2018

OMPI Seminar Archive

OMPI Seminar: Elizabeth Orton and Elizabeth Henderson + Tour of GammaPod

Date: Thursday, January 18, 2018

Tour

Time: 2:15
Location: Main enterance to The Ottawa Hospital, By the escalators and the Second Cup

Presentation: The Ottawa Hospital Cancer Centre has recently acquired a GammaPOD unit by Xcision for specific types of breast cancer treatments. It is the only one of its kind in Canada. Dr. Eric Vandervoort is the lead physicist for GammaPOD, and he graciously agreed to give a tour of the GammaPOD suite to those interested before the OMPI seminar this Thursday. No reservation Required.

Seminar

Time: 3:30-5:00 pm. Refreshments start at 3:15 pm.
Location: The Ottawa Hospital Auditorium, 2nd floor, main hospital, 501 Smyth Road

Presentations:
1. "Towards accurate bowel dosimetry in radiation therapy"
By Elizabeth Orton, PhD, Physics resident, The Ottawa Hospital Cancer Centre. (Supervisor: Elsayed Ali)

Abstract: The bowel is an important organ-at-risk during radiation therapy of many pelvic and spinal disease sites. Accurate knowledge of the radiation dose to the bowel is important for correlating bowel dose with early (nausea, vomiting, diarrhea) and late (obstruction, ulceration) toxicities, for bowel sparing during treatment planning, and for determining if prophylactic medication is necessary to proactively reduce the effects of early toxicity (as these medications themselves have unwanted side effects). The literature on this topic is extremely limited, and clinicians currently operate on the basis of their own experience. In the first part of this talk, the barriers to accurate bowel dosimetry will be identified. These barriers include lack of practical "ground truth" and associated uncertainty for the bowel (inconsistent bowel definitions, inter- and intra-observer contouring variability, etc), bowel mobility during fractionated radiation therapy, bowel visibility on daily cone beam CT images, deformable-image registration challenges in the abdominal area, and issues with dose accumulation for the bowel. The second part of the talk will report on the development of practical guidelines for bowel contouring definitions and evaluation of the associated inter- and intra-observer variability on treatment planning CT and on cone beam CT.

2. "Training clinical medical physicists at The Ottawa Hospital Cancer Centre"
By Elizabeth Henderson, PhD FCCPM

Abstract: The Ottawa Hospital (TOH) has a long history of training medical physicists for careers as clinical radiation oncology physicists. In this talk, I'll present the evolution of our training program, connections (past and future) between OMPI and the TOH radiation oncology physics residency program, and give an overview of our current program. I'll also discuss the contributions that physics residents make to both the clinical work and the research and development work at TOH. Finally, I'll share what I've learned from recent recruitments, and give some tips for graduate students considering residency programs.

OMPI Seminar and Social Outing: Iymad Mansour and Balazs Nyiri

Date: Thursday, February 15, 2018
Time: 3:30 - 5:00 pm - Refreshments start at 3:15 pm.
Location: Herzberg Building Room 4351, Carleton University.

Presentations:

1) "Development of a mailed audit protocol for Canada using Alanine dosimeters"
by Iymad Mansour, MSc student, National Research Council and Carleton University

Supervisor: Dr. Malcolm McEwen

Abstract: The National Research Council of Canada (NRC) is currently in the process of developing a mailed audit system using alanine dosimeters. The intention is to offer an on-demand dosimetry service that would provide an independent check on the dose measurements of each Canadian cancer center and thus ensure consistency of treatment across the country. The focus of this talk will be on the development of a clinically applicable alanine dosimetry protocol. Alanine, which was originally developed for dosimetry at the kGy level, has a series of hurdles when considering clinically applicable dosimetry caused by both the readout procedure as well as pellet handling conditions. To achieve a mailed dosimetry service with the targeted sub 1% uncertainty a robust protocol must be developed in order to mitigate these sources of error.

2) "Investigations towards Raman Spectroscopy based blood dosimetry"
by Dr. Balazs Nyiri

The Ottawa Hospital Cancer Centre

Abstract: Raman spectroscopy has recently gained interest for providing biochemical information using a label-free, non-invasive approach. It is non-destructive and applicable on all sample types with minimal sample volume requirement and has successfully been applied in recent years, among others, in biological, medical, and food industry applications. It also offers portability for the real-time assessment of biochemical changes, a feature most welcome in clinical and in-field applications.

Here, we present work towards the development of a novel approach to identify Raman spectral features in blood that are modified by radiation exposure. Whole blood, lysed blood and isolated white blood cells were used for initial assessment. A workflow from sample handling to analysis was established. A pilot study was conducted using freshly drawn blood from 8 healthy donors. The blood was ex-vivo irradiated at doses ranging from 0-5 Gy. Three hours post-irradiation, the samples were frozen to lyse cellular contents. Each sample was analyzed on a commercial portable Raman spectrometer system. The initial results are promising and show convincing evidence of discrimination between blood samples of different radiation doses using multivariate statistical analysis methods. However, further work is needed to optimize spectrum quality and measurement efficiency. For this purpose, we are currently investigating the possibility of developing a "flow-cell" attachment to the portable Raman system. With this we hope to minimize sample degradation thereby improving spectrum quality, also increase reproducibility, and data collection efficiency.
Social event details (a message from Nick Majtenyi)

With a recent change in the weather predicted for Thursday the canal is CLOSED overnight on Wednesday for maintenance, and may not be open Thursday for skating. Instead, let's all meet up for beer closer to Carleton at The Senate Tavern on Bank (1159 Bank Street, near the intersection of Belmont & Bank) following the seminar! It has its own stop off the #7 bus or about a 20 minute walk away. Please feel free to bring friends, significant others, or anyone you'd like for this great opportunity to socialize with other OMPI members!

I hope to see everyone there!

OMPI Seminar: Harry Allen and Raphael Galea

Date: Thursday, March 22, 2018
Time: 3:30 - 5:00 pm - Refreshments start at 3:15 pm.
Location: Room RPB 205 (boardroom), Health Canada, 775 Brookfield Road, Ottawa. Please check in at the front desk.

Presentations:

1) "Towards classification of cells by dose using Raman spectroscopy"
by Harry Allen, MSc student, Carleton University,

Supervisor: Dr. Sangeeta Murugkar

Abstract: Recent studies investigating the effects of ionizing radiation (IR) on the lens of the eye indicate dose-related lens opacification occurs at much lower doses (<2 Gy) than indicated in past radiation protection guidelines.

Research efforts are thus now being directed towards identifying early predictors of lens degeneration resulting in cataractogenesis. In particular, Health Canada is interested in the possibility of developing quick, non-invasive methods for performing in vivo radiation dosimetry. This talk will focus on the study conducted by the Carleton Biophotonics Research Group, in cooperation with Health Canada, investigating the effects of IR on human lens epithelial (HLE) cells exposed to doses ranging from 0.01 Gy to 5 Gy using Raman micro-spectroscopy. Raman spectroscopy is a non-invasive method of generating a molecular fingerprint of a sample from the spectrum of inelastically scattered light it produces when illuminated with a laser.

Statistically significant differences were found between the mean spectra of each dose relative to control (0 Gy). Using linear discriminant analysis (LDA) in conjunction with principal component analysis (PCA), it was found possible to discriminate between the Raman spectra of a given dose and control to an accuracy of > 74% for doses ranging from 0.25 for 5 Gy. Leave-one-out cross-validation (LOOCV) was used to determine accuracy. Full multi-class classification is still a work in progress, as will be explained during the talk.

2) "Absolute activity standards"
by Dr. Raphael Galea, National Research Council Canada

Abstract: There is a great deal of familiarity with ionizing radiation standards in the medical field. Standards for dosimetry and radioactivity are used in radiology and nuclear medicine. The production of certified reference materials (CRMs) in radioactivity can be compared to chemical metrology in that they essentially quantify the amount of material in an artifact. The essential difference is in the inherent shelf life of the CRM which is defined by the isotopes half-life. This presentation will focus on some methods of absolute activity determination. Applications of the standards and research in the measurement of radioactivity will also be presented as examples of the dissemination of the radionuclide metrology in medical applications and in nuclear security.

OMPI Seminar: Martin Martinov and Zoltan Nagy

Date: Thursday, April 19, 2018
Time: 3:30 - 5:00 pm - Refreshments start at 3:15 pm.
Location: The Ottawa Hospital Auditorium, 2nd floor, main hospital, 501 Smyth Road

This session will be available for off-site viewing via the following webcast link (firefox or Chrome): https://meeting.ottawahospital.on.ca/invited.sf?id=24912&secret=4fe4528a-1163-4105-b783-4b4e6b8d6fbf

Presentations:

1) “Pushing the limits of EGSnrc: Computing microscopic dose metrics on a macroscopic scale using multiscale modeling”

by Martin Martinov, PhD student, Carleton University

Supervisor: Dr. Rowan Thomson

Abstract: Monte Carlo (MC) simulations of radiation transport to investigate microscopic dose metrics are being used with increasing regularity. Expanding such detailed models to tumour-sized volumes often proves to be beyond the computational limit of most codes. This work presents the multiscale model, in conjunction with the already fast EGSnrc, as an accurate and efficient method of extracting microscopic dose metrics on a macroscopic scale. EGSnrc’s radiation transport algorithms are first verified at short length scales with other Monte Carlo codes typically used in the field. The multiscale model is then demonstrated with simulations of different gold nanoparticle therapy scenarios.

2) “In-vivo cortical parcellation with Diffusion MRI: concept and implementation challenges”

by Dr. Zoltan Nagy, Institute for Biomedical Engineering, University of Zurich, Switzerland.

Abstract: In-vivo histology is an effort to characterise tissue non-invasively and based on multi-modal imaging data. Specifically, I focus on fingerprinting cortical grey matter of the brain, based on information we can extract form diffusion MRI data. I will present the proof-of-principle, explain the aspects of MRI acquisitions that hinder these efforts and describe magnetic field monitoring technology that helps eliminate or alleviate these technical limitations. The talk will finish with some future outlook toward planned and possible experiments.

OMPI Seminar: Mathew Efseaff and Ran Klein

Date: Thursday, May 24, 2018
Time: 3:30 - 5:00 pm, Refreshments start at 3:15 pm.
Location: NRC - 1200 Montreal Road, Building M-36 - Kelvin Room (please check in at the front desk).

As usual, the end-of-season BBQ will start after the seminars, ~5 pm. If you plan on attending the BBQ please RSVP to Byran Muir so that the NRC folks get an idea of how much food to prepare. Deadline for RSVP is May 21st. Also if you have any dietary restrictions, please let Bryan know.

Presentations:

1) Evaluating the accuracy of a general cavity theory

by Matthew Efseaff, PhD student, Carleton University

Supervisors: Dr. Miller MacPherson and Dr. Dan La Russa

Abstract: In radiation dosimetry protocols, the primary objective is to derive the absorbed dose in an irradiated medium, Dmed, from the dose to a detector placed in that medium, Ddet. The relationship between Dmed and Ddet is determined from cavity theory, whose formulation has traditionally depended on the nature of the radiation source, detector, and geometry (including field size, material combinations, etc). In this presentation, a general cavity theory will be introduced that has potential applications over a wide range of incident energies and detector types, making it a suitable candidate for the growing landscape of radiation devices not encompassed by existing dosimetry protocols, or to augment protocols currently in use. The approach to evaluating the accuracy of this general cavity theory using Monte Carlo methods (EGSnrc) will be presented along with preliminary results.

2) Squeezing medical insight out of photons

by Ran Klein, PhD Elec Eng, The Ottawa Hospital, Nuclear Medicine Department.

Abstract: The quality of medical exams and the quality of their interpretation can limit the precision of the indications derived from these exams and hence limit appropriate patient care. A holistic approach towards quality is essential for optimal patient care and is the primary responsibility of medical physicists. This presentation will highlight potential sources of error in nuclear medicine tests and describe some of the approaches being applied at The Ottawa Hospital to improve quality at all stages of the medical procedure. Past, current and future research projects relating to quality in the Nuclear Medicine Department will be described.

OMPI Seminar: Rowan Thomson and Nick Majtenyi

Date: Thursday, September 20, 2018
Time: 3:30 - 5:00 pm, Refreshments start at 3:15 pm.
Location: Herzberg Building Room 4351, Carleton University.

Presentations:

1) Quantitative measurement of brain perfusion parameters using intravoxel incoherent motion

by Nick Majtenyi, PhD Candidate, Carleton University

Supervisor: Professor Ian Cameron

Abstract: Clinically-useful quantitative parameters can be obtained from MR perfusion imaging based on signal intensity changes following the injection of a gadolinium-based contrast agent (GBCA). One conventional perfusion technique, dynamic contrast-enhanced (DCE)-MRI, can be unreliable in its measurement methodology. Intravoxel incoherent motion (IVIM) is an MR-based diffusion-weighted imaging technique that differentiates diffusion and perfusion properties of tissue without the use of a GBCA. The IVIM acquisition and data processing techniques are currently not standardized, and its comparison to conventional perfusion parameters has been under-investigated. In this work, we investigate the origin of the IVIM signal and test several different data-fitting methods. Additionally, we compare the results of the perfusion parameters to those obtained from DCE-MRI in human patients with gliomas.

2) Taking Monte Carlo to new lows

by Rowan Thomson, PhD, Carleton University

Abstract: Monte Carlo (MC) simulations are applied in diverse contexts in medical physics to model radiation interactions and energy deposition. Traditionally, Monte Carlo simulations in medical physics focused on mm to cm length scales, often in the context of cancer radiation therapy. However, recent work is extending the range of widely-used MC codes to subcellular length scales. While there are many exciting prospects for these MC simulations, from advancing knowledge of the biological effects of radiation to the development of new treatment techniques, there are also challenges. This presentation will focus on research connecting macroscopic and microscopic MC simulations, and challenges encountered in applying MC techniques on subcellular levels.

OMPI Seminar: Rolf Clackdoyle and Nathan Murtha

Date: Thursday, October 18, 2018
Time: 3:30 - 5:00 pm, Refreshments start at 3:15 pm.
Location: Room RPB 205 (boardroom), Health Canada, 775 Brookfield Road, Ottawa. Please check in at the front desk.

Presentations:

1) "Tomographic Imaging of a Source in a Restricted Area Using Compton Gamma Imaging"

by Nathan Murtha, PhD Candidate, Carleton University

Supervisors: Laurel Sinclair (Natural Resources Canada) and Patrick Saull (National Research Council)

Abstract: Compton gamma imaging uses the kinematics of Compton scattering to constrain the reconstructed origin of a detected gamma ray to somewhere on a conical surface. Two-dimensional projections of these conical surfaces then form rings, the intersections of which may be used to form contours delineating where in the field-of-view the source is likely to lie. Reconstruction of the shape of a distributed source in an area restricted to entry is a particularly challenging problem which may be resolved by observing the source from multiple points of view. In March 2018, an L-shaped extended source of La-140 measuring 120 m by 20 m on one arm and 60 m by 10 m on the other arm was laid out at an experimental proving ground in Suffield, AB. This L-shaped distribution was contained in a 500 m by 500 m exclusion zone, restricting the proximity within which measurements were possible. Data were accumulated at seven positions around the exclusion zone. Using a simple back-projection method, we demonstrate preliminary results of a tomographic reconstruction of the activity distribution inside the exclusion zone.

2) "Radar and Scatter Imaging: Dual Image Reconstruction Problems"

by Rolf Clackdoyle, L'Université Grenoble Alpes

Abstract: In synthetic aperture radar (SAR) a nominal image reconstruction problem arises. The idea is that an airplane flying a straight line along (say) the x-axis receives radar signals that are averages over circles (of various radii) centered on the x-axis. The "tomographic" reconstruction problem is to map out the radar signal at each point on the ground, based on these "circular" ray sums. This problem has been well-studied and has all the same mathematical features as the usual tomographic reconstruction problem that we are familiar with in medical imaging – there is a back-projection step which alone gives a blurred image, and pre-back-projection filtering – yielding the well-known Filtered Back-Projection (FBP) algorithm. Previous work has been presented (OMPI) that describes a system for imaging scattered radiation – a collection of overlapping "radial profiles" is obtained where each radial profile can (potentially) provide diagnostic information about a point of the sample that was irradiated with a primary beam of x-rays. In the hypothetical situation where a large collection of overlapping radial functions are acquired, all with their centers along a straight line, we see some similarity with the SAR problem, except that in this case, the unknown quantities are the individual radial functions. In this presentation, it will be shown

OMPI Seminar: Susan Al-Abboodi and Yani Picard

Date: Thursday, November 15, 2018
Time: 3:30 - 5:00 pm - Refreshments start at 3:15 pm.
Location: The Ottawa Hospital Auditorium, 2nd floor, main hospital, 501 Smyth Road

Presentations:

1) "Patient-specific respiratory motion models for 4D Monte Carlo simulations of radiation therapy"

by Susan Al-Abboodi (PhD Candidate), Carleton University

Supervisors: Emily Heath (Carleton University), Joanna Cygler (University of Ottawa)

Abstract: Errors during radiotherapy treatment delivery can arise from different sources. Errors in the patient set-up and the beam delivery are possible. Also, the shapes and positions of the treatment targets and surrounding tissues may vary from day-to-day and even during the treatment. For example, motion of the organs in the thoracic and abdominal region due to respiratory motion can cause clinically significant targeting errors. All these errors lead to a deviation ofthe delivered radiation dose from the original planned dose. Therefore, methods to determine the delivered patient dose are needed in order to verify that the correct dose is delivered to the patient as calculated by the treatment planning system. This information could also be used to adapt the treatment plan to compensate for delivery errors.

The objective of this research project is to develop patient-specific respiratory motion models from measurements acquired during radiotherapy delivery. These models will be used for 4D Monte Carlo simulations to reconstruct the delivered dose to the patient. In this initial work, principal component analysis was used to generate a parametric model to correlate the patient surface motion with the internal motion. This PCA method was tested using a numerical phantom, 4D XCAT, which simulates respiratory motion. Both the phase and amplitude of the surface motion were used as inputs to the PCA model. Preliminary results show the external surface motion amplitude can provide a more accurate prediction of the internal motion than using the phase of the surrogate motion.

2) "Regulating accelerators in Canada"

by Yani Picard, PhD, Canadian Nuclear Safety Commission

Abstract: This presentation is an overview of how CNSC regulates accelerators in Canada, from medical linacs and cyclotrons to the newly announced proton therapy facility.

OMPI Seminar: Luke McCooeye and Costel Flueraru

Date: Thursday, December 13, 2018
Time: 3:30 - 5:00 pm, Refreshments start at 3:15 pm.
Location: University of Ottawa Heart Institute, 40 Ruskin St., East Foustanelas auditorium (H2368)

Presentations:

1) "Monte Carlo dose calculations considering edema in permanent implant prostate brachytherapy"

by Luke McCooeye, Carleton University (Supervisors: Rowan Thomson, and Emily Heath)

abstract: The implantation procedure for permanent implant prostate brachytherapy (PIPB) treatments can cause an edema response and the resulting swelling increases prostate volume and displaces seeds, disrupting the treatment plan and causing reduced dose to the target. The dynamic nature of the edema necessitates a 4D approach to accurately account for delivered dose. A framework is presented that, beginning with a post-implant CT image, allows for full-tissue MC (egs_brachy) simulations to calculate dose delivered at discrete stages of edema resolution and ultimately accumulate these doses into a single dose representative of the total dose delivered to an organ considering edema. Results indicate the dosimetric effect of edema in PIPB is sensitive to both patient specific geometries and the characteristics of the edema. For a subset of patients the dose reduction due to edema is significant for assessing implant quality which is associated with treatment outcomes.

2) "Can Optical Coherence Tomography be used to monitor radiation therapy?"

by Costel Flueraru, National Research Council (NRC)

abstract: Optical Coherence Tomography is an imaging modality that provides high-resolution cross-sectional imaging using a minimally invasive approach. In the first part of my talk, I will be explaining how the Optical Coherence Tomography works. I will guide you through a few development stages of this imaging modality and share some successes and failures. In the second part of my presentation, I will show you how OCT can be used to monitor changes in the tumor vasculature during the radiotherapy. It is not a direct monitoring of the tumor but it is a relevant modality for monitoring the effect of radiation therapy. I hope to convince you that the answer to my title is affirmative.