2017

OMPI Seminar Archive

OMPI Seminar: Stephen Deering and Ernesto Mainegra-Hing

Date: Thursday, January 19, 2017
Time: 3:30 - 5:00 pm - Thursday 19 January 2017. Refreshments start at 3:15 pm.
Location: East Foustenallas Auditorium (H2368), Second Floor, The University of Ottawa Heart Institute, 40 Ruskin Street.

1) Calculating Dose Distributions with EGS Brachy - A new EGSnrc user code

By Stephen Deering, MSc student, Carleton University, Supervisor: Dr. Rowan Thomson

Abstract: egs_brachy is a new, efficient Monte Carlo user code which has been developed in order to enable more accurate brachytherapy dose calculations for both research and clinical applications. This talk will present some preliminary research done using egs_brachy, in the form of dose calculations for ocular and breast brachytherapy. For ocular brachytherapy, depth dose curves were calculated and benchmarked for a large range of photon and beta-emitting eye plaques, which are widely used in the treatment of intraocular tumors. Then, the ability of egs_brachy to provide a comprehensive look at model-based dose calculations for permanent seed implant breast brachytherapy will be discussed. These two topics show a small sample of the possible uses for egs_brachy and provide good examples to introduce both the user code and its ability to improve on current model-based dose calculations.

2) Accuracy of electron transport in the presence of magnetic fields with EGSnrc

By Ernesto Mainegra-Hing, PhD, National Research Council Canada

Abstract: Since the 2016 release, EGSnrc, a well-known toolkit for the Monte Carlo simulation of electron, positron and photon transport, allows the inclusion of the effect of electromagnetic fields on the transport of charged particles. EGSnrc's main strength resides in its ability to transport charged particles accurately and efficiently thanks to its charged particle transport algorithm and exact multiple scattering theory. The approach used to model the transport of charged particles in the presence of a magnetic field is described, and its accuracy tested by means of a modified Fano test, valid under very specific conditions. Fano tests are carried out for an ion chamber and a slab geometry of varying density showing that accurate results can only be obtained when restricting charged particles to take very small condensed-history steps. The impact on simulation time is discussed as well as the possibility of increasing calculation efficiency using variance reduction techniques.

OMPI Seminar: Ming Lui and Pat Saull

Date: Thursday, February 16, 2017
Time: 3:30 - 5:00 pm. Refreshments start at 3:15 pm.
Location: Carleton University, 1125 Colonel By Drive, Herzberg Building, Room 4351.

Agenda:

1) Student speaker: "Accuracy of the CyberKnife Synchrony respiratory tracking system for liver cancer"

By Ming Liu, PhD student, Carleton University

Supervisors: Drs. Eric Vandervoort and Joanna Cygler.

Abstract: Organ motion management during radiotherapy treatment is the biggest challenge for accurate dose delivery to the tumor. The CyberKnife® Robotic Radiosurgery System tracks real-time respiratory motion and automatically corrects for changes in the tumor position. The Synchrony respiratory motion compensation system used by CyberKnife estimates tumor motion based on the positions of internally implanted fiducials and external motion from LED markers located on the exterior of the patient. For each treatment, the CyberKnife system generates log-files that include estimates of its own tracking accuracy, based on the difference between predicted and internal fiducial position measurements acquired every 1 to 2 minutes. Today, I will present a retrospective analysis of the log-files for 40 liver patients treated on the CyberKnife at TOHCC. I will also show a software tool I created that allows for off-line analysis of patient breathing traces recorded in treatment log-files.

2) Member speaker: "Compton gamma imaging"

By Pat Saull, PhD, National Research Council Canada

Abstract: I present recent results on the development of Compton gamma imagers for safety and security, an effort lead by NRC in collaboration with researchers and end users from NRCan, DRDC, CBSA, the RCMP, and DND. Starting off with EGSnrc simulations of a pinhole camera imaging gamma rays of varying energy, I briefly discuss the coded-aperture approach before showing how well the Compton method works using experimental data from a 262-channel, all-scintillator, lab-based Compton imager. The design and fabrication of a 40-channel portable imager read out entirely with silicon photomultipliers is reviewed and the results obtained with it during recent field exercises shown. Our first pass at a commercial imager is introduced. Finally, because Compton imagers are also spectrometers, a method is outlined for calibrating an imager in terms of air-kerma rate at different energies using calibrated liquid sources combined with EGSnrc simulations. There may be a movie, but maybe not.

3) Social Event: Message from the graduate student representative Martin Martinov:

Due to the relatively hot temperatures of this winter, skating down the canal does not seem as viable an option this year as it was in previous years. Worry not though, as you can drink your warm winter woes away at Patty's Pub, located at 1186 Bank Street. It is only a 5 minute drive,

15 minute bus ride or even a 30 minute walk (if you are so inclined) from Carleton. It is a great opportunity to socialize with other OMPI members whom you normally see only once a month. I hope to see you there!

OMPI Seminar: Ericka Venturina and Janos Szanto

Date: Thursday, March 23, 2017
Time: Refreshments start at 3:15 pm. Seminar 3:30 - 5:00 pm
Location: NRC - 1200 Montreal Road, Building M-36 - Kelvin Room (please check in at the front desk).

1) "Modern implementation of dynamic conformal arc therapy"

By Ericka Venturina, MSc student, Carleton University, Supervisor: Elsayed Ali.

Abstract: Dynamic Conformal Arc Therapy (DCAT) is an external beam radiation therapy modality that conforms the beam to the tumor while the linac head is rotating around the patient. The classical version of DCAT allows for only a single dose rate and no modulation. A modern implementation of DCAT features dose rate variation and modulation around the periphery of the target. These additional degrees of freedom make this modern implementation of DCAT closer to that of Volumetric Modulated Arc Therapy (VMAT) – a modality known for its ability to conform the radiation dose to the target and to carve it away from nearby healthy tissues. In this talk, I will present the methods and results of my characterization of this modern implementation of DCAT.

Based on this characterization, I will present the potential niches of DCAT in the current radiation therapy landscape in terms of planning efficiency, conformality, and robustness against machine and patient uncertainties.

2) "Clinical innovations of stereotactic radiotherapy in Ottawa"

By Janos Szanto, PhD, The Ottawa Hospital cancer Centre

Abstract: One of the first LINAC-based stereotactic radiotherapy in 1991 was established in Ottawa. Shortly after, we developed a patient position monitoring system (PPMS) - a world first. Our successful stereotactic radiotherapy clinical program has been functional for more than 17 years. CyberKnife entered a new era in 2010. Since then, we have had numerous clinical innovations: specialized imaging for trigeminal neuralgia or arteriovenous malformation (AVM); new fiducial application was evolved for liver lesions, prostate cancer treatments, etc; we also established a new patient-specific quality assurance program.

OMPI Seminar: Eric Christiansen and Lesley Buckley

Date: Thursday, April 20, 2017
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.

Agenda:

1) "Implementation of VMAT in matRad, an open source treatment planning toolkit"

By Eric Christiansen, PhD student, Carleton University

Supervisor: Dr. Emily Heath

Abstract: Purpose: To implement and evaluate single-arc volumetric modulated arc therapy (VMAT) plan optimization within matRad, an open-source treatment planning system. Materials and Methods: The three-step approach to VMAT optimization was followed: fluence map optimization (FMO) followed by arc sequencing, then direct aperture optimization (DAO). FMO was performed at control points (CPs) spaced every 28°, with the optimal fluence maps sequenced in a sliding window fashion. Resulting apertures were spread to CPs neighbouring those initialized by FMO. These apertures were refined during the DAO step, with machine delivery constraints included in the optimization. Sequencing parameters were optimized using conformal index and delivery time as two preliminary benchmarks. Following this, three representative cases were planned: a C-shaped target surrounding a critical structure, a prostate target, and a head-and-neck target (both of the latter included lymph nodes). Dose volume metrics in the target and organs at risk (OARs) were calculated and compared to local clinical guidelines. Results: All clinical OAR constraints were met for the three investigated plans. Dose in each target exhibited varying degrees of homogeneity, with the C-shaped target, prostate, and head and neck having variations of 3.7%, 7.6%, and 9.2% between D95% and D5%. Delivery time ranged from 2.2-2.6 min; optimization time ranged from 9-12 min. Conclusions: matRad is now capable of optimizing high-quality VMAT plans that have reasonably short treatment times. VMAT optimization has been implemented as an extended module, which will be released in an upcoming update of matRad.

2) "Imaging dose in radiation therapy: a sad tale of neglect"

By Lesley Buckley, PhD, The Ottawa Hospital Cancer Centre

Abstract: Increased use of imaging in radiation therapy has impacted many aspects of treatment: including targeting, patient positioning and dose fractionation. Many new treatment techniques rely heavily on the information provided by improved imaging at the time of both simulation and treatment. The radiation dose from imaging is small when compared to the therapeutic dose and is therefore seldom taken into account when computing the total patient dose. This talk will discuss the various sources of imaging dose for a patient undergoing radiation therapy and will quantify this dose for a variety of cases. Methods to reduce this dose will be discussed, including clinical protocols as well as software driven dose reduction techniques.

OMPI Seminar: Particia Oliver and Graeme Wardlaw and Year-end BBQ

Date: Thursday, May 25, 2017
Time: 3:30 - 5:00 pm - Thursday 25 May 2017. Refreshments start at 3:15 pm. BBQ starting at 5 pm.
Location:NRC - 1200 Montreal Road, Building M-36 - Kelvin Room (please check in at the front desk).
Agenda:

Program:

1) Investigating energy deposition in glandular tissues for mammography using multiscale Monte Carlo simulations

By Particia Oliver, PhD student, Carleton University

Supervisor: Dr. Rowan Thomson

Abstract: Multiscale models of compressed breasts are developed, and a mammographic exam is simulated using Monte Carlo. These multiscale models combine varying levels of detail on different lengthscales: cell populations consisting of >1000 mammary epithelial cells and ~200 adipocytes are embedded throughout the breast tissue. We compute specific energy (energy imparted per unit mass) in mammary epithelial cell nuclei, and doses to corresponding macroscopic (~mm) voxels containing glandular issue for a 30 kVp Mo/Mo spectrum.

Mammography glandular voxel doses underestimate mean specific energies to epithelial cell nuclei by ~25%, with considerable variations (~82% relative to the mean for a glandular voxel dose of 4 mGy) in specific energy throughout corresponding cell populations, in addition to considerable dose variations (between 1 and 18 mGy) throughout the breast. Energy deposition within mammary epithelial cell nuclei is sensitive to microscopic model details including cellular elemental composition and nucleus size. Results may be relevant for radiation-induced cancer risk evaluation in mammography.

2) Computed Tomography (CT) Diagnostic Reference Levels (DRLs): Context, Canada, and Caveats

By Graeme Wardlaw, PhD, Health Canada

Abstract: The concept of the Diagnostic Reference Level (DRL) has existed for some time – dating back to publication of ICRP reports 60 and 73 in 1991 and 1996. With increased attention on radiation safety in recent years, especially in relatively higher dose procedures such as computed tomography (CT), DRLs have become widely developed and promoted as a means to help manage patient exposures while avoiding restrictive limits on imaging practice. A brief introduction to the DRL concept and proposed DRLs obtained from the recent National CT Survey will be presented, along with a summary of some important DRL limitations.

3) End of yeart BBQ

If you plan on attending the BBQ please RSVP to Byran Muir (Bryan.Muir@nrc-cnrc.gc.ca) so that NRC folks get an idea of how much food to prepare.

OMPI Seminar: Sara Kashi, Dal Granville, Malcolm McEwen

Date: Thursday, September 21, 2017
Time: 3:30-5:00 pm (Refreshements start at 3:15)
Location: Herzberg Building Room 4351, Carleton University.

Note: Seminar will be followed by annual social event: TBD

Agenda:

1. "Experimental verification of 4D Monte Carlo simulations of dose delivery to a deforming anatomy"

by Sara Kashi, Supervisors: Emily Heath and Joanna Cygler.

Abstract: One of the main concerns during radiotherapy treatment of lung cancer is the impact of respiratory motion on the dose delivered to the target. Different approaches have been used to estimate the dose delivered to a patient while accounting for such motions. In this talk I will present our 4D Monte Carlo simulation method that uses measurements of a patient's respiratory motion pattern to calculate the dose delivered to a deformable phantom during static or VMAT beam deliveries.

The phantom is designed in a way to emulate the radiological and motion properties of the lung. A Monte Carlo model of the Elekta Infinity linac has been used for dose calculations with this method. Validation of this method using measurements on a respiratory motion phantom will be presented as well.

2. "Machine learning applications in patient-specific quality assurance"

by Dal Granville, Supervisors: Justin Sutherland and Dan La Russa

Abstract: Patient-specific quality assurance (QA) measurements are routinely performed prior to the delivery of intensity modulated radiotherapy treatments to verify accuracy in dose calculation and plan delivery. In this work, we applied machine learning techniques to our database of ~2000 patient-specific QA measurements to examine the impacts of treatment plan complexity and linac performance on patient-specific QA results. The goals of this work were to isolate problematic plan features from problematic linac issues and to pre-emptively identify treatment plans that are likely to fail QA. Such techniques allow clinical physicists to better identify corrective actions when failures occur, and have the potential to reduce the considerable resources dedicated to the patient-specific QA process.

3. "OMPI: state of the union"

by Malcolm McEwen, PhD

Abstract: As OMPI looks towards its 30th Anniversary we have a lot to be proud of. This celebratory presentation will provide an overview of OMPI: where it came from, who is involved and what makes it special. In a sentence, OMPI is a self-governing volunteer network that is the foundational element to building a world-class medical physics educational program in Ottawa that capitalizes on expertise distributed over several clinical, government, and academic centres. The presentation will expand on this and attendees will be energized by the content, finding it hard not to plunge headlong into volunteering with OMPI in any way they can.

4. Social Event

Details: Nick Majtenyi has made a reservation at Patty's Pub near Carleton (1186 Bank Street) for a group gathering after the seminar.

OMPI seminar: Sarah Cuddy-Walsh and Dave Wilkins

Date: Thursday, October 19, 2017
Time: 3:30 - 5:00 pm (Refreshments start at 3:15 pm)
Location: East Foustenallas Auditorium (H2368), Second Floor, The University of Ottawa Heart Institute, 40 Ruskin Street.

Presentations:

1. "Standardizing Image Quality: A weight-based dosing method for dedicated cardiac SPECT"

by Sarah Cuddy-Walsh PhD Candidate (Supervisor: Glenn Wells)

Abstract: Given the same injected activity (330MBq) and acquisition time (5 min), large patients (102 kg) will have more SPECT image noise (6.7%) due to attenuation effects than petite patients (70 kg, 4.8%). Current guidelines for SPECT imaging recommend tailoring the administered activity to patient habitus, however robust methods to do so are lacking. We have developed a weight-based formula to calculate patient specific radiotracer activity requirements to standardize the magnitude of image noise present in all images. Use of this formula improves the standardization of image quality, holding the image noise constant with 4.8% and 5.0% noise for 70 and 102 kg patients given 332 MBq and 483 MBq respectively.

2. "Medical Physics for World Benefit (MPWB): A sustainable development initiative to improve global access to radiotherapy"

by Dave Wilkins, PhD

Abstract: It is estimated that 12.5 million cancer patients will need radiation therapy in 2035, but the world's capacity to deliver this treatment is inadequate, especially in low and middle income countries. This talk will discuss the challenges in meeting this need and some recent efforts to overcome these challenges, and the development of a nascent charitable organization, Medical Physics for World Benefit (MPWB), which is dedicated to providing support for medical physicists in low and middle income countries.

OMPI Seminar: Kevin Britton and Jennifer Renaud

Date: Thursday, November 23, 2017
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.

Agenda:

1) "A radium series multimedia model as a tool in health physics"

By Kevin Britton, MSc student in Earth Sciences, University of Ottawa

Supervisor: Dr. Trevor Stocki

Abstract: Health Canada is responsible for collecting and utilizing information to protect Canadians from health risks associated with radionuclides in food and the environment. Improved modelling of radionuclides enables better human dose assessments. The present study is to develop the easy to use and adaptable Hg Environmental Ratios Multimedia Ecosystem Sources (HERMES) model to estimate concentrations of radium-226, lead-210 and polonium-210 in waterways that may be elevated by location and / or human activity. This sub-series is prevalent at significant concentrations in air, soil, water and organisms. The series comprises about 30% of ingestion doses to humans, and more significant overall doses to many populations and species. Lead-210 and polonium-210 are more difficult to measure than other radionuclides in potential human food sources. The model can inform sampling design optimization where media and biota data are difficult to collect or not available.

2) "Canadian technology for rubidium-82 PET: perfusion imaging and blood flow quantification"

By Jennifer Renaud, Msc, University of Ottawa Heart Institute

Abstract:Cardiovascular disease remains the leading cause of death worldwide. Traditionally, relative perfusion imaging with SPECT has been the most commonly used technique for the diagnosis and prognosis of coronary artery disease. However, the reduced supply of Tc-99m has motivated the investigation of alternative methods. PET imaging with rubidium-82 is gaining more widespread use due to its superior diagnostic accuracy and its availability without the need for an onsite cyclotron. The Canadian-developed technology for delivery of rubidium-82 to patients and its utility in PET perfusion imaging and blood flow quantification will be the focus of this presentation.

OMPI Seminar: Zack Parsons and Rob deKemp

Date: Thursday, December 14, 2017
Time: 3:30 - 5:00 pm - Refreshments start at 3:15 pm.
Location: Boardroom H-2403, Second Floor, The University of Ottawa Heart Institute, 40 Ruskin Street.

Presentations:

1. Monte Carlo calculation of doses for eye plaque brachytherapy.

By: Zack Parsons, MSc student.

Supervisor: Rowan Thomson.

Abstract: egs_brachy is a new Monte Carlo user code developed by members of the CLRP research group for fast brachytherapy dose calculations. This talk presents recent results obtained with egs_brachy that focus on eye plaque brachytherapy, a treatment widely utilized for ocular melanomas. The use of egs_brachy allows for the development of techniques for a more accurate model based approach to the calculation of dose as opposed to the more generally used TG-43 approximations. The results to be presented include the comparison of dose to previous data for both photon eye plaques and beta-emitting Ru/Rh-106 eye plaques for benchmarking purposes, and the implementation of the new EGSnrc egs_radionuclide source for use with beta-emitting plaques. Future work leading to the simulation of the non-uniformity in beta plaque dose distributions will also be discussed.

2. Title: PET Molecular Imaging of (Para-)Sympathetic Innervation of the Heart: Understanding the (Yin-) Yang Control of Cardiac Function.

By: Rob deKemp, PhD.

Abstract: The autonomic nervous system regulates heart function through a balance of sympathetic (fight-or-flight) and para-sympathetic (rest-and-digest) control signals. Non-invasive imaging of so-called ‘cardiac innervation’ can be performed using radio-labeled tracers, which are generally analogs of the respective neurotransmitters, nor-epinephrine and acetyl-choline. The two most commonly used tracers (I-123-mIBG and C-11 mHED) have been developed for SPECT and PET imaging of the sympathetic nervous system (SNS) in patients with poor cardiac pump function, i.e. those in various stages of heart failure. Imaging and analysis methods vary from planar measurements of relative heart-to-mediastinum ratios, to dynamic volumetric measurements for quantification of receptor or transporter density and activity. Pre-clinical and clinical applications of PET SNS imaging will be shown in diabetes, heart failure, sleep apnea, coronary artery disease and atrial fibrillation.