

CEEPUS Network: CIII-AT-0042-00-1920

Abstract:

CIII-AT-0042-00-1920 exists since 22 years and represents an interdisciplinary network consisting of medical and engineering departments and grows. AT-42 keeps growing year by year by adding new partners every year – this time one new partner joined. Size matters because of the complexity of the subjects dealt with, so the expertise of each new partner is a valuable input for the whole network. On the other hand we are also trying to spread best practice solutions – so again, size matters.

We also need to accommodate the specific set up of medical studies, where semester exchanges are not very often possible.

Our main educational efforts are organizing several unique schools and workshops (for this application year) and one academy. All these schools and workshops are targeted to different topics as well as different education level – eg the “CEEPUS Summer Academy of Pediatric Medicine” to students, “CT School” or “School of Pediatric Haematology” to Radiology residents / specialists, or others like the “Summer School on Image Processing” to residents or on Master or PhD level. Due to the “School of Pediatric Haematology” and associated activities like network exchange it was possible to raise considerably survival of childhood leukemia in Kosovo – one of the real big achievements within the last years. It is noteworthy to mention, that due to the organisation of the “CEEPUS Summer Academy of Pediatric Medicine” now a structural cooperation with the University of Brisbane / Australia and the Western University / Canada could be established with regular participation of their students.

In addition to these efforts CIII-AT-0042-00-1920 is trying to promote, advertise and enhance individual student mobility between partners during the lecture free time.

There is continued scientific cooperation of partners and all together about 170 papers (congress contributions, book chapters/books) were published. Due to the involved institutions there is a strong focus on pediatric medicine.

The last year added institutions of Nuclear Medicine in Serbia, Macedonia and Bosnia-Herzegovina organised congresses with invited lectures as well as organized exchange.

All partners share their experience and eg the network knowledge is used to enhance patient care eg by operation simulations, improving algorithms – a sketch of these activities were recorded as a movie for the CEEPUS 20 years celebration (<https://www.youtube.com/watch?v=duEVBet4gsA&feature=youtu.be>). Moreover a closer cooperation with the American Austrian Foundation (AAF) – Open Medical Institute (<http://www.aaf-online.org/>) since there is a considerable overlap between the educational activities of CIII-AT-0042-00-1920 and AAF. Univ.-Prof.Dr.Erich Sorantin, acting head of the Division of Pediatric Radiology, Department of Radiology, Medical University Graz /A is also the Co-President for AAF Pediatric Radiology courses – together with the Children’s Hospital of Pennsylvania in Philadelphia/US (CHOP <http://www.chop.edu/>). Since for the AAF course recommendations are needed, there is the possibility for the CEEPUS partners to share information about proper candidates.

There is one point more to mention. We are now 51 partners in 15 countries and it is obvious, that there is some asymmetry in the activities and exchange of the partners. Since the Medical University Graz is the flagship of that network it is clear there are more wishes to have exchange with Graz than with other partners. Moreover, up to the best of my knowledge as the network coordinator, there are several constraints in different participating institutions – eg ambitious students and your researches are not supported adequately within their home institutions

because of the fear of brain drainage. Furthermore in not all institutions there is clear competence hierarchy leading to the well know game “not on my desk” thus handicapping a smooth process. Changing team members in the international offices need time and overexponential support to get on track and are usually confused by the competence “jungle” of their institution.

At this point I want to thank the Austrian Academic Exchange Service (www.oead.at) for the excellent cooperation and service as well as the CEEPUS Central Office and the International Relation Office of the my own university (Medical University Graz / A).

The frequently raised critics of reviewers of the mentioned asymmetry is well known to me as the network coordinator. But it has to be considered that I cannot visit all partners every year – according CEEPUS guidelines I would be on the road the full year. Despite all my actions by using all available communication channels like emails, personal phone calls, video conferences, personal meetings during the organised schools as well as combining private holidays with visits of the partners institutions it is sometimes not possible to change those things at an speed I would regards as desirable.

Background:

CEEPUS Network: CIII-AT-0042-00-1920 represents an interdisciplinary network between medical and engineering departments and exist since 1997.

Special focus is put on sharing experiences and on cooperation -- as a result, eg. we all share experience especially for children (from radiation protection to diagnosis and treatment of leukemia) as well as developed specialized software.

The Departments of the Pediatric Center (Dep. of Pediatrics and Adolescent Medicine, Dep. of Pediatrics and Adolescent Surgery, Division of Pediatric Radiology-Department of Radiology), Medical University Graz/A are leading institution in their field and support their partners where necessary. Therefore exchange has some asymmetry in favor of Graz and additionally “The Summer Academy of Pediatric Medicine” are held in Graz and therefore contribute to this asymmetry too. Just to give an example at the “CEEPUS Summer Academy of Pediatric Medicine” usually more than 40 students from 20 countries over the world participate – thus also enhancing to mutual social exchange. 2019 the “Summer School on Image Processing” will be organized by Faculty of Mathematics and Computer Science West University of Timisoara/Ro – therefore there are more exchange months for Romania in this application.

In order to compensate this four unique schools, workshops are organized distributed over all participating institutions and partners – partly in cooperation with other organisations like the European Society of Pediatric Radiology (ESPR – www.espr.org).

Two took already place at Cluj-Napoca/Ro in June 2016 and Bukarest June 2017 as well as the course “Advanced Pediatric Radiology” in 2018 as well as the workshop “CT Protocols made easy” in 2018 at Cluj-Napoca/Ro – between partners from Graz, Cluj-Napoca and Bukarest in cooperation with Pediatric Radiology Group of the Romanian Radiological Society (GRP-SRIM <http://www.radiologie-pediatria.ro/course-2016> and <http://www.radiologie-pediatria.ro/course-2017/>) and financial support by ESPR (European Society of Pediatric Radiology – www.espr.org). Titlepage of the corresponding flyers is shown in Figure 1. More than 80 radiology residents or specialists were trained in Pediatric Radiology.

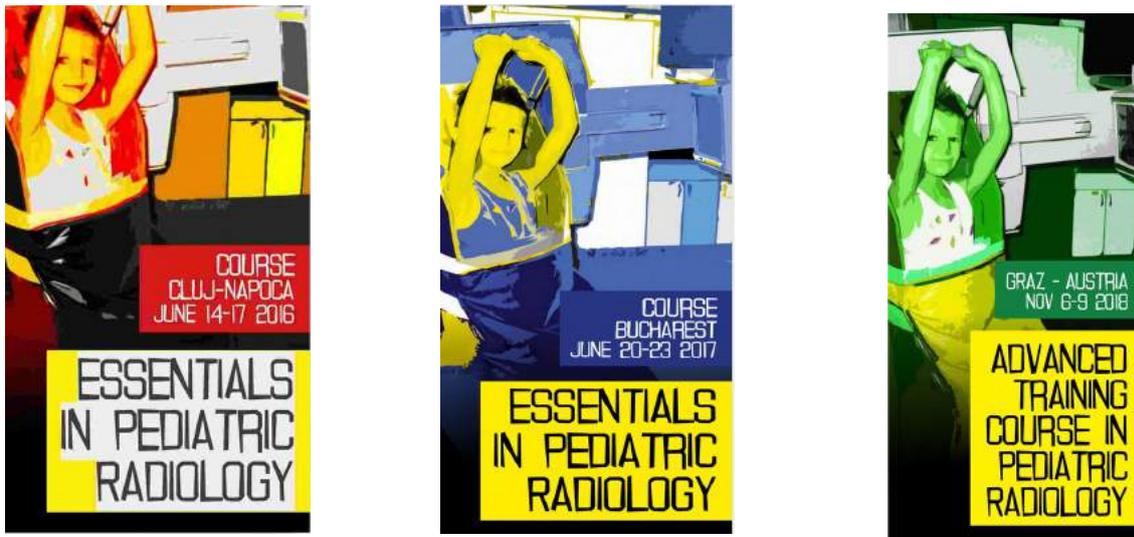


Figure 1: Flyer titlepages for the pediatric radiology course in Cluj-Napoca 2016 and Bukarest 2017 and Graz 2018 – a joint cooperation between the CEEPUS partners in Graz/A, Cluj-Napoca/A and the Pediatric Radiology Group of the Romanian Radiological Society (GRP-SRIM). Course got financial support by the ESPR (European Society of Pediatric Radiology – www.espr.org).

About 170 publications, congress and book contributions, done in cooperation as well as awards, confirm and underline these efforts. In the last period the following publications appeared:

Papers from Belgrade/SRB:

[Atypical localization of intraosseous angioleiomyoma in the rib of a pediatric patient: a case report.](#)

Djuričić G, Milošević Z, Radović T, Milčanović N, Djukić P, Radulovic M, Sopta J.
 BMC Med Imaging. 2018 Dec 19;18(1):54. doi: 10.1186/s12880-018-0297-x.
 PMID: 30567503 [PubMed - in process] **Free Article**

[A posttraumatic pseudoaneurysm of the left radial artery as a result of a stab wound in an 8-year-old girl.](#)

Djuricic G, Milosevic Z, Radovic T, Dasic I, Alempijevic D, Sopta J.
 Forensic Sci Med Pathol. 2018 Sep;14(3):406-409. doi: 10.1007/s12024-018-9975-9. Epub 2018 Apr 11.
 PMID: 29644530 [PubMed - indexed for MEDLINE]

[Fractal and Gray Level Cooccurrence Matrix Computational Analysis of Primary Osteosarcoma Magnetic Resonance Images Predicts the Chemotherapy Response.](#)

Djuričić GJ, Radulovic M, Sopta JP, Nikitović M, Milošević NT.
 Front Oncol. 2017 Oct 19;7:246. doi: 10.3389/fonc.2017.00246. eCollection 2017.
 PMID: 29098142 [PubMed] **Free PMC Article**

Paper from CEEPUS Partners Graz/A, Novi Sad/SRB and international partners

Protocol and Guidelines for Point-of-Care Lung Ultrasound in Diagnosing Neonatal Pulmonary Diseases Based on International Expert Consensus

Jing Liu¹, Roberto Copetti², Erich Sorantin³, Jovan Lovrenski⁴, Javier Rodriguez-Fanjul⁵, Dalibor Kurepa⁶, Xing Feng⁷, Luigi Cattaross⁸, Huayan Zhang⁹, Misun Hwang¹⁰, Tsu F. Yeh¹¹, Yisrael Lipener⁶, Abhay Lodha¹², Jia-Qin Wang¹³, Hai-Ying Cao¹⁴, Cai-Bao Hu¹⁵, Guo-Rong Lyu¹⁶, Xin-Ru Qiu¹, Li-Qun Jia¹⁷, Xiao-Man Wang¹⁷, Xiao-Ling Ren¹, Jiu-Ye Guo¹, Yue-Qiao Gao¹, Jian-Jun Li¹, Ying Liu¹, Wei Fu¹, Yan Wang¹⁸, Zu-Lin Lu¹, Hua-Wei Wang⁷, Li-Li Shang¹⁹

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Journal of Visualized Experiments – in press

The last papers represents a truly international cooperation where CEEPUS partners Graz/A and Novi Sad/SRB (Dr. Jovan Lovrenski, University of Novi Sad Institute for children and youth health care of Vojvodina, Novi Sad/SRB). He got the idea of lung ultrasound during a CEEPUS exchange at the Medical University Graz / A. Afterwards he has chosen this topic for his PhD, which was done under the umbrella of the CEEPUS “These en Cotutelle” between his home university and the Medical University Graz /A, mentored by E.Sorantin. Today Dr.Lovrenski is an Associate Professor of the University of Novi Sad/SRB and an internationally reputed Pediatric Radiologist and specialist for lung ultrasound. Due to his expertise he was also an invited speakers at the “40th Post Graduate Course & 54th Annual Meeting” of the European Society Pediatric Radiology (www.espr.org) in Berlin 2018.

Moreover due to the longstanding cooperation between the Research Unit of Digital Information and Image Processing, Medical University Graz/A (head: Univ.-Prof.Dr. Erich Sorantin) in mutual teaching, organizing of “Summer Schools on Image Processing” mentoring and co-authoring papers Univ.-Prof.Dr.Erich Sorantin was awarded with an “*Doctor honoris cause in informatics by the University of Szeged/HU*” - Figure 2 demonstrate the celebration and Figure 3 the document given.



Figure 2: on November 10st, 2018 the CEEPUS partner University of Szeged/HU awarded the network coordinator and pediatric radiologist Univ.-Prof.Dr.Erich Sorantin with an “Doctor honoris causa” in Informatics. Images depict the hand over of the decret by the rector (left) and vice dean of Informatics (middle).



Figure 3: Dr. honoris causa document of Univ.-Prof.Dr.Erich Sorantin

Furthermore the “Summer School on Image Processing (SSIP)” (<https://SSIP2018.medunigraz.at/>) was organized in Graz as well as the “CEEPUS Summer Academy of Pediatric Medicine (CSAPM)”.

At SSIP Graz hosted 33 participants from 22 countries – the programm and photographs can be found in Fig.6, list of participants under Table 1.

For and at CSPAM 34 from 15 countries – photographs and the directory of CSPAM can be found under Figure 6.

Moreover a document defining the framework for the “These en Cotutelle” is signed by all partners with appropriate legal property to grant PhD – currently one is executed between Division of Pediatric Radiology, Department of Radiology, Medical University Graz/A and Institute for Children and Youth Health Care of Vojvodina, University of Novi Sad/SRB.

Last year added partners from Nuclear Medicine organized the exchange with hosting of three students PET Center, Univ. of Belgrade/SRB. Moreover partners in Nuclear Medicine drafted studies dealing with the application of artificial intelligence to data from patients suffering from lymphomas.

Additionally the following CEEPUS partners from the Medical University Graz/A and institutions and from the University Sts.Cyril and Methodius Skopje/MK:

- Division of Pediatric Radiology, Department of Radiology, Division of Pediatric Hemato-Oncology, Department of Pediatrics, Institute of Cell Biology, Histology and Embryology – all Medical University Graz/A
- Institute of Immunobiology and Human genetics, Faculty of Medicine in cooperation with Institute of Chemistry, Faculty of Natural Sciences and Mathematics, both University Sts.Cyril and Methodius Skopje/MK

Monday, 5.7.2018	Tuesday, 6.7.2018	Wednesday, 6.7.2018	Thursday, 5.7.2018
<p>"Management of congenital pulmonary malformations" Invited Prof. Dr. Haege-TH</p> <p>"Acute abdominal pain in infancy and childhood" Dr. Eliza-Lore Hladik</p> <p>Pediatric and Adolescent Surgery</p>	<p>"Treatment of soft tissue sarcomas" Invited Prof. Dr. Haege-TH</p> <p>Plastic, Aesthetic and Reconstructive Surgery</p>	<p>"Basics in Transcatheter Medicine, old and new" Invited Prof. Dr. Haege-TH</p> <p>Blood Group Serology and Transfusion Medicine</p>	<p>"Medical emergencies in acute hepatology" Invited Prof. Dr. Haege-TH</p> <p>Pediatric and Adolescent Medicine</p>
Monday, 9.7.2018	Tuesday, 10.7.2018	Wednesday, 11.7.2018	Thursday, 12.7.2018
<p>"Children with febrile convulsions: Diagnosis and Management" Invited Prof. Dr. Haege-TH</p> <p>Pediatric and Adolescent Surgery, Pediatric and Adolescent Neurology</p>	<p>"Burns" Invited Prof. Dr. Haege-TH</p> <p>Plastic, Aesthetic and Reconstructive Surgery</p>	<p>"Basics of radiation protection" Invited Prof. Dr. Haege-TH</p> <p>Pediatric Radiology</p>	<p>"Acute Gastroenteritis" Invited Prof. Dr. Haege-TH</p> <p>Pediatric and Adolescent Medicine</p>
Monday, 16.7.2018	Tuesday, 17.7.2018	Wednesday, 18.7.2018	Thursday, 19.7.2018
<p>"Nonoperative fluid and pain management in children" Invited Prof. Dr. Haege-TH</p> <p>Pediatric and Adolescent Surgery</p>	<p>"Hemodialysis" Invited Prof. Dr. Haege-TH</p> <p>Pediatric and Adolescent Medicine</p>	<p>"How to interpret a chest X-ray" Invited Prof. Dr. Haege-TH</p> <p>Pediatric Radiology</p>	<p>"Cardiovascular resuscitation of newborns and children" Invited Prof. Dr. Haege-TH</p> <p>Pediatric and Adolescent Medicine</p>
Monday, 23.7.2018	Tuesday, 24.7.2018	Wednesday, 25.7.2018	Thursday, 26.7.2018
<p>"Pediatric Trauma, the Do's and Don'ts" Invited Prof. Dr. Haege-TH</p> <p>Pediatric and Adolescent Surgery</p>	<p>"The Pediatric MRI, a showcase of applied physics and pediatrics" Invited Prof. Dr. Haege-TH</p> <p>Blood Group Serology and Transfusion Medicine</p>	<p>"Pediatric Radiology - Today, Tomorrow" Invited Prof. Dr. Haege-TH</p> <p>Pediatric Radiology</p>	<p>"Hemophilia and other coagulopathies" Invited Prof. Dr. Haege-TH</p> <p>Pediatric and Adolescent Medicine</p>

Venue: Lecture Hall Dep. of Pediatric and Adolescent Medicine, daily 14.30 - 16.00
 Organized by the Division of Pediatric Radiology/Dep. of Radiology and Dep. of Pediatric and Adolescent Medicine
 Organizational Chair: Dr. Robert Mader, Secretary: an Univ.-Prof. Dr. Erich Sennhauser, Co-Chair: PD Dr. Jörg Jankov



Figure 6: left → directory of “CEEPUS Summer Academy of Pediatric Medicine”, right upper → students of summer academy at lecture hall, right down → students in computerlab for SSIP

Country	Participant
Ägypten	4
Armenien	1
Australien	1
Brasilien	1
China	2
Austria	3
Irland	1
Canada	4
Kasachstan	1
Kolumbien	1
Kongo	1
Luthenia	2
Oman	2
Peru	1
Poland	1
Egypt	1
Slovenia	1
Spain	1
Czech	1
Turkey	2
Ukraine	1
USA	1

Table 1: participants and their home country for CEEPUS Summer Academy of Pediatric Medicine

were able to acquire a grant of Scientific & Technological Cooperation (S&T Cooperation) from the Austrian Academic Exchange Service with the title “Titel: "Theoretical studies of DNA damage induced by ionizing radiation through direct exposure, secondary low-energy electrons and molecular radicals" (MK 12/2018), which fits perfect to the basic research activities of the group at the Medical University Graz/A.

It is notheworthy, that CIII-AT-0042-00-1920 is growing every year by adding new partners – for this application one new member could be acquired:

- School of Electrical Engineering, Laboratory for Biomedical Engineering and Technology
University of Belgrade (coordinator: PhD Milica Jankovic)

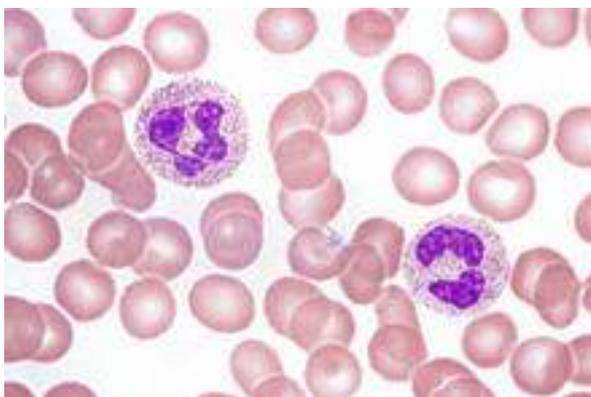
The application in detail:

A) Educational:

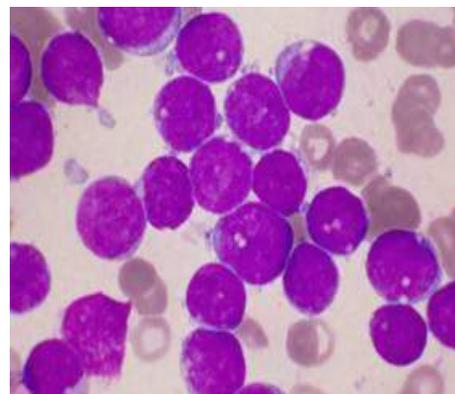
Four schools and workshops and one academy are organized, since these educational concept provides knowledge transfer in depth and partners can share their experience. For the medical schools it has to be considered, that resident teaching owns a multiplier effect and many of them are doing their PhD in combination with their medical specialization.

In addition to these efforts CIII-AT-0042-00-1920 is trying to promote, advertize and enhance individual student mobility – as it was done already in the past for internships already in eg in Austria, Croatia, Czech Republic, Macedonia and Serbia.

1. "School of Pediatric Haematology", Division of Pediatric Haemato/Oncology, Dep. of Pediatrics and Adolescent Medicine, Medical University Graz/A: children suffer from different oncologic spectrum than adults but the prognosis is usually better – overall about 75% can be cured with accurate diagnosis and treatment, in leukaemia even about 90%. In young children leukemia and lymphomas represents almost 50% of malignant diseases. In leukaemia one of the hallmarks are stained smears from blood taps and bone marrow aspiration -- both procedures are easy to perform and do not need special equipment. After staining of these smears types of leukaemia can be differentiated by light microscopy (Figure 3) -- available in almost hospitals. The processing of those smears is straightforward but needs a certain expertise. Badly stained smears handicap accurate diagnosis during light microscopy, even by experts. Moreover up to date tools like flow cytometric methods (FACS - fluorescence-activated cell sorting) enable additional subtyping.



a)



b)

Figure 7: a) blood smear from a healthy patient – there are numerous red cells (Erythrocytes) and two white blood cells (pink core). b) Demonstrates smear of a patient with leukaemia → the purple dots represent pathologic, white (leukaemia) blood cells. The shape and staining of these cells allows the characterisation – therefore accurate processing of these samples is mandatory.

The proposed school can deliver leading edge knowledge to its participants thus fitting perfectly in the education efforts of CIII-AT-0042-00-1920. Moreover it is noteworthy, that together with previous “Schools of Pediatric Oncology” in Prishtina/Kosovo a considerable success could be achieved – as already described in detail in application 2018/2019.

2. CEEPUS Summer Academy of Pediatric Medicine
<http://international-office.medunigraz.at/outgoing-mobility/ceepus/>
 This academy was organized for the first time in summer 2014, and afterwards yearly up to 2018. Usually participants consist of 30 – 40 students from more than 20 different nations. Participants also shared free time activities and therefore this academy supports bilateral understanding and may contribute to a more peaceful world for our children. Furthermore 5 medical specialities/subspecialities (Pediatrics, Pediatric Surgery, Plastic Surgery and Pediatric Radiology and Blood Transfusion Medicine) organized and contributed to this interdisciplinary course. A novel concept was developed and applied: interactive lessons teaching those topics which are hard to find in textbook or difficult to understand as well as hot topics in research. Moreover universities from other continents like from Australia and Canada send their students for participation. This is a huge success of the involved CEEPUS partners thus showing the global recognition of CIII-AT-0042-00-1920.

3. "Summer School on Image Processing 2020 (SSIP)" , Research Unit and Division of Pediatric Radiology, Department of Radiology, Medical University Graz / A (for SSIP please see <http://www.inf.u-szeged.hu/~SSIP/>). The SSIP was already organized 26 times, in 2018 from the Research Unit for Digital Information & Image Processing, Department of Radiology, Medical University Graz/A. 22 years this school was supported by CEEPUS. SSIP is the only summer school in the area of image processing. The SSIP is organized in 2 parts: lectures in the morning and project work in the afternoon - where the participants have only computers with internet connection. Lectures in the morning cover all aspects of image acquisition, image reconstruction, image processing as well as related topics of natural science. For the project work the academic supervisors prepare up to 20 projects covering a wide range of image applications. Students can make a selection of their favorite topics and afterwards they are divided in groups of 4 persons. Within each group all members should speak different native languages in order to be forced to use one of the official CEEPUS languages. Academic teachers supervise the project work and support students. In particular, team work is encouraged. At the end of the SSIP students have to pass a written test, they have to present their project work orally in English, as well as to create a web page - examples can be seen on the SSIP homepage. It is noteworthy that software developed within the students' projects at the SSIP 2004 is now used for research in dermatology (classification of digital laser microscopic images). In 2020 it will be organized by Department of Informatics, University of Szeged/HU.

4. "CT School 2020" of the Clinical Center Novi Sad/Serbia (<http://www.ctschool.eu/>): provides high level medical education within the central European region since 2003. Medical partners of the CEEPUS network will send participants as well as academic teachers. Medical University Graz special focus is on radiation protection, since Computed Tomography (CT) studies represent only 10% of all imaging modalities based on ionizing radiation but accounts for 50-70% of medical radiation. The "CT School" is held in Slavic language (besides the international teachers) since there are many radiologists in that area, which are not fluently speaking English. Figure 8 shows the announcement of this school in 2018 – from the Division of Pediatric Radiology Dr. Robert Marterer (he is also the chairman of the CEEPUS Summer Academy of Pediatric Medicine at Medical University Graz/A) supported the school by giving lectures about Computed Tomography in paediatric patients.

ŠKOLA

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SCHOOL OF COMPUTED TOMOGRAPHY

The 16th Educational Course

Novi Sad, November 29th – December 1st, 2018

The CT school will be held on Clinic for medical rehabilitation of Clinical center of Vojvodina, Hajduk Veljkova 1-9.

The Programme of the 16th CT School can be downloaded from the following link:
[CT School program](#)

Establisher of the school: Prof. dr Sanja Stojanović
 Chairman of the school Prof. dr Viktor Till

All information can be obtained from the page [registration](#) or from the technical organizer of the CT School, Dekon Congress d.o.o.

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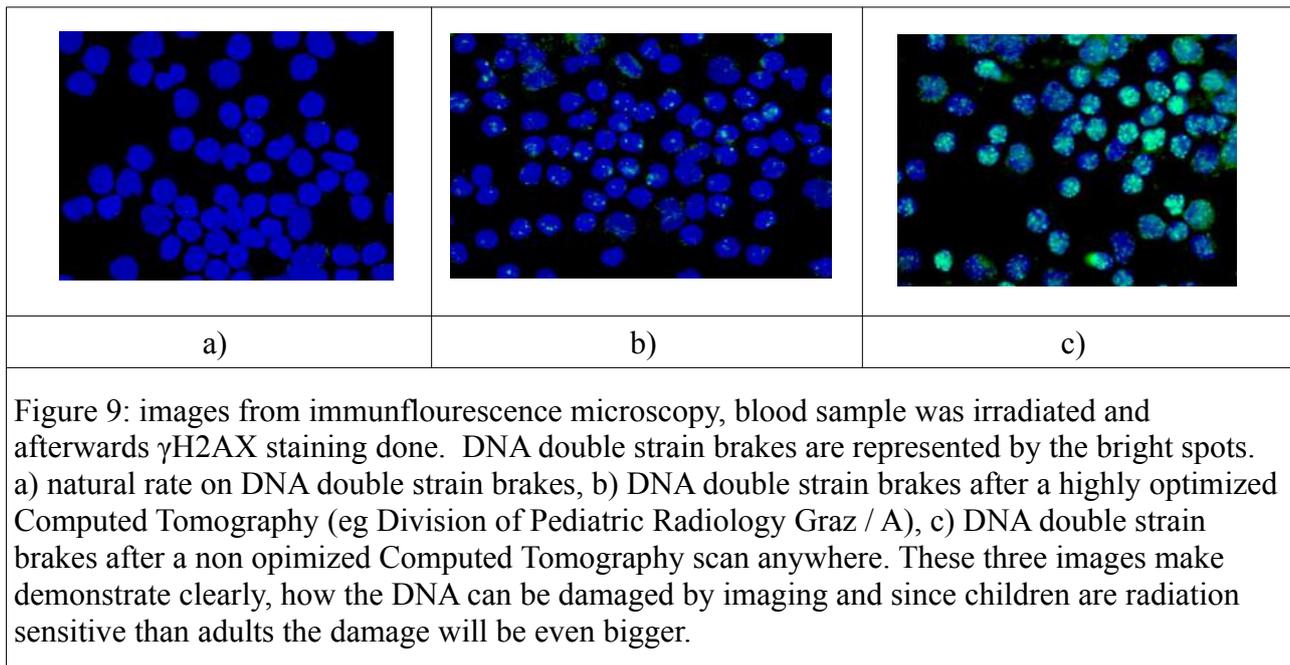
SIEMENS Healthineers

neomedica

Figure 8: Announcement of the 16th CT School 2018 in Novi Sad /SRB

B) Multicenter Research Studies:

- *Lung Ultrasound in Premature Babies and Neonates* is another project and fits perfect in the field of radiation protection and non invasive imaging. The rationale behind is, that if we can prove the results of the Vojvodina Mother and Child Center, then there is the potential for reducing the number of chest x-rays in these small patients thus reducing the radiation burden. A book supported by E.Sorantin appeared already in China and an English version is going to appear in 2019.. Due to this efforts Assoc.Prof.Dr. Lovrenksy, Institute for Children and Youth Health Care of Vojvodina, University of Novi Sad/SRB an active member, prior student of the network and now mentor, got his professorship while performing long standing research on this topic. He was invited speaker on the “40th Post Graduate Course & 54th Annual Meeting” (www.espr2018.org).
- *Detection of DNA Double Strain Brakes (DDSB) after imaging procedures:* due to new, innovative techniques (histone γ H2AX staining) it is now possible to quantify DNA double strain brakes following medical imaging utilizing ionizing radiation



Research between the Division of Pediatric Oncology and Haematology, Dep. of Pediatric and Adolescent Medicine and Division of Pediatric Radiology, Dep. of Radiology, both Medical University Graz /A in cooperation with CEEPUS partners from the Public Health Institute, University Sts.Cyril and Methodius Skopje/MK a known immunofluorescence technique could be setup, but this method consumes considerable human resources. Using CEEPUS as promoter there was a chance for an ambitious young molecular biologist to join this interdisciplinary team by facilitating exchange. As a consequence a new Flow cytometry technique (FACS) quantification tool could be developed which allow faster processing. Available results were presented at the annual congress of the “European Society of Pediatric Radiology” (www.espr2017.org). One of the next steps will be, not only counting the DNA double strand breaks but to detect which locus of the genome is hit by ionizing radiation eg tumor control genes. For that purpose CEEPUS partners from Pediatric Center Graz, Medical University Graz/A and University of Skopje/MK submitted a research proposal to Austrian Academic Exchange Service together with Institute of Chemistry, Faculty of Natural Sciences and Mathematics regarding theoretical modelling of the interaction of ionizing radiation and the human genome. This should enable to target the laboratory proof by molecular biological laboratory analytics. This would put new lights and insights on the cancerogenesis following medical imaging exploiting ionizing radiation.

Partners from Macedonia and Austria cooperate on this topic makes exchange necessary. One of the achievements of the last year was to establish a clear relationship between applied radiation dose and DNA double strand breaks as marker of the injured genome. Until now two different approaches were developed

- a) Immunofluorescence Staining – dose dependency of DDSB in Computed Tomography
- b) FACS method – dose dependency of DDSB in Computed Tomography

Quantification of DNA double strand breaks is not only important for characterization of the individual radiation sensitivity but could also revolutionize cancer therapy, since many of those drugs are acting by inducing DNA double strand breaks. If the individual sensitivity

could be characterized anti cancer drugs could be adopted in much better way to the individual person as before – a major step to “Personalized Medicine”. More details were already given in the application 2018/2019.

- *Current Management in Diagnostic Imaging and Treatment of Minor Pediatric Head Trauma in Central Europe:* CT will be performed in up to 50-70% of children, thus exposing this vulnerable patient group to a considerable high radiation exposure, which will induce one fatal cancer in every 3000-4000 head CT. At the Medical University Graz a algorithm was developed, where only 13% of children with head trauma undergoes CT. A combined effort of the Div. of Pediatric Radiology, Dep. of Radiology and the Dep. of Pediatric and Adolescent Surgery, both Medical University Graz / A, resulted in an already published review about diagnostic pathways in pediatric headtrauma (Sorantin, E; Wegmann, H; Zaupa, P; Mentzel, HJ; Riccabona, M Computed Tomographic Scan in Head Trauma: What is the Rational in Children? Eur J Pediatr Surg. 2013; 23(6):444-453). Results of this review depict, that the Graz diagnostic pathway in imaging pediatric head trauma shows that the Graz approach offers considerable dose savings in children - thus saving them in the longterm from unnecessary cancer. Czech CEEPUS partners from Prague already conducted the first survey on that topic. Moreover at the workshop “CT Protocols made easy” organized from the team of the Division of Pediatric Radiology, Medical University Graz/A together with the CEEPUS partners from the Medical Faculty of the University Cluj-Napoca and with the Pediatric Radiology Group of the Romanian Radiological Society at the Children’s Hospital of Cluj-Napoca Dec 18st-20st, 2018 the group was able **to reduce the dose by 60% in pediatric Computed Tomography.**
- *3D Printing:* at the Research Unit of Digital Information and Image Processing, Department of Radiology, Medical University Graz / A 3D Printing of human organs were already successfully implemented eg as training objects for training in minimal invasive surgery – several examples were already given in the previous applications. Data preparation for 3D Printing consists of several, partly complex and sophisticated steps. Engineering partners will contribute to make the workflow easier by transforming their expertise in image segmentation.
- *Nuclearmedicine:*

The established cooperation between Medical University of Vienna, University of Banja Luka, University Sts. Cyril and Methodius – Skopje (University of Belgrade - Faculty of Medicine, Center of nuclear medicine, Clinical Center of Serbia is also participant of this network and BMIT has a long cooperation with this institution).

 - Knowledge transfer to the BMIT from the previous experience of partners in the field of lymphoma tumor delineation in PET/CT scans based on machine learning approaches.
 - Multicentric renal study using different software tools: Syngo software (Siemens, Germany), HERMES Renogram Analysis Program (Hermes Medical Solutions, Inc. Sweden), IAEA Software Package for the Analysis of Scintigraphic Renal Dynamic Studies [1,2] and home-made GammaKey Add-On for the renal analysis [3]. The aim of the study is checking interobserver and intraobserver variability of standard renal parameters and considering of extraction of novel optimized features taking into account the surgical feedback.

C) Teleteaching:

The excellent tool of the CEEPUS partners at the Technical University Cluj-Napoca / Ro forms the professional basis for teleteaching.

Courses for all partners in medical imaging and corresponding transmission protocols and standards are of common interest -- thus enabling spreading the excellence of this network to a greater community at no costs. Furthermore this system was and will be plugged in to other academic networks in particular to the Eurasia Pacific Uninet for cooperation with academic partners in Nepal and China. Courses were given since the wintersemester 2012/2013 eg for "Introduction to Scientific Working" thus supporting young scientists. Moreover, there are not only participants from the CEEPUS CIII-AT-0042-00-1920 but from all regions of the world and therefore enhances networking between the participants. Efforts will be taken to increase the offer of international, multi-institutional courses on teleteaching courses.

D) Knowledge Exchange in the field of Pediatric Radiology and Radiation Protection:

The Basic Safety Standards (BSS) require attention to the image quality, by considering corrective actions "if exposures do not provide useful diagnostic information and do not yield the expected medical benefit to patients". If the benefit was lost, the exposure would not be justified. There is tremendous amount of wastage of resources due to images of poor quality. In many situations poor quality images constitute as much as 15-40%. This results in unnecessary radiation exposure to patients, loss of diagnostic information, increased social costs besides the economical aspects on health care. Further, BSS requires that Guidance levels (GLs) for medical exposure shall be established and these are intended to give reasonable indication of doses for averaged sized patients. Many countries have not established GLs. Experience from national surveys in some countries such as UK and information from European Community surveys has shown the possibility of large variation in patient doses for common examinations differ of about 20 times or more in different hospitals or even on different machines within same hospital. Moreover children are more than 10 times (some say almost 100 times) to radiation than adults – radiation induced cancer being one of the most worse consequences.

Various educative material is available -- eg from the International Atomic Energy Agency (IAEA - <https://rpop.iaea.org/RPoP/RPoP/Content/index.htm>), where also the Division of Pediatric Radiology, Medical University Graz/Austria contributed, the "Image Gently Campaign" (<http://imagegently.dnnstaging.com/>), "Radiological Society of North America" (<http://api.rsna.org/lms/org/physics/courses/index.cfm?CFID=5917754&CFTOKEN=be2857d586e34f7e-D48F0459-DFBA-7D70-0AC01355BBA057C4>) or "American College of Radiology (ACR - http://www.radiologyinfo.org/en/safety/index.cfm?pg=sfty_xray) just to give a few examples. Besides many others things, posters were developed, which will distributed within the medical partners of the network. Within the organized schools these topics will be included. Moreover our CEEPUS Network cooperated also with the EC Tender Project "Project ENER/2013/NUCL/SI2.671441 European Diagnostic Reference Levels for Paediatric Imaging PiDRL".

The CEEPUS network CIII-AT-0042-00-1415 won already two third party, competitive, funded research projects for radiation protection and quality control in Radiology -- one in Macedonia and another in Montenegro.

E) These en Cotutelle:

Joint Degree and These en Cotutelle are initiatives, which are quite complex to the involved universities. For a joint degree with just a few applicants both universities must set up individual PhD commissions which have to manage the difficulties due to different statutes of the involved universities, legal environment, just to name a few. The “These en Cotutelle” it is simpler to execute but still needs an agreement and coordination contract between the partner universities. All partners of CIII-AT-0042-00-1819 signed a framework document for easier management.

Fears of the involved universities to have extra expenses are the main difficulty times where all budgets are tight. CEEPUS has to be prolonged every year, a PhD lasts more than one year. Therefore there is always the question, who will pay for a PhD defense and interview, when the CEEPUS network was not prolonged. Therefore legal departments of universities tend to call the Joint Degree and These en Cotutelle as illegal in order to avoid troubles. Besides the content management of a PhD there are considerable and sometimes not successful efforts necessary to achieve at least a “These en Cotutelle”.

I personally stress to use a web conference tool like that from our partners at the Faculty of Electronics, Telecommunications and Information Technology, Univ. of Cluj-Napoca /Ro. In PhD defenses based on the These en Cotutelle, where I was involved, this worked perfectly.

F) Silent Partners:

The Division of Pediatric Radiology, Department of Radiology, Medical University Graz/A has several longstanding, which are embedded in the CEEPUS network:

The National Centre of Radiobiology and Radiation Protection (NCRRP)/BG: exchange in knowledge regarding interaction of ionizing radiation and human genome.

Siemens Healthineers: there is a longstanding partnership, E.Sorantin was for a period of 10 years (1996-2006) consultant for computer graphics for the company during this period two products for virtual endoscopy were developed (Virtuoso3D and Leonardo Workstation). Later two software versions were developed for optimizing image reconstruction algorithms in Computed Radiography and Digital Radiography for pediatric use, followed 2015 by cooperating in the field of fetal Magnetic Resonance Imaging.

Canon Medical Systems Gesellschaft m.b.H. (former Toshiba Medical Systems Inc.): since 2008 there is a cooperation for exploiting Volume Computed Tomography in children. This includes development of imaging protocols and new, dose saving applications for children as well as support of other company customers.

ulrich medical: Division of Pediatric Radiology, Department of Radiology, Medical University Graz/A developed algorithms how to inject intravenous contrast medium for pediatric Computed Tomography keeping balance between image quality and dose. Those algorithms were freely distributed within the network and evaluation was done together between radiology partners. ulrich medical will now release a product to the market.

G) Conclusion:

This is the 21st application from network” CIII-AT-0042-00-1920 - Image Processing, Information Engineering & Interdisciplinary Knowledge Exchange” representing a multidisciplinary network with units from a considerable part of Europe. More than 170 publications, regulary schools and an academy which gains global recognition, executing “These en Cotutelle”, raising survival of childhood leukaemia in Kosovo, combining engineering with medical (just to name a few topics) proove the activity of the network.

As everywhere there more institutions more active than others but it generates a gravitation to the others.