2021

OMPI Seminar Archive

OMPI Seminar: Odai Salman and Ruth Wilkins and Social

Date: Thursday, February 4, 2021
Time: 15:30
Location: This is a virtual seminar via this Zoom Meeting.

Presentations:

1) Development of an Integrated System for Automatic Tumor Detection for PET-CT Images

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

Supervised by Ran Klein, PhD (The Ottawa Hospital) and Andy Adler, PhD, Carleton University

Abstract: The key to improving outcomes in cancer treatment is accurate early diagnosis. Hybrid imaging of 18F-lablelled-fluorodeoxyglucose (FDG) using hybrid positron emission tomography (PET) and x-ray computed tomography (CT) is highly sensitive to detecting and characterizing many types of cancers and is gaining increasing clinical use. Human interpretation of these images is difficult due to large data volume and large number of possible clinical findings. Artificial intelligence for cancer detection and interpretation may assist human observers in producing more accurate clinical interpretations. However, having an effective and reliable tumor detection and segmentation system is a major challenge because of the wide variations in the clinical environments and tumors shapes and sizes. In this work, we introduce a tumor detection system that starts by identifying anatomical regions of interest then use these for organ segmentation and finally, use precise organ regions for tumor segmentation. The work also includes identification of associated limitations and possible solutions. The presented work was taken from a thesis work, mainly covering CT modality.

2) New strategies for understanding the health effects of low dose radiation

by Ruth Wilkins, PhD (Health Canada)

Abstract: One of the biggest questions in radiation protection is: What is the risk at low doses?. In order to determine increased risk at doses below 100 mSv, huge epidemiology data sets are required which do not exist. There is, however, a massive amount of radiobiological research data that addresses this question. What is needed, is a framework to consolidate all of this data such that mechanistic pathways from exposure to adverse outcome could be elucidated. The Adverse Outcome Pathway (AOP) framework is a collaborative tool that maps out measured key events at all levels of biological organization leading to an adverse outcome. The framework has origins in the field of chemical toxicity but is now gaining interest within the radiation research community. Furthermore, much of the recent radiobiological data available examines the gene and protein expression of systems after exposure to radiation. These large data sets are challenging to analyse but recent work has been conducted at Health Canada on applying Benchmark Dose Modelling (BMD) to this data. This modelling identifies the point of departure from background levels of a response to determine whether thresholds of effect exist. Both BMD modelling and the AOP framework will be discussed with respect to their application to low dose radiation effects.

3) Social event

The 2021 Winter social will be a virtual games night. For this year, we will be playing Jackbox games. Jackbox has a series of virtual games designed for any individual to be able to play without any prior experience. Come out, bring your favorite drink, and enjoy a friendly round of competition with the community.

OMPI Social

Date: Wednesday, February 17, 2021

By popular demand, there will be a second OMPI social held this month: round two of Jackbox games. The social will be held after the OMPI professionalism workshop which will on February 17th, and start at 5 pm. Expect it to last about 60-90 minutes, see below for zoom invitation.

If you've never had the opportunity to play Jackbox, it is a set of online games which a group of people can play together. It's about creativity rather than knowledge (although knowing stuff can help!) and it really is about taking part rather than winning. Any internet enabled device will allow you to participate. This is a chance for everyone to enjoy a beverage, engage in some healthy competition and catch up with the community. Look forward to seeing you there!

OMPI Seminar: Ghada Aldosary and Reggie Taylor

Date: Thursday, February 25, 2021
Time: 15:30
Location: This is a virtual seminar via this Zoom Meeting.

Presentations:

1) The reliability of surgical clips for defining breast radiotherapy treatment targets following oncoplastic surgery

by Ghada Aldosary (PhD Candidate)

Supervised by Eric Vandervoort, PhD and Dr. Clare Foottit (The Ottawa Hospital)

Abstract: Breast cancer patients usually receive radiotherapy (RT) after surgery, during which surgical clips are placed to demarcate the excised tumour's location. Radiation oncologists (RO's) rely on these clips as an aid for defining the tumor bed on a patient's computed tomography (CT) image. In the past few years, oncoplastic breast surgery (OBS) has gained popularity among surgeons as a technique that offers efficacious breast cancer treatment with improved cosmetic results. In this talk, I will introduce OBS, and show how surgical clips are used to define breast tumor beds (TBs). I will also show how we used realistic breast phantoms to simulate different OBS surgeries. In the presented work, each phantom was CT imaged at different phases of surgery in order to record pre- and post-OBS closure surgical clip displacements, as well as to extract the true TB (TBTrue). Two experienced radiation oncologists (ROs) were then asked to contour TBs on CTs by relying on surgical clips as per standard clinical protocol. Their original contours, as well as those expanded using 5-15 mm margins, were then compared to TBTrue. It was determined that post-OBS surgical clips are often significantly displaced beyond the original tumor's location. Results also showed that while inter- and intra-RO TB contours were consistent, they both systematically differed from TBTrue. Using expansion margins did not improve contour congruence and caused significant over-contouring of "healthy tissue". Based on our data, we conclude that following OBS, surgical clips alone are not reliable for defining TBs, and that accurate TB delineation is challenging. Finally, we will also share potential options for providing efficacious treatments for post-OBS patients.

2) Advanced magnetic resonance spectroscopy techniques for studying glutamate, GABA, and glycine in the human brain

by Reggie Taylor, PhD (Royal Ottawa)

Abstract: Magnetic Resonance Spectroscopy (MRS) is a valuable tool for non-invasively examining metabolite concentrations in the brain. While basic MRS techniques have proven to be useful for measuring many neuronal metabolites, there are certain metabolites that they are often unable to measure reliably. Three such metabolites that are of interest in neuropsychiatry are gamma aminobutyric acid (GABA), glycine and glutamate. GABA is an inhibitory neurotransmitter that is of growing interest in many neuropsychiatric disorders. It is difficult to quantify because it experiences strong spectral overlap with other metabolites. Using a spectral-editing technique called MEGA-PRESS, it is now possible to get reliable measurements. Glycine, an agonist to the NR2 subunit of the N-methyl-D-aspartate (NMDA) receptor, could provide critical missing information in psychiatric disorders like schizophrenia. It is difficult to quantify with MRS due to its low concentration and spectral overlap. TE-averaging is a technique that is being developed locally to measure it. Glutamate can be measured with routine MRS sequences, but it experiences strong spectral overlap with its metabolic precursor, glutamine, and can be difficult to quantify separately. TE-averaging may also help separate them. This presentation will give a background on MRS and outline studies currently being carried out at The Royal that are interested in these three metabolites.

OMPI Seminar: Liz Fletcher, and Special Event Panel Discussion - Med phys and 1 y of covid19

Date: Thursday, March 18, 2021
Time: 15:30
Location: This is a virtual seminar via this Zoom Meeting.

Presentations:

1) Multiscale modelling of gold nanoparticle enhanced radiation therapy

by Liz Fletcher (PhD Candidate)

Supervised by Rowan Thomson, PhD (Carleton Physics)

Abstract: Although radiotherapy is an effective cancer treatment, there are limitations in its ability to deliver dose to cancerous tissue while sparing healthy tissue. Because of this, novel radiotherapy treatments are continually being developed in order to enhance the dose to cancerous cells while decreasing the dose to healthy cells. One such novel therapy involves the use of gold nanoparticles (GNPs), which are incorporated into cancerous cells in order to enhance energy deposition close to the particles (within nano- to micrometers of the GNPs). This technique is known as gold nanoparticle dose-enhanced radiotherapy (GNPT). In order to understand the biological effects of this treatment, an understanding of the pattern of energy deposition in the cells is needed, so it is necessary to have a MC framework that can accurately and efficiently model large populations of realistic cells. In this talk I will introduce the MC framework I have built in EGSnrc to model realistic cell populations both with and without GNPs. I will also present the preliminary results of my studies on the effects of GNPT at the cellular level as a function of GNP concentration, beam energy, and absorbed dose.

2) Panel Discussion - Med phys and 1 y of covid19

Panelists: Claire Foottit (The Ottawa Hospital Cancer Centre), Raphael Galea (NRC Ionizing Radiation Standards), Ming Liu (PhD alumnus), Julia Wallace (Carleton Univ., Assoc. Dean of Science), Graeme Wardlaw (Can. Nucl. Safety Comm., formerly at Health Canada)

Moderator: Malcolm McEwen (NRC Ionizing Radiation Standards, OMPI Director)

This special event marks the one-year anniversary of the Ontario announcement that emptied buildings and had people scrambling to set up offices in basements, bedrooms and any space they could find. Since then we've learnt a lot of new terms and acronyms - N95, Zoom, WFH, positivity rates, virtual classrooms - and developed new skills (and likely lost some others). We've faced up to the challenge of being remote from our colleagues while at the same time being very local to our fridges. We've gone cold turkey on international travel but discovered the pleasure of walking round our neighbourhoods. We've scoured streaming sites every evening for new content and, of course, said "Can you hear me" or "You're muted" way more times that we can count!
But, what about medical physics? 12 months on, we are going to hear from a panel of OMPI members about their experiences of working (or not working) through the pandemic. Our panelists will provide their perspectives on how their activities - research, teaching, learning, clinical service delivery, manufacturing and client support - have been impacted and how they have adapted, both personally and in their organizations. The aim is to learn from others and understand how our experience fits into the wider community.

We also want to hear from the wider OMPI membership, so come with your questions, comments, life hacks, etc and be prepared to share.

Note - we are NOT planning a follow-up in 2022...

OMPI Seminar: Mehan Haidari and Eric Vandervoort

Date: Thursday, April 15, 2021
Time: 15:30
Location: This is a virtual seminar via this Zoom Meeting.

Presentations:

1) Towards Rapid Palliative Conformal Radiation Therapy: Synthetic CT Generation

by Mehan Haidari (PhD Candidate)

Supervised by Dr. Elsayed Ali, The Ottawa Hospital Cancer Centre

Abstract: The standard clinical process of scan-plan-treat in external beam photon treatment has each of those 3 steps performed separately over a period of 1-2 weeks. This process may be cumbersome to a subset of patients who require radiation treatment for palliation, or for emergency intervention. Past and current approaches to expedite this process compromise on conformality of the treatment, and/or have been resource intensive, which makes them not scalable. We propose a solution to automate this process to reduce resource utilization without compromising treatment quality. This talk will provide an overview of the proposed solution and will then focus on the first step: the generation of synthetic high-quality CT images for targeting and treatment planning.

2) Maintaining quality for ablative radiotherapy using multiple treatment modalities

by Eric Vandervoort, PhD (The Ottawa Hospital)

Abstract: Many large radiation oncology departments now have different stereotactic ablative radiotherapy (SABR) treatment techniques available. Patients need to be directed to the appropriate modality weighing technical considerations and competing demands on resources. This could lead to variations in treatment quality if processes deviate across treatment platforms. In our center, the primary SABR modality is the CyberKnife radiosurgery system. Demand has increased as more and more evidence has been published demonstrating the efficacy of SABR treatments. We have needed to increase capacity across our radiation oncology program for different types of ablative treatments and anticipate where increased demand will be in the future. To provide the same quality of care to all patients, the equivalency of treatment on the alternative treatment modality (usually conventional gantry mounted linear accelerator) must be demonstrated. Some of the factors investigated include intra-fraction motion, plan quality across modalities, and dose delivery accuracy. A framework is proposed to ensure that an appropriate SABR technique has been selected which is based on evidence from our own patient population and radiation therapy system performance evaluations. Disease sites to be discussed include brain, spine, liver and prostate cancer.

OMPI Seminar: Sara Gholampourkashi and Frederic Tessier

Date: Thursday, May 27, 2021
Time: 15:30
Location: This is a virtual seminar via this Zoom Meeting.

Presentations:

1) Clinical implementation of a fully automated evaluation tool for 4DCT quality control

by Sara Gholampourkashi, PhD (Medical Physics Resident, The Ottawa Hospital Cancer Centre)

Supervisor: Dr. Lesley Buckley, The Ottawa Hospital Cancer Centre

Abstract: 4DCT imaging is a routine clinical imaging protocol in radiotherapy clinics, used for thorax and upper abdominal scans. The 4D images are used to generate an average scan, used for target delineation, organ at risk identification and treatment planning. As such, Routine quality assurance of the 4DCT imaging should be included as part of the CT QC program. These tests evaluate image quality parameters of a moving target including mean and standard deviation of CT numbers, spatial integrity (dimension and location) and spatial resolution. The operational impact of such extra tests would be the additional workload and user-dependent results due to manual analysis in a clinic. Our automated analysis tool, using a simple respiratory motion phantom, has enabled us to offset some of the operational impact by speeding up the process the additional advantage of improving reproducibility of the analysis between test cycles and operators.

2) Towards key comparisons of Monte Carlo simulations: 1. Registry of detector models for dosimetry calculations

by Frederic Tessier, PhD (NRC)

Abstract:

Radiation dosimetry, in a way, is the poor child of metrology: while other SI units seek bragging rights through high precision primary standards (up to 16 decimal digits in the case of the second!), radiation dose measurements are typically reported with 3 digits of precision at best (why is that?). Monte Carlo simulations over the past few decades have afforded insight into radiation physics at or beyond this level of precision, by considering small changes between otherwise identical simulations. However, I have observed over time that disagreements in simulations results between different research groups—even different people in the same group!—are the norm rather than the exception, somewhat surprisingly. The reality is that there is still some degree of “art” today in running Monte Carlo simulations, with any of the general-purpose radiation transport software available: different modelling choices, and dull mistakes, lead to significant discrepancies. At best these lead to erroneous data and conclusions, and at worse discredit the Monte Carlo approach altogether (or the other way around, depending on your own proclivities). To resolve this absurd situation, I propose a standard metrological approach: key comparisons that go much beyond the historical “comparison between codes”, towards public computational models, shared validation data and routine testing within a continuous integration perspective. Not only would such a framework improve the quality, validity and credibility of simulation work, it would also serve as a rigorous vetting environment for future development of all radiation transport software toolkits.