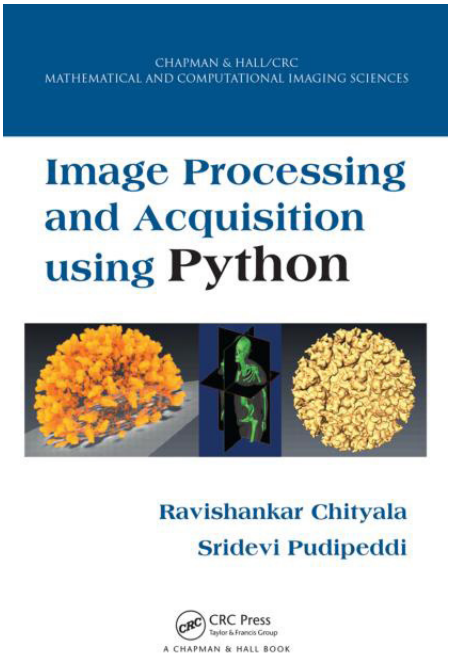
forward to get started at home. Interested? A good start can, for instance, be a starter kit for the 8-bit microcontroller platform called Arduino. Or the mini-computer platform Raspberry Pi. At a few tens of Euros, they're great gifts for anyone and will offer many hours of tinkering. 3D-printers can be quite expensive, but look for a Maker space in your local community. There's a high chance you'll find what you need there. Start Making!

Johan Sjöberg

Karolinska University Hospital

Besides the entrepreneurial side shows, Johan is a certified Medical Physicist and certified practitioner in PRINCE2 project management. He is a member of the Medical Physics sub-committees for ECR 2019, ECR 2020 as well as of the program planning committee for the Swedish National Medical Physics meeting. He is the project manager of a national initiative on QA of medical imaging equipment in Sweden. He is on the teaching faculty of the EFOMP-EUTEMPE module 'Leadership in Medical Physics, development of the profession and challenges for the MPE' (www.eutempe-net.eu/mpe01)

Book Review: Image Processing and Acquisition using Python by Ravishankar Chityala and Sridevi Pudipeddi



CRC Press Taylor and Francis Group, Boca Raton, FL, USA, 2014, 390 pages, ISBN 9781466583757, printed hardcover £77.99 £, ebook £37.79, also available for Amazon Kindle.

As the title of the book suggests it is structured in three parts. The first part introduces the reader to the programming language Python. In the second part an introduction to image processing is given where the various concepts and methods are illustrated by Python code. The third part (which is unrelated to Python) gives an overview about a selection of image acquisition technologies.

— ***Useful Python code is explained, e.g. the routines for reading and writing images***

The first part gives a basic introduction to Python which is equally useful for programming novices, newcomers to Python from different programming languages and even advanced readers. It explains the data structures, their specialities and the modules of Python. Useful Python code is explained, e.g. the routines for reading and writing images, so that a beginner is ready to start working efficiently. An appendix is devoted to the installation of freely available Python distributions for all three major operating systems, Windows, MacOS and Linux. The Spyder interface is presented which provides a working environment with which a MATLAB® user will be accustomed. Another appendix gives in this respect a very valuable correspondence table between MATLAB and Numpy function syntax which makes the switch to Python for the routine MATLAB® user much easier.

The second part starts with standard spatial filters like mean, median, max and min filters. Edge detection by derivative filters is discussed. Various transformations to enhance images are explained. The Fourier Transformation, its numerical implementation as Fast Fourier Transform, convolution and various filters are introduced. The image processing part is explored more deeply by subchapters on segmentation, morphological operations and image measurements. Every method and concept is illustrated with corresponding Python code so that the reader can directly start

— ***The third part of the book gives an overview in four subchapters on image acquisition by X-rays, magnetic resonance, light microscopy and electron microscopy.***

with their own explorations and numerical experiments and, for example, comprehend the discussions of the pros and cons of the various filtering techniques.

The third part of the book gives an overview in four subchapters on image acquisition by X-rays, magnetic resonance, light microscopy and electron microscopy. In total 100 pages are devoted to this, beginning with the basic physical principles of each technology and ending with the techniques which give the final images in each case. Python is not used here and no Python codes are given in this part of the book.

It is this part on image acquisition which turns out to be a weak point of the book. At best it can be used to give a very first superficial impression for complete novices to the field of image acquisition. The mathematical foundation in form of the central slice theorem is properly discussed in the subchapter on X-rays and Computer tomography. The filtered back projection technique is mentioned but not explained in an illustrative manner. At this point it would have been useful to have included a Python example to enable unexperienced readers to perform their own numerical experiments on unfiltered and filtered back projections.

I think that a real understanding of magnetic resonance images and their weighting can only be developed when the relation of the signal intensity with the machine-dependent parameters – the repetition time and echo time – and the physical parameters – the longitudinal relaxation time T1 and the spin-lattice relaxation time T2 – is given explicitly and explained in detail. Unfortunately, the text lacks this connection.

But, to be fair the challenge to explain all this technologies and its features on 100 pages comprehensively is condemned to fail. In a future edition I would suggest to the authors that they focus on one major imaging technology. This technology could be discussed in detail, then hopefully illustrated with integrated Python code.

The parts on Python and image processing are the strengths of the book. I enjoyed these parts and heavily profited from them – in fact they saved me a lot of time – so that I can highly recommend the whole book. The book actually motivated me, as MATLAB® user for two decades, to migrate to Python. Furthermore, I will use this book as textbook for Python and image processing for my future classes in the imaging and processing lab that I teach.

Prof. Andreas Modler

Andreas Modler studied physics in Heidelberg, Berlin and Tel Aviv. He did his PhD in Biophysics at the Max Delbrück Center for Molecular Medicine in Berlin Buch and graduated from the Humboldt University, Berlin. He did a two years Postdoc about insulin formulations and processing at Potsdam University, founded by Sanofi-Aventis. During this time he graduated as medical physicist in a joint program between Free University and Humboldt University, Berlin. Afterwards he joint Karl Storz enterprise and worked in the field of endoscopy, minimal-invasive surgery and shock wave lithotripsy for six years as patent engineer and product manager. In 2011 he received a call as lecturer at the School of Engineering of the Zurich University of Applied Sciences. Since 2013 he was there head of the medical and biophysics group physics. In 2016 he received a call as professor for physical technology and medical physics and is working since then at Beuth University for Applied Sciences in Berlin.

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ESMPE European School for Medical Physics Experts

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Innovation in technology in Nuclear Medicine

Jointly organised by ESMPE, ESMIT and COCIR

23rd-25th January 2020, Prague, Czech Republic

The EFOMP, EANM (The European Association of Nuclear Medicine) and COCIR (The European Coordination Committee of the Radiological, Electromedical and Healthcare IT Industry) in collaboration with the Czech Association of Medical Physicists and the Department of Dosimetry and Application of Ionizing Radiation of Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague would like to invite you to the next ESMPE on **23nd-25nd January 2020**.

The school will be aimed at advanced tasks connected to molecular imaging related to methods and detector technology . The school will cover the main physics aspects of multimodal PET and SPECT imaging systems, patient dosimetry and optimization.

This edition is jointly organized by EFOMP, ESMIT and COCIR. Lecturers identified by COCIR will give insides on the new trends for novel PET and SPECT equipment.

This two-and-half day event will be accredited by EBAMP (European Board of Accreditation for Medical Physics) and is intended for practicing clinical Medical Physicists who are involved in the Nuclear Medicine Imaging field. As in last year's school, there will be an optional examination at the end for those seeking a higher level of certification beyond attendance.

Content

Methods and detector technology for improved imaging
New technology related to imaging positron and single photon emitters
Image optimization, dose reduction and future perspectives
Progress in SPECT, SPECT-CT and SPECT-MR
Progress in PET, PET-CT and PET-MR
Nuclear Medicine and Machine Learning
Quantification methods

Final exam

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

Organisers

Adriaan Lammertsma , Stefaan Vandenberghe (Scientific Chairs)

Alberto Torresin (Chair of the School)

Jaroslav Ptáček, Tereza Kráčmerova (CAMP)

EFOMP ČSFM CZECH ASSOCIATION OF MEDICAL PHYSICISTS FJFI

Time-table

Thursday 23rd January 2020				
	Session	**Title**	**Description**	**Lecturer**
8:00-9:00	Registration			
9:00-9:30	Introduction	Setting the scene	Presentation of the ESMPE and introduction to the course	Torresin, Lammertsma, Vandenberghe
9:30-10:30	Single photon imaging	Novel shapes and production processes for collimation	Methods and detector technology to improve imaging of single photon emitters	Roel van Holen
10:30-11:30		Dedicated and CZT based SPECT systems		Brian Hutton
11:30-12.00	Coffee break			
12:00-13:00	Single photon imaging	Molecular imaging outside conventional nuclear medicine	Methods and detector technology to improve imaging of non-standard single photon emitters, used in theranostic applications	Stephan Walrand
13:00-14:30	Lunch break			
14.30-15.00	General Electric	Single photon imaging New technology , image optimization , dose reduction and future perspectives	Acquisition and reconstruction protocols optimized by the vendor. QA tests carried out by vendor. Feedback processes. How to configure the relevant parameters. Future perspectives	TBD from COCIR
15.00-15.30	Mediso			TBD
15.30-16.00	Philips			TBD from COCIR

Thursday 23nd January 2020				
	Session	**Title**	**Description**	**Lecturer**
16:00-16:30	Coffee break			
16:30-17:30	Siemens	Single photon imaging New technology , image optimization , dose reduction and future perspectives	Acquisition and reconstruction protocols optimized by the vendor. QA tests carried out by vendor. Feedback processes. How to configure the relevant parameters. Future perspectives	TBD from COCIR
17.30-18.00	Spectrum Dynamics			TBD
20:00-23:00	Social dinner - participants + lecturers			

Friday 24th January 2020				
	Session	**Title**	**Description**	**Lecturer**
09:00-10:00	PET imaging	PET/MR	Progress in PET/MR detector performance, system design and analysis methods	Mark Lubberink
10:00-10:30	Coffee break			
10:30-11:00	PET imaging	Digital PET	Progress in PET, PET-CT and PET-MR based on SiPMs	Ronald Boellaard
11:00-11:30		PET systems	Progress in PET system design combined with machine learning	Stefaan Vandenberghe
11:30-12:30		On-line blood sampling and kinetic analysis	Detailed description of methods for advanced quantification of dynamic PET studies	Michel Koole

Friday 24nd January 2020				
	Session	**Title**	**Description**	**Lecturer**
12:30-14:00	Lunch time			
14:00-14:45	GE	PET imaging New technology , image optimization , dose reduction and future perspectives	Acquisition and reconstruction protocols optimized by the vendor. QA tests carried out by vendor. Feedback processes. How to configure the relevant parameters. Future perspectives	TBD from COCIR
14:45-15:30	Mediso			TBD
15:30-16:00	Coffee break			
16:00-16.45	Philips	PET imaging New technology , image optimization , dose reduction and future perspectives	Acquisition and reconstruction protocols optimized by the vendor. QA tests carried out by vendor. Feedback processes. How to configure the relevant parameters. Future perspectives	TBD from COCIR
16:45-17:30	Siemens			TBD from COCIR
17:30-18:15	United Imaging			TBD

Saturday 25nd January 2020				
	Session	**Title**	**Description**	**Lecturer**
09:00-10:00	The future of SPECT	Standard imaging	Summarize the progress in the field of SPECT for imaging low enery photons	Roel VanHolen
10:00-11.00		Theranostic imaging	Summarize the progress in the field of SPECT for imaging higjer enery photons	Stephan Walrand
11:00-11:30	Coffee break			
11:30-12:15	Total body PET	New possibilities for clinical (research) applications	Advantages of TB PET for clinical (research) studies	Adriaan Lammertsma
12:15-13:00		New innovative designs	Progress in the development of medium cost TB PET	Stefaan Vandenberghe
13:00-13:45		Progress in and challenges for postprocessing	What do we need to fully utilise total body PET?	Ronald Boellaard
13:45-14:30	Final examination			

Further Information

Course language	English
Level	MPE
Registration fee* (2 main meals, 5 coffee breaks, 1 social dinner)	300 € 350 € (from 1 December 2019)
Reduced registration fee* • subsidized by EFOMP • first-come, first-served policy • deadline for application (20.12.2019)	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, Turkey, Ukraine.
Maximum number of participants	80
Duration	23nd - 25nd January 2020
Study load	17.5 hours of lectures and demonstrations
Venue	Department of Dosimetry and Application of Ionizing Radiation, Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Břehová 7, 115 19 Prague 1, CZECH REPUBLIC
GPS coordinates	50°5'27.737"N, 14°24'58.713"E
Accommodation	Individual
Information, programme at:	www.efomp.org
Registration	Electronic registration via EFOMP website
Registration period	1st September 2019 – 15th January 2020

* 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

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Online Registration Open

November 30, 2019

ESR Membership 2019 Final Application Deadline

December 15, 2019

Submission Deadline for Case-Based Diagnosis Training

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ESMPE
European School for Medical Physics Experts

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Statistics in Medical Physics

23th-25th April 2020, Athens, Greece

The 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 in **Statistics 2020**

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-and-half day event will be accredited by EBAMP (European Board of Accreditation for Medical Physics) and is intended for practicing clinical Medical Physicists who are involved in data management and research. As in last year's school, there will be an optional examination at the end for those seeking a higher level of certification beyond attendance.

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.

Organizers

Marco Brambilla (Scientific Chair)**, Alberto Torresin** (Chair of the School)

Pola Platoni, **Gerasimos Messaris** (HAMP), **Efi Koutsouveli** (ESMPE Board)

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1969
ΕΦΙΕ
Ένωση Φυσικών Ιατρικής Ελλάδος

ESMPE
European School for Medical Physics Experts

Faculty

Marco Brambilla	University Hospital, Novara, Italy
Mathieu Hatt	LaTIM INSERM, Brest, France
Renata Longo	University of Trieste, Trieste, Italy
Brendan McClean	St Luke's Radiation Oncology Network, Dublin, Ireland
Michael Sandborg	Linköping University hospital, Linköping, Sweden
Peter Sharp	University of Aberdeen, Scotland
Jeroen van de Kamer	Netherlands Cancer Institute, Antoni van Leeuwenhoek, Amsterdam, The Netherlands
Dimitris Visvikis	LaTIM INSERM, Brest, France
Federica Zanca	Palindromo Consulting, Leuven, Belgium

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1969
ΕΦΙΕ
Ένωση Φυσικών Ιατρικής Ελλάδος

ESMPE
European School for Medical Physics Experts

23th April 2020				
	Session	**Title**	**Description**	**Lecturer**
8:00-9:00	Registration			
9:00-10:00	Setting the scene	Statistics with Confidence	How to design the experiment How to analyze the data How to report the data: Hypothesis testing or confidence intervals?	M Brambilla
10:00-10:30	Coffee break			
10:30-11:30	Diagnostic test	Evaluation of a diagnostic test. I: Theory	Sensitivity, specificity, diagnostic accuracy, ROC, FROC, AFROC	F Zanca
11:30-12:30		Evaluation of a diagnostic test. I: Worked examples	The practical session will focus on how to lead ROC analyses	F Zanca
12:30-14:00	Lunch break			
14.00-15.00	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	M Brambilla
15.00-16.00		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.	M Brambilla
16:00-16:30	Coffee break			
16.30-17.00	Applied Regression Analysis	Logistic Regression. I Theory	Logistic Function, Logistic Transformation;odds	M. Brambilla
17.00-18.00		Logistic Regression. II Worked examples	Analysing data from visual grading experiments with logistic regression models	M. Sandborg
20:00-23:00	Social dinner - participants + lecturers			

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ΕΦΙΕ
Ένωση Φυσικών Ιατρικής Ελλάδος

24th April 2020				
	Session	**Title**	**Description**	**Lecturer**
9:00-10:00	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	R Longo
10:00-10:30	Coffee break			
10.30-11.30	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.	R Longo
11.30-12.30	Survival Analysis	Survival Analysis. I. Theory	Relative Risks. Odds ratio. Survival curves with Kaplan Meyer; Log-rank Test; Cox Models	P Sharp
12:30-14:00	Lunch time			
14.00-15.00	Survival Analysis	Survival Analysis. II. Worked examples	The practical session will focus how on to build and interpret survival curves	P Sharp
15.00-16.00	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	D Visvikis
16:00-16:30	Coffee break			
16.30-17.30	Statistical Methods in Radiomics	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	M Hatt
17.30-18.00		Challenges and Limitations	Guidelines to improve the reporting quality and the reproducibility of radiomics studies, as well as the statistical quality of radiomics analyses.	M Hatt

25th April 2020				
	Session	**Title**	**Description**	**Lecturer**
9.00-10.00	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	B McClean
10.00-11.00		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	
11:00-11:30	Coffee break			
11:30-13:00	Agreement in Radiotherapy	Comparing dose	Comparing measured and calculated dose distributions: distance to agreement, dose difference and gamma evaluation	J van de Kamer
		Comparing Volumes	Determining volume differences by means of DICE, Hausdorff distance	
13:00-15:00	Final examination			

ESMPE
European School for Medical Physics Experts

Further Information

Course language	English
Level	Medical Physics Expert (MPE)
Registration fee* (2 main meals, 5 coffee breaks, 1 social dinner)	300 € 350 € (from 15.03.2020)
Reduced registration fee* • subsidized by EFOMP • first-come, first-served policy • deadline for application (23.09.2019)	150 € - for the first **15** attendees (max. 2 from one country) coming from the following European countries: Albania, Belarus, Bosnia & Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Kosovo, Latvia, Lithuania, North Macedonia, Moldova, Montenegro, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Turkey, Ukraine.
Maximum number of participants	80
Duration	23th April 2020 – 25th April 2020
Study load	17 hours of lectures and practical demonstrations
Venue	National and Kapodistrian University of Athens (NKUA), Central building, Panepistimiou 30, Athens 106 79
Website:	www.efomp.org
Accommodation	Individual
Information, programme at:	www.efomp.org
Registration	Electronic registration via EFOMP website
Registration period	1st September 2019 – 10th April 2020

* 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

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Ένωση Φυσικών Ιατρικής Ελλάδος

Educational Activities 2019-2020

Date	Description	URL	Location
Sep 6th, 2019 - Sep 7th, 2019	Symposium in Future Trends in Photon Radiotherapy	IBA DOSIMETRY	Palma de Mallorca, Spain
Sep 8th, 2019 - Sep 11th, 2019	24th International Conference on Medical Physics	ICMP2019	Santiago, Chile
Sep 18th, 2019 - Sep 21st, 2019	50 Jahrestagung der Deutschen Gesellschaft für Medizinische Physik (DGMP)	DGMP	Stuttgart, Germany
Sep 23rd,2019 - Sep 25th, 2019	MPEC 2019	IPEM	Bristol, UK
Oct 3rd, 2019 - Oct 5th, 2019	36 Annual Scientific Meeting European Society for Magnetic Resonance in Medicine and Biology	ESMRMB	Rotterdam, Netherlands
Oct 10th,2019 - Oct 12th, 2019	European School for Medical Physics Experts (ESMPE) Radiotherapy edition 2019	EFOMP	Warsaw, Poland
Oct 12th,2019 - Oct 16th, 2019	EANM'19 – 32nd Annual Congress of the European Association of Nuclear Medicine	EANM	Barcelona, Spain
Oct 14th, 2019 - Oct 18th, 2019	European Radiation Protection Week 2019	EPRW	Stockholm, Sweden
Oct 18th, 2019 - Oct 19th, 2019	EuSoMII Annual Meeting 2019	EUSOMII	Valencia, Spain
Oct 21st, 2019 - Jun 19th, 2020	Institute of Cancer Research courses	ICR	London, UK
Oct 25th,2019 - Oct 26th, 2019	ESTRO Physics Workshop	ESTRO	Budapest, Hungary
Nov 3rd, 2019 - Nov 6th, 2019	ESTRO Research Course in Radiotherapy Physics 2019	ESTRO	Madrid, Spain
Nov 7th, 2019 - Nov 8th, 2019	BIR Annual Congress 2019	BIR	London, UK
Nov 17th, 2019 - Nov 22nd, 2019	VIII International Geant4 School	INFN	Belgrade, Serbia
Dec 6th, 2019 - Dec 7th, 2019	1st AICI Forum Villach - Artificial Intelligence in Clinical Imaging	AICI-Forum	Villach, Austria

Date	Description	URL	Location
Jan 23rd, 2020 - Jan 25th, 2020	European School for Medical Physics Experts (ESMPE) Nuclear Medicine edition 2020	EFOMP	Prague, Czech Republic
Feb 7th, 2020 - Feb 8th, 2020	Symposium of Belgian Hospital Physicist Association 2020	BHPA	Belgium
Mar 11th, 2020 - Mar 15th, 2020	European Congress of Radiology 2020	MYESR	Vienna, Austria
Apr 3rd, 2020 - Apr 7th, 2020	ESTRO39	ESTRO	Vienna, Austria
Apr 20th, 2020 - Apr 22nd, 2020	Optimisation in X-ray and Molecular Imaging 2020	OXMI2020	Gothenburg, Sweden
Apr 23rd, 2020 - Apr 25th, 2020	European School for Medical Physics Experts (ESMPE) Satistics edition 2020	EFOMP	Athens, Greece
May 10th, 2020 - May 12th, 2020	NACP2020 Symposium	NACP	Reykjavik, Iceland
Sep 24th, 2020 - Sep 26th, 2020	3d European Congress of Medical Physics	ECMP20	Torino, Italy

ESMPE

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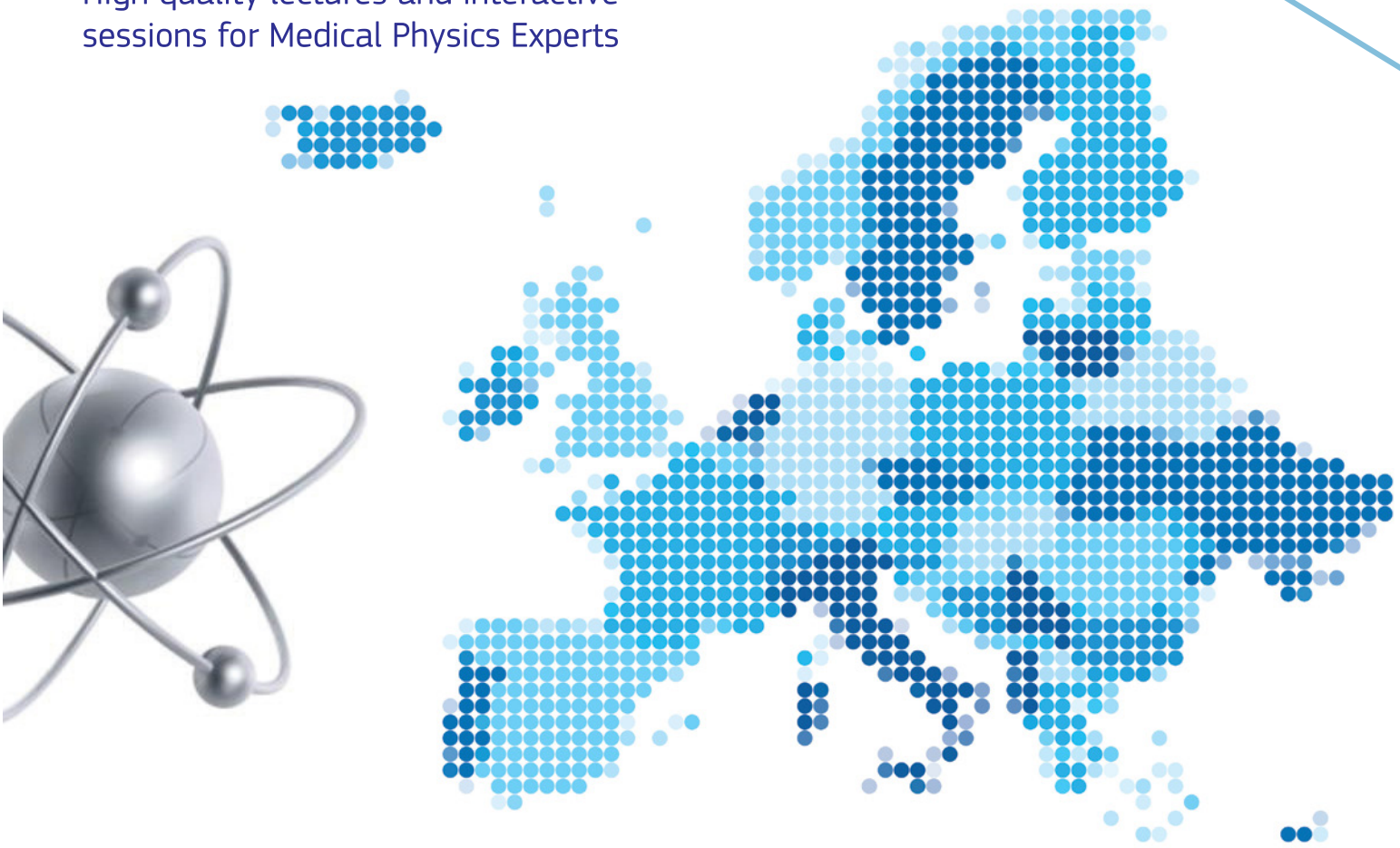

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PRAGUE, WARSAW, ATHENS, TORINO

Editions in 2019-2020: **Radiology, Prague**, July 4-6, 2019, **Radiotherapy**, **Warsaw**, October 10-12, 2019, **Nuclear Medicine**, **Prague**, January 23-25, 2020, **Statistics Athens**, April 23-25, 2020
Satellites in Nuclear Medicine, **Radiotherapy**, **Artificial Intelligence**, **Torino**, September 23, 2020

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The purpose of the newsletter is to provide a communications forum for medical physics organisations, and for medical physicists, across Europe.

We are always looking for Europe-wide contribution to the EMP News.The editors would like to hear from you! Developments in science, in education and in training are all relevant. Cross-border or international initiatives are particularly of interest, and these can be in any area of physics and engineering applied to medicine. Comparisons between the practice and organisation of medical physics in different countries are particularly welcomed.

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Jul 1st, 2018
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AAPM REPORT NO. 246

New!

Estimating Patient Organ Dose with Computed Tomography: A Review of Present Methodology and Required DICOM Information

A Joint Report of AAPM Task Group 246 and the European Federation of Organizations for Medical Physics (EFOMP)

August 2019

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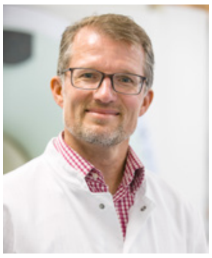


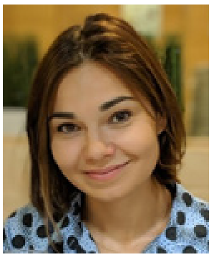
























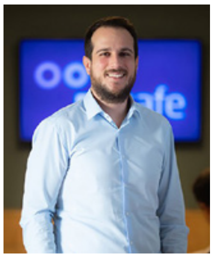










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The European Federation of Organisations in Medical Physics (EFOMP) was founded in May 1980 in London to serve as an umbrella organisation for medical physics societies in Europe. The current membership covers 34 national organisations which together represent more than 8000 medical physicists and clinical engineers working in the field of medical physics. The moto 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".

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