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EUROPEAN JOINT PROGRAMME FOR THE INTEGRATION OF RADIATION PROTECTION RESEARCH CONCERT

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PODIUM
Personal Online Dosimetry Using computational Methods

EJP-CONCERT

European Joint Programme for the Integration of Radiation Protection Research

H2020 – 662287

D9.115 – Workshop for the dissemination of the results and the application of the ALARA

Lead Authors: Z.Thrapsanioti, E. Carinou, M.Abdelrahman, M.Andersson, U.O Connor, M.Ginjaume, O. Van Hoey Olivier

Reviewer(s): F. Vanhavere
and CONCERT coordination team

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1. Objective

Scientific dissemination of the PODIUM results was foreseen within the framework of the project, one of the tolls being the organization of a workshop. The main objective of the workshop was to emphasize and to present the advantages of online dosimetry systems in routine practice.

For better dissemination of the results it was decided to organize the workshop back to back with the ALARA network. The ALARA workshop was focussed on innovative ALARA tools and their use in advancing Radiation Protection and ALARA principle.

2. Organisation matters

The joint PODIUM – ALARA dissemination workshop was held in the Congress Center of the National Centre for Scientific Research "Demokritos" and in the facilities of the Greek Atomic Energy Commission in Athens, Greece. On the 26th November 2019 the results of the PODIUM project were presented while from the 27th to the 28th of November the 19th European ALARA Network presented the "Innovative ALARA Tools".

The final programme of the joint workshop can be found in ANNEX 1.

The total number of participants registered to PODIUM workshop was 49 but finally 45 of them participated. The attendance list for both workshops is found in ANNEX 2.

3. Workshop

The workshop was divided into 4 sessions, where the objectives, methodology, results and future work of each work package were presented and discussed.

3.1. Session 1

The first session started with the presentation of the PODIUM project by its coordinator, Filip Vanhavere. The presentation was focused on the general framework of the project, i.e. the motivations that led to the accomplishment of this project, the objectives, the materials and methods used and the tasks of each one of the six work packages.

Afterwards, the floor was given to Joan Aranda, who presented the use of Indoor Positioning Systems (IPS) in PODIUM. Joan Aranda referred to the development of the Indoor Positioning System with the use of single and multiple RGB-Depth camera systems to track all people in the operation room in order to provide with 3D position all the staff body parts in real time. The two tracking systems (single and multiple camera systems) were compared to each other and Joan Aranda specified, when asked, that the maximum number of persons that can be detected by the cameras is 6 persons per camera.

The last presentation of the first session was focused on the use of look-up approach, presented by Maria Zankl. The objectives of this task were to provide fast dose calculations for workers moving in realistic fields using computational phantoms for various statures and postures and Monte Carlo methods for both photon and neutron radiation workplaces. The speaker referred to the methodology that was followed in order to develop a library of pre-calculated conversion coefficients (look-up table approach). It was mentioned that the look-up table approach has been established as alternative method to fast online Monte Carlo calculations. The RAF phantoms that were used for the simulation of the workers were protected with 0.5mm Pb lead apron. A question was raised asked if other protective equipment is going to be used in the future such as lead glasses or thyroid collar and the answer was that it depends on the continuation or not of the project. Another question from the audience was if the room was simulated in the simulations performed but it was indicated that all the calculations were performed free in air.

3.2. Session 2

The second session of the workshop dedicated to present the computational method used within podium especially in regards the Monte-Carlo tools and the computational human phantoms. The first presentation was given by P. Lombardo with the title: “individualized phantoms” and the second by M. Amor Duch with the title: “MC-GPU Monte Carlo code”. In the first presentation, the use of computational phantoms in PODIUM was presented. The phantoms were used for both the online simulations and for the look-up table approach. During PODIUM, several phantoms were used for the calculation of different dose quantities. Computational phantoms from HMGU, namely DONNA and IRENE, together with the Realistic Anthropomorphic Flexible (RAF) phantom of SCK•CEN were used to create the database of dose conversion coefficients for different postures and statures for the look-up table approach. Computational phantoms from HMGU, namely REX and REGINA, were used in MC-GPU Monte-Carlo code for the online simulation approach. To facilitate the modification of the posture of the RAF phantom, a user-friendly software called Interactive Posture Program (IPP) was developed where the user can easily change the pose of the phantom and export it in either voxel or polygonal mesh formats for different MC codes. For this presentation, the discussion was oriented around the further use of the computational phantoms, the IPP software and the library of the dose conversion coefficients developed within PODIUM. The speaker elaborated that the results and the outcome of WP2 of PODIUM project can be extended to be used in other applications.

In the second presentation, the methodology of using Monte-Carlo codes for dose calculations were introduced. The presentation also introduced the fast Monte-Carlo code, MC-GPU. Within PODIUM, three different approaches using three different Monte-Carlo codes were investigated. PenEasy-IR, MCNP and MC-GPU were used for occupational dose calculations in interventional radiology fields. MC-GPU can simulate complex voxel geometries on a massively parallelized cluster of GPUs which accelerate the simulation run time. In PenEasy-IR and MCNP, a combination of simplified geometries (solids) and multi-threaded CPU simulations were used to accelerate the simulation run-time. In addition, the presentation explains how all different parameters for the dose calculation from the motion tracking system and from the radiation field were combined. Finally, the results of the first validation test performed in a controlled experiment at the hospital of Lund university in Malmö was presented where the personal dose equivalent Hp(10) measured by several personal dosimeters (EPDs and TLDs) and compared with simulations. The results shows good agreement between the measured Hp(10) and the calculated Hp(10) using PenEasy-IR, MCNP and MC-GPU. For the second presentation, the discussion focused on the practicality of the real-time simulations in interventional radiology radiation field. For the application of ALARA principle, introducing real-time feedback to the worker about their dose can help in reducing their exposure. At the same time, dose per procedure may be sufficient.

3.3. Session 3

The third session was about the development of the online dosimetry application and the application of PODIUM in IR/IC fields and in neutron fields.

The first presentation of the session was on the application in IR/IC fields at the University of Lund in Malmö and at the St. James hospital in Dublin and was presented by Anja Almén and Una O'Connor together. The discussion afterwards was about the general feedback from all the staff involved in the project. Both hospitals had received positive feedback from the involved staff.

The second talk was presented by Olivier Van Hoey and was focused on the creation and developments of the online dosimetry tool. The discussion afterwards was about how much time and training are needed for the staff of the hospital before the online dosimetry system would be operational without any assistance.

The last presentation was given by Jonathan Eakins on the application of PODIUM in neutron fields. The question from the audience was about how to prioritize the tracking coverage in large geometries and what was the general feedback of the project from the involved staff. The coverage of the tracking was a case by case problem/solution and the general feedback was positive from the involved staff.

3.4. Session 4

In the fourth session, the first presentation was given by the invited speaker Prof. Jim Malone from the Trinity College of Dublin. Prof. Jim Malone opened this session with his invited talk on 'Personnel Monitoring: Ethics, The Tech Trap and Social Expectation?'. This was a very stimulating talk from a renowned expert in the field of ethics and radiation protection in medicine. Prof. Malone introduced the audience to the concept of the value set of ethics that should be used in medicine. He emphasized that we must not just rely on our personal moral compass, but rather professional ethics values. A value set has been published by the ICRP, and a similar set in the recent publication (Ethics for Radiation Protection in Medicine published as a Series in Medical Physics and Biomedical Engineering, Malone et al). The audience were given some real examples of when doctors and hospital management are faced with difficult moral and ethical questions. Prof. Malone spoke about the need to look carefully at privacy and ethics issues for the PODIUM type approach, to ensure that the concept of

surveillance or tracking is acceptable to health professionals and patients. Overall this was a fascinating and engaging talk from the ethics point of view and was very well received by the audience.

The next part of the forth session was a panel discussion with interaction with the audience. The panel members were Eleftheria Carinou (EEAE, PODIUM), An Fremout (FANC, HERCA), Jim Malone (Trinity College Dublin), Sengli Niu (ILO, ICRP), Fernand Vermeersch (SCK•CEN, ALARA Network). The discussion was moderated by Rick Tanner (PHE, PODIUM).

The first topic of discussion was the potential advantages of online computational dosimetry.

Fernand Vermeersch started the discussion by stating that having the computed doses available in real-time is very beneficial for ALARA because it allows immediate feedback during a procedure which will lead to lower doses. Furthermore, this also has strong potential for training. Doses can be calculated even without actually receiving doses, which allows training of manipulations with feedback about the dose that would be received.

An Fremout agreed that the PODIUM approach has great potential as optimizing and training tool. She also indicated that the price might be a practical limitation. When limited budget is available, priority should be given to radiation protection rather than on radiation dosimetry.

Shengli Niu stated that accuracy is priority for a technique to become applied in practice. Only when a technique is more accurate than existing techniques it has the potential to replace these. There are also other considerations that are important. For PODIUM for instance data and privacy issues are an important consideration. Is there a risk that the data be mis-used for certain purposes?

One member of the audience also indicated that if we are able to measure doses even lower than 1 µSv, then people might be more worried because they used always to have a dose reported as below the detection limit of the system. So, one has to be careful on how to communicate this to the involved staff.

Jim Malone indicated that it would be useful for the staff report to include an estimate of the risk (in addition to the dose), because that is in the end what people want to know.

The next topic of the discussion was the feasibility of the PODIUM approach in medical field, nuclear and other industries.

Sotirios Economides (EEAE) of the audience asked whether ALARA for the staff does not come in conflict with proper patient treatment in interventional radiology. Mahmoud Abdelrahman (SCK, PODIUM) replied that lowering staff dose typically goes hand in hand with lowering patient dose and that radiation protection methods like protective shields, lead thyroid collars do not hamper the procedure. This opinion was shared by several members of the panel.

Mercè Ginjaume stated that technologically the PODIUM approach will be possible, but for practical implementation issues related to privacy might be a barrier.

Rick Tanner indicated that for aviation workers, computational dosimetry is already legally accepted. Eleftheria Carinou stated that based on this fact the PODIUM approach could be seen as an extension of this approach. An Fremout doubted about this, because computational dosimetry is legally only allowed if physical dosimetry is not possible or adequate. But in some fields, one could state that physical dosimetry does not provide sufficiently accurate results. Mahmoud Abdelrahman proposed that as a start, physical and computational dosimetry can be used in parallel and then computational dosimetry can be gradually introduced officially (similar to active dosemeters). Tom Grimbergen (Mirion, Netherlands) stated that a physical measurement will always be necessary because computational dosimetry is always limited by what is inserted into the model and some accident scenarios might not be included in the model. So, he found the approach interesting to reduce the number of dosemeters, but he believed that 1 dosimeter should still be used in addition to the computational dosimetry to avoid missing certain accident scenarios.

Ethical issues, together with legal issues were topics of interest for the implementation of the PODIUM solution considered for the discussion. However, because of lack of time, the moderator had to close the session.

Mercè Ginjaume gave the final talk of the PODIUM workshop with a summary of the project achievements. It was concluded that the feasibility study by PODIUM over two years has been a success. The technology is now available for tracking people to be monitored, calculating doses in a fast way (using a look-up table approach/dose mapping or Monte Carlo calculation), at a rate of less than 30 s/event. Detailed and personalised phantoms are also available. PODIUM is a new tool for training and ALARA, to confirm which workers require legal dosimetry. Some limitations and challenges that remain were presented. Future work plans were described along with how PODIUM fits in with the TRL (Technology Readiness Levels) defined by H2020. Overall the conclusions of the project are very promising.

The chairperson brought this successful workshop to a close and thanked all the speakers and attendees.

4. ANNEX 1

Personal Online DosImetry Using computational Methods (PODIUM) project dissemination workshop
&
19th European ALARA Network Workshop on Innovative ALARA Tools

26 -28 November 2019, Athens, Greece

PROGRAMME

Tuesday, 26 November 2019
PODIUM project dissemination workshop

08:30-09:00	Departure of the shuttle bus and transportation to EEAE
09:00-09:30	Registration

SESSION 1 (Chair: Z. Thrapsanioti)

09:30-10:00	General framework of the PODIUM project, *F. Vanhavere, SCK•CEN*
10:00-10:30	Use of indoor positioning systems in PODIUM, *J. Aranda, UPC*
10:30-11:00	Use of "Look up approach", *M. Zankl, HMGU*
11:00-11:30	Coffee break

SESSION 2 (Chair: M. Abdelrahman)

11:30-12:00	Individualized phantoms, *P. Lombardo, SCK•CEN*
12:00-12:30	MC-GPU Monte Carlo code, *M. Amor Duch, UPC*
12:30-13:30	Lunch

SESSION 3 (Chair: M. Andersson)

13:30-14:00	Application in IR/IC fields, *A. Almen and U. O'Connor, University of Lund and SJH*
14:00-14:30	Development of the online dosimetry application, *O. Van Hoey, SCK•CEN*
14:30-15:00	Application in neutron fields, *J. Eakins, PHE*
15:00-15:30	Coffee break

SESSION 4 (Chair: U. O'Connor)

15:30-16:00	Personnel Monitoring: Ethics, The Tech Trap and Social Expectation?, *Prof. J. Malone, Trinity College, St James's Hospital, Dublin, Ireland*
16:00-17:00	Round table discussion: Advisory group-*E. Carinou, A. Fremout, J. Malone, S. Niu, R. Tanner, F. Vermeersch, Moderator: R. Tanner*
17:00-17:30	Conclusion and future work, *M. Ginjaume, UPC*
17:30	Departure of the shuttle bus and transportation to city centre

Wednesday, 27 November 2019
19th European ALARA Network workshop

8:30	Departure of the shuttle bus and transportation to EEAE
09:00-09:30	Registration

SESSION 1. INNOVATIVE ALARA TOOLS IN THE RADIOLOGICAL CHARACTERISATION AND THE FIRST EVALUATION OF THE EXPOSURE (CHAIR: F. VANHAVERE, F. VERMEERSCH)

09:30-10:00	Welcome address, *E. Carinou, EEAE*
	Introduction and setting the scene, *F. Vanhavere, F. Vermeersch, SCK•CEN*
10:00-10:30	Use of drones in the assessment of uncommon exposure situations, *J. Camps, SCK•CEN*
10:30-11:00	Personal dose computation using monitoring systems and 3D cameras, *M. Abdelrahman, SCK•CEN*
11:00-11:30	Coffee break
11:30-11:50	The Way of CEN - Dose Assessment for Construction Products, *B. Hoffman, BfS*
11:50-12:10	In-vivo incorporation of radionuclides of workers: measurements vs. evaluation with GEANT4, *S. Medici, IRA*
12:10-13:30	Lunch and Group photo

SESSION 2. INNOVATIVE ALARA TOOLS IN THE PLANNING AND DECISION PHASES (CHAIR: S. ANDRESZ)

13:30-13:50	The VISIPLAN software: to perform dose assessment under different scenarios, *F. Vermeersch, SCK•CEN*
13:50-14:20	ALARA, Ethics, the ICRP System and Innovation: Aligned?, *Prof. J. Malone, Trinity College Dublin, Ireland*
14:20-14:30	Introduction to working groups - EAN Representatives
14:30-16:40	Working group session (1/2) *(coffee break at 15:00)*
16:45	Welcome reception
17.30	Departure of the shuttle bus and transportation to city centre

Thursday, 28 November 2019
19th European ALARA Network workshop

08:30	Departure of the shuttle bus and transportation to EEAE
09:00	Registration

SESSION 2. INNOVATIVE ALARA TOOLS IN THE PLANNING AND DECISION PHASES (CONT.) (CHAIR: S. ANDRESZ)

09:00-09:20	Artificial intelligence in interventional techniques, *Prof. E. Efstathopoulos, National and Kapodistrian University of Athens*
09:20-09:40	Decision aiding tools considering multiple criteria, *T. Kenny, EPA*
09:40-10:00	Manuela: an advanced 3D characterization material in NPP, *B. Chagneau, Orano*
10:00-10:20	Using RayXpert© Monte Carlo code to optimize radiological protections in a nuclear medicine service, *B. Simony, C. Dossat, A. Ghilardi (TRAD), J. F. Rauch, L. Whitfield (Hôpital Albi)*
10:20-11:00	Coffee break

SESSION 3. INNOVATIVE ALARA TOOLS FOR THE FOLLOW-UP AND FEEDBACK (CHAIR: P. CROÜAIL)

11:00-11:20	The D-Schuttle for the collection, capitalization and broadcasting of radiological data after radiological events, *P. Croüail, W. Naito, CEPN, AIST*
11:20-11:40	Impact of the Euratom Directive on the need of follow up and feedback from activities, *C. Pafilis, S. Economides, EEAE*
11:40-12:10	Evolving Fluoro Worker Dosimetry, *Prof. S. Balter, New York University*
12:10-13:30	Lunch
13:30-16:00	Working group session (2/2) *(coffee break at 15:00)*
16:00-17:00	Working group reports
	Synthesis and concluding remarks
17:00	Departure of the shuttle bus and transportation to city centre

5. ANNEX 2

Personal Online Dosimetry Using computational Methods (PODIUM) project dissemination workshop
&
19th European ALARA Network Workshop
on Innovative ALARA Tools
26 -28 November 2019, Athens, Greece

Attendance list

α/α	Last name	First name	Organization	Signature 26/11/2019	Signature 27/11/2019	Signature 28/11/2019	GDPR info	GDPR photo
1	Abdelrahman	Mahmoud	The Belgian Nuclear Research Center				✓	✓
2	Almén	Anja	Lund University				✓	✓
3	Andersson	Martin	Lund University				✓	✓
4	Andresz	Sylvain	CERN				✓	✓
5	Aranda	Joan	UPC-BarcelonaTECH				✓	✓
6	Askounis	Panagiotis	Greek Atomic Energy Commission (EEAE)				✓	✓
7	Birschwilks	Mandy	Federal Office for Radiation Protection (BfS)				✓	✓
8	Budayova	Miluse	State Office for Nuclear Safety				✓	✓
9	Camp Brunés	Anna	Institut de Tècniques Energètiques - Universitat Politècnica de Catalunya				✓	✓
10	Camps	Johan	Belgian Nuclear Research Centre	—			✓	✓

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11	Carinou	Eleftheria	Greek Atomic Energy Commission (EEAE)				✓	✓
12	Chagneau	Benjamin	orano				✓	✓
13	Croüail	Pascal	CEPN	—			✓	✓
14	Duch	Maria A.	Universitat Politècnica de Catalunya					✓
15	Eakins	J.	PHE					✓
16	Economides	Sotirios	Greek Atomic Energy Commission (EEAE)				✓	✓
17	Efstathopoulos	Efstathios	Medical Radiation Physics, 2nd Dept. of Radiology, Medical School, National and Kapodistrian University of Athens	—	—		✓	✓
18	Fotos	Nikolaos	MEDIRAY				✓	✓
19	Fremout	An	FANC					✓
20	Gallagher	Aoife	University Hospital Limerick				✓	✓

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21	García Balcaza	Víctor	UPC				✓	✓
22	GHILARDI	Antoine	TRAD Tests & Radiations				✓	✓
23	Ginjaume	Merce	Universitat Politècnica de Catalunya (UPC)				✓	✓
24	Grimbergen	Tom	Mirion Dosimetry Services				✓	✓
25	Gueli	Fabio	Joint Research Centre of Ispra - European Commission				✓	✓
26	Hanzl	Robin	OKG AB	—			✓	✓
27	Hoffmann	Bernd	German Federal Office for Radiation Protection	—			✓	✓
28	Jansen	Jan	Public Health England				✓	✓
29	Kabrt	Franz	AGES - Austrian Agency for Health and Food Safety				✓	✓
30	Kanellopoulou	Stamatiki	MEDIRAY				✓	✓

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31	Knezevic	Zeljka	Ruder Bošković Institute				✓	✓
32	Kyriakidou	Alexandra	Greek Atomic Energy Commission				✓	✓
33	Lombardo	Pasquale Alessandro	SCK.CEN				✓	✓
34	Majer	Marija	Rudjer Boskovic Institute					
35	Malone	Jim	Trinity College Dublin				✓	✓
36	Manetou	Aggelki	NIMTS Hospital				✓	✓
37	Maramathas	Christos	teleDOS Laboratories S.M. P.C. - teleDOS Nuclear Tech	—			✓	✓
38	Medici	Siria	CERN & Institute of Radiation Physics of Lausanne	—			✓	✓
39	Niu	Shengli	International Labour Office				✓	✓
40	O'Connor	Una	St. James's Hospital				✓	✓

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41	Papadopoulou	Sofia	Radioanalytics S.M. P.C.	—	—			
42	Pavelic	Luka	Institute for Medical Research and Occupational Health				✓	✓
43	Sans Merce	Marta	University Hospital of Geneva		—	—	✓	✓
44	SIMONY	Benoit	TRAD Tests & Radiations				✓	✓
45	Sotiropoulou	Panagiota	General Oncology Hospital of Kifisia "Agioi Anargyroi"	—	—			
46	Tanner	Rick	Public Health England				✓	✓
47	Thrapsanioti	Zoi	Greek Atomic Energy Commission (EEAE)				✓	✓
48	Upton	John	HSE				✓	✓
49	Van Hoey	Olivier	Belgian Nuclear Research Center SCK-CEN					✓
50	Vanhavere	Filip	SCK-CEN, Belgian Nuclear Research Centre				✓	✓

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51	Vermeersch	Fernand	SCK.CEN				✓	✓
52	von Barnekow	Ariel	Universitat Politècnica de Catalunya · BarcelonaTech (UPC)				✓	✓
53	Waly	Ahmed Galal	CASBEC	—	—			
54	Yildiz	İlkay	Psychological Counsellor	—	—			
55	Zankl	Maria	Helmholtz Zentrum München German Research Center for Environmental Health (GmbH)	M. Zankl	M. Zankl		✓	✓
56	Zemanová	Eva	State Office for Nuclear Safety				✓	✓
	PEREZ	~~MUGAS~~ ARTURO	CSN (Spain)/EAN	27.11.19			✓	✓