

2020

OMPI Seminar Archive

OMPI Seminar: Spencer Manwell and Richard Richardson and Winter Social

Date: Thursday, January 23, 2020

Time: 15:30

Location: Carleton university

Presentations:

1) The phantom with the blurry heart: Motion correction in cardiac PET/CT

by Spencer Manwell, PhD Candidate

Supervisors: Tong Xu, Ran Klein, Rob deKemp

Abstract: In positron emission tomography (PET) studies acquisition times can range from 10 to 60 minutes. As one may imagine, demanding that a patient remains perfectly still during this time is often unreasonable. The effect of patient motion during imaging is two-fold: image blur leads to loss of the image contrast for regions with radiotracer uptake; and spatial mis-registration between the PET emission data and the transmission data used for attenuation correction (AC) which can lead to AC artifacts. Generally, these effects are not so significant that they impact clinical decision making or diagnosis, but moderate to severe motion is certainly not uncommon and has the potential to reduce overall diagnostic accuracy. In this talk I'll describe a framework for motion correction that is based on tracking the motion of a small radioactive marker placed on patients during cardiac PET perfusion studies using the PET scanner itself. This approach was designed to address both the motion-induced artifacts described above, as well as obviate the need for external motion tracking hardware, e.g. optical cameras. In particular, this talk will focus on a recent experiment where we imaged an anthropomorphic torso phantom that allowed us to simulate cardiac PET studies and test our motion correction algorithm. I'll review our findings of the case of the phantom with the blurry heart and finish with a description of where our research is headed.

2) Radon Non-Lung Cancer Health Effects and the Search for Radon Biomarkers in the Blood of Canadian Residents

by Richard Richardson, PhD (Atomic Energy of Canada Limited)

Abstract: The following questions are addressed:

- What are the concerns about radon exposures in Canadian homes?
- Does inhaled radon affect tissues beyond the lung?
- Does systemic radon cause leukaemia, non-cancer diseases and aging?
- Are stem cells in hypoxic niches vulnerable to high LET radon exposures ('oxygen effect')?
- Has radon the potential to accelerate aging?
- What radon biomarkers in the blood of Canadian residents will CNL test for and what are the confounding factors?

3) The 2020 Winter social will be held at Mike's Place. For this year a round of pub trivia, spanning general knowledge outside of medical physics, is planned. Those interested should contact

lymadMansour@cmail.carleton.ca

OMPI Seminar: Keren Mayorov and Emily Heath

[to be rescheduled]

Date: Thursday, February 27, 2020

Time: 15:30

Location: The Ottawa Hospital, General Campus, 501 Smyth Ave, Main Auditorium

NOTICE: This event has been cancelled due to inclement weather. These talks will be rescheduled for later in the term.

Presentations:

1) Postmastectomy radiation therapy for patients with tissue expanders

by Keren Mayorov (MSc Candidate)

supervisor: Elsayed Ali

Abstract: An increasing number of women choose to undergo breast reconstruction after mastectomy, with a rising trend towards implant-based reconstruction. A common technique involves the insertion of a temporary tissue expander at the time of mastectomy to stretch and prepare the overlying skin for a permanent implant. The tissue expander contains a metal port that is accessed with an external magnet and used for gradual saline injections. Some of these patients receive radiation treatment with the metal port in the radiation field. Perturbations in the dose distribution occur if the presence of the high-density metal port is not accurately modelled in the treatment planning calculation, or if its' location at the time of treatment is different from its location in the simulation scan. In this study I investigated the magnitude and the dosimetric effect of the inter-fractional positional variations of the metal port in different treatment techniques, and compared their robustness in treatment delivery.

2) Robust Optimization for Mixed-Beam Radiotherapy

by Emily Heath, PhD (Carleton University)

Abstract: Mixed-beam radiotherapy (MBRT) is an emerging external beam radiotherapy technique that uses intensity-modulated beams of different radiation types. MBRT using photon and electron beams has been shown to be dosimetrically superior to conventional photon IMRT in cases where part of the tumour is close to the skin. Considerable progress has been made towards enabling clinical implementation of MBRT. A remaining challenge is that conventional treatment margins to account for patient setup uncertainties may not be valid. Robust optimization is an alternative planning approach where uncertainties in the radiotherapy delivery are modelled in the treatment plan optimization. Treatment plans which compensate for the modeled uncertainties can be automatically generated. In this talk I will describe the implementation of a robust optimization process for MBRT followed by results of experimental validation of the delivery of these plans. A comparison of conventional PTV-based plans and robust plans will be presented.

OMPI Seminar: Odai Salman and Emily Heath

[to be rescheduled]

Date: Thursday, March 26, 2020

Time: 3:30 - 5:00 pm, Refreshments start at 3:15 pm.

Location: The Ottawa Hospital, General Campus, 501 Smyth Ave, Main Auditorium

Cancelled due to COVID-19 social distancing

Presentations:

1) TBD

by Odai Salman, PhD Candidate, Carleton University, Department of Systems and Computer Engineering

Supervisor: Ran Klein

Abstract: TBD

2) TBD

by Emily Heath, PhD, Carleton University, Department of Physics

Abstract: TBD

OMPI Seminar: Byron Wilson and Gerd Melkus

Date: Thursday, April 30, 2020

Time: 15:30

Location: This is a virtual seminar via this [Microsoft Teams link](#) (you do not need to install software and can access using most modern smart devices).

Presentations:

1) My Experience in a Medical Physics Residency and Technologies that I'm Somewhat Knowledgeable About

by Byron Wilson (Medical Physics Resident, Ottawa Regional Cancer Centre, The Ottawa Hospital)

Abstract: Are you interested in doing a residency? This talk is going to be an amalgamation of the various things that I have learned during my residency and the projects that I have been able to do. Some of the projects discussed will be my work on automated contouring, MRI QC, and Cyberknife patient specific QC. I will try to tie everything together with philosophical ramblings about early career medical physics pedagogy, and the role that research plays in clinical physics.

2) Biochemical and functional imaging of the hip in patients with cam-type FAI

by Gerd Melkus, PhD (Department of Radiology, The Ottawa Hospital)

Abstract: Cam morphology of the hip femoral head-neck junction can lead to osseous conflict with the acetabular rim and may predispose to femoroacetabular impingement (FAI). The impingement damages the cartilage, which can lead to the development of osteoarthritis. However, the timing of changes to the bone and cartilage is unclear, as arthritic changes existed in adults regardless of symptomatology. A biomarker is required that is more specific and sensitive to changes in periarticular tissues, especially in the very early stages of degeneration. Non-invasive imaging methods, such as MRI or PET are promising tools to research and investigate FAI longitudinally and clinically and have the potential to serve as biomarkers. In this presentation, MRI T1p mapping for biochemical sensitive imaging of cartilage and PET techniques in functional bone imaging for FAI will be reviewed and discussed.

OMPI Seminar: Keren Mayorov, Julia Wallace and Miller MacPherson

Date: Thursday, May 21, 2020

Time: 15:30

Location: Virtual Teams meeting

Presentations:

1) Postmastectomy radiation therapy for patients with tissue expanders

by Keren Mayorov (Student)

Supervisor: Elsayed Ali, The Ottawa Hospital Cancer Centre.

Abstract: An increasing number of women choose to undergo breast reconstruction after mastectomy, with a rising trend towards implant-based reconstruction. A common technique involves the insertion of a temporary tissue expander at the time of mastectomy to stretch and prepare the overlying skin for a permanent implant. The tissue expander contains a metal port that is accessed with an external magnet and used for gradual saline injections. Some of these patients receive radiation treatment with the metal port in the radiation field. Perturbations in the dose distribution occur if the presence of the high-density metal port is not accurately modelled in the treatment planning calculation, or if its location at the time of treatment is different from its location in the simulation scan. In this study I investigated the magnitude and the dosimetric effect of the inter-fractional positional variations of the metal port in different treatment techniques, and compared their robustness in treatment delivery.

2) Experiential learning in an undergraduate physics course: Practical dosimetry skill development at NRC's Ionizing Standards Lab

by Julia Wallace, PhD (Institute of Environmental and Interdisciplinary Science and Department of Physics, Carleton university)

Abstract: As one component of a third year modern physics course, my students undertook a half-day field trip to NRC's Ionizing Standards Lab. The purpose of this exercise was for students to gain hands-on practical experience in a work environment. The activity was divided into a mini-lecture, measurements of background radiation (inside and outside the building), a tour of the Compton Gamma Imaging Lab and finally a round-up discussion about jobs related to this field. I will describe how this activity enhanced my course and share some of my students' reflections.

3) Update from The Ottawa Hospital Cancer Centre: Covid-19 Impact

by Miller MacPherson, PhD (Ottawa Regional Cancer Centre)

OMPI Seminar and Social: Iymad Mansour and Emily Heath

Date: Thursday, September 17, 2020

Time: 15:30

Location: This is a virtual seminar via this Zoom Meeting.

Presentations:

1) Haralick analysis in microdosimetry: characterization of energy deposition in cellular targets

by Iymad Mansour

Supervised by Rowan Thompson, PhD (NRC)

Abstract: Microdosimetry accounts for the stochastic nature of the energy deposition processes in microscopic structures, considering spatial and temporal aspects. Macroscopic quantities such as dose and dose rates are averages that disregard the inherent fluctuations thereby providing limited information on energy deposition on cellular length scales. The focus of this talk will be on the application of Haralick analysis to microdosimetry, towards advanced analyses of energy deposition on microscopic length scales. Haralick analysis, which was historically developed for image analysis and classification, can analyze the texture within an image. Applying this technique to energy distributions computed using Monte Carlo simulations in micron scale geometries demonstrates the potential of the technique.

2) Robust Optimization for Mixed-beam radiotherapy

by Emily Heath, PhD (Department of Physics, Carleton University)

Abstract: Mixed-beam radiotherapy (MBRT) uses combinations of intensity modulated electron and photon beams in order to treat tumours that have both a superficial and deep component. Planning studies have shown the MBRT plans can achieve a superior plan quality compared to conventional radiotherapy techniques for certain treatment sites. Recent developments in planning and delivery of MBRT have brought this technique closer to clinical implementation, however, it has been shown that conventional PTV margins may not be effective at compensating for setup errors in MBRT. A promising alternative to margins is the use of robust optimization techniques where the dosimetric effects of setup errors are modeled in the plan optimization.

This talk will give an overview of the motivation for, and recent developments in, mixed-beam radiotherapy. I will describe the application of robust optimization to a novel treatment planning framework for MBRT and the subsequent experimental validation of the first delivery of a robust MBRT plan. Preliminary results from a planning study comparing robust optimized MBRT plans with margin-based MBRT plans will be presented.

3) SOCIAL EVENT

Join us for the first OMPI virtual social event ever (we think)!

“OMPI-is-never-trivial Pursuit”!

Grab a beverage and a snack after the seminar and be ready for 6 rounds of fiendishly easy quiz questions. Show that you know more than your specialized subject of medical physics and be crowned OMPI Polymath 2020!

There will be prizes (real, physical prizes!) and hopefully a lot of fun too.

Logistics for those who need to know all the details beforehand:

1. Quiz will start around 15 minutes after the seminar finishes – time for a visit to the bathroom/kitchen/LCBO (if you are very fast)/your favourite fast-food establishment and/or place your delivery order.
2. Google is not your friend – stay away from search engines for the duration of the quiz
3. Have fun!



OMPI Seminar: Matthew Efseaff and Paul Johns

Date: Thursday, October 15, 2020

Time: 15:30

Location: This is a virtual seminar via this Zoom Meeting.

Presentations:

1) Evaluating the accuracy of a new general cavity theory

by Matthew Efseaff (PhD Candidate)

Supervised by Miller McPherson, PhD and Dan La Russa, PhD (The Ottawa Hospital)

Abstract: Cavity theory provides the foundation of modern radiation dosimetry protocols. However, the cavity theory formalisms in conventional use are confined to a narrow range of incident beam energies and detector configurations. This is partly due to the limiting assumption that the detector cavity minimally perturbs the charged particle fluence in the surrounding medium. This presentation will explore a novel cavity theory that is formulated to explicitly account for the perturbing effect of the cavity, thereby affording it the potential to be generally applicable over a broader range of physical conditions. Of particular interest is the performance over the range of incident beam energies and detector configurations where traditional cavity theory formalisms are known to be inaccurate. This was explored computationally using the EGSnrc Monte Carlo (MC) code to first calculate the dose to the cavity of an idealized plane-parallel ion chamber, free-in-air, exposed to a range of mono-energetic incident photon beams. Calculations were performed for various combinations of incident beam energies, chamber wall materials, cavity sizes, and threshold energies for creating and tracking charged particles to form a set of benchmark calculations. Using a consistent set of interaction cross-sections, stopping powers, scattering powers, and transport parameters the EGSnrc code was also used to calculate cavity theory formalism parameters, including the charged particle spectra and chamber-dependent charged particle energy deposition functions. Cavity doses predicted by the general cavity theory formalism agree well with full MC simulations. For example, the cavity theory calculations performed with the lowest particle transport energy threshold (1 keV) for a 300 keV photon beam incident on an aluminum chamber are within 0.3% of full EGSnrc calculation. At an incident energy of 1.25 MeV combined with a chamber made with copper walls, the maximum deviation with full Monte Carlo calculations decreases to within 0.13%. The accuracy of the formalism in this energy range suggests it can underscore dosimetry protocols applied to orthovoltage units and other kV x-ray irradiators, as well as to those applied in the MV energy range. It also suggests that detectors constructed with non-air-equivalent materials can be used without introducing large correction factors to offset the associated charged particle fluence perturbations.

2) X-ray coherent scatter imaging

by Paul Johns, PhD (Department of Physics, Carleton University)

Abstract: Conventional x-ray projection and CT images are based on measurement of the radiation transmitted through the object without interaction. Much information is also carried by the radiation scattered out of the object, by either Compton or coherent scattering. The latter is the basis of x-ray diffraction analysis and so is particularly sensitive to material composition. Scatter imaging researchers are prototyping systems with increased image contrast for medicine, nondestructive testing, and security inspection. Using an array of multiple pencil beams, we have demonstrated step-and-shoot and continuous motion scatter imaging using 33.2 keV synchrotron x rays and more recently using a polychromatic spectrum from a conventional rotating anode source. The current status and next steps will be described.

OMPI Special Event to mark International Day of Medical Physics 2020

Date: Thursday, November 5, 2020

Time: 3:30pm

Location: <https://zoom.us/j/97033650367?pwd=T3FLckMxTGIDeUZyYb2VUaCtmUkFJQT09>

Meeting ID: 970 3365 0367

Passcode: omp

International Day of Medical Physics special OMPI Event - S4

In 2019 COMP introduced S3 at the Annual Scientific Meeting – “Science Spoken Succinctly”. In 2020 OMPI is going one better with S4 – “Science Spoken Succinctly by Seniors”!

The premise of S3 is that the presenters (competitors) have to present their research in an accessible way in 3 minutes with no visual aids except a single slide. S3 was targeted at graduate students and residents but we are flipping things around and those doing the presenting will be senior researchers - our own OMPI members. We ask our graduate students to be ready with their elevator pitch at a moment's notice. For IDMP 2020 we thought it would be a bit of fun to see if established researchers can also present their work in a succinct manner that is understandable by all.

Starting at 3:30pm on the 5th, you will see and hear the best of OMPI present their research in a way they are probably not comfortable with. It will not only be a test of our members, it will give an overview of all that is going on within the OMPI community in less than 90 minutes!

The session will be moderated by two of our senior graduate students, Nathan Murtha and Iymad Mansour, and they will make sure everyone sticks to time and follows the rules. You, the audience, will be able to submit questions, as we want to test our researchers' ability to not only present clearly, but not waffle their way through an answer!

The best presenters in OMPI – our graduate students – will be the judges but there may be a category of “fan favourite” (stay tuned for further details from Iymad and Nathan). And if there are judges, then there will be prizes!

OMPI Seminar: Meaghen Shiha and Laurel Sinclair

Date: Thursday, November 19, 2020

Time: 15:30

Location: This is a virtual seminar via this Zoom Meeting.

Presentations:

1) 4D Monte Carlo based patient dose reconstruction incorporating surface motion measurements

by Meaghen Shiha (M.Sc. Candidate)

Supervised by Joanna E. Cygler, The Ottawa Hospital Cancer Centre and Emily Heath, Dept. of Physics, Carleton University

Abstract: In radiation therapy it is of great importance to deliver a planned amount of radiation to the tumor while sparing the healthy tissue. This can be made difficult in the case of lung cancer where there may be significant motion due to respiration. This motion, which can vary throughout the course of treatment, may cause deviations in the delivered dose distribution possibly leading to the under-treatment of the tumor and the unintentional irradiation of healthy tissue. Methods to reconstruct the delivered dose, accounting for respiratory motion, can be used to verify correct delivery of the prescribed dose and to inform development of methods to compensate for respiratory motion effects. The 4Ddefdosxyznrc dose reconstruction tool has been previously verified in a phantom to calculate the dose delivered to a moving and deforming anatomy. This tool incorporates machine log files and patient surface motion measurements recorded during treatment. The framework for the application of this tool to patient dose reconstructions will be described and preliminary results will be presented.

2) Spatial Deconvolution in Mapping of Radioactivity: The forty-minute version

by Laurel Sinclair, PhD (Natural Resources Canada)

Abstract: Natural Resources Canada is responsible for mobile survey and mapping in case of a radiological or nuclear emergency. Researchers support that function developing calibration methods and improvements to operational procedures, and introducing novel instrumentation and advances in algorithms and data processing. We present an overview of the impact to nuclear emergency response operations of these innovations broadly. We then get into the details of a very current analysis using data from a direction-capable gamma spectrometer (ARDUO) which is mounted on an unmanned aerial vehicle. The capability of ARDUO to point toward radioactivity can be exploited to improve spatial precision of radioactivity maps, and also to extrapolate the map into areas which have not been traversed during the survey. This is the forty-minute version of the three-minute presentation of the same title which was given at the International Day of Medical Physics special OMPI Event two weeks ago.

OMPI Seminar: Islam El Gamal and Rebecca Thornhill

Date: Thursday, December 17, 2020

Time: 15:30

Location: This is a virtual seminar via this Zoom Meeting.

Presentations:

1) Developing a Metrology Standard for Synchrotron Produced X-ray Beams

by Islam El Gamal (PhD Candidate)

Supervised by Malcolm McEwen, PhD (NRC)

Abstract: Synchrotrons produce beams of collimated and high flux X-ray photons with dose rates several orders of magnitude greater than conventional X-ray tubes. The potential to produce micro-meter sized pencil beams with the appropriate collimation makes them a valuable research tool and a potential unique therapeutic delivery modality. As with any radiation source, accurate dosimetry is essential and, to date, most measurements have relied on ion chambers calibrated for use with conventional X-ray tubes, resulting in a lack of direct traceability to a primary standard at the beam quality and dose rate of interest. To realize the full potential of synchrotron radiation sources as medical physics tools, a metrology-quality dosimetry standard is being developed. Preliminary experiments to characterize the monochromatic synchrotron beams at the Canadian Light Source will be discussed along with associated measurement challenges. A new calorimeter design to address these challenges will be presented.

2) Adventures in Ottawa Radiomics

by Rebecca Thornhill, PhD (Department of Radiology, The Ottawa Hospital)

Abstract: Conventionally, imaging clinicians produce diagnoses on the basis of a combination of their training, experience, and individual judgment. Radiologists perceive image patterns and associate or infer a diagnosis consistent with those patterns. However, there will be an inevitable degree of variability in image interpretation as long as it relies primarily on human visual perception. Radiomics can provide a quantitative vocabulary for the otherwise subjective characteristics of lesions. This presentation will summarize how we have applied radiomics and machine learning to a number of relevant medical imaging applications in Ottawa. There will be a special focus on CT imaging of renal masses, as this example application will provide opportunities to discuss some of the pitfalls and challenges we have faced in radiomics and our strategies for for improving interpretability and acceptance among clinicians.