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Full Reference: Nicholas Hindley and Paul Keall “*Voxelmap: An Open-Source Deep Learning Framework for 3D Intrafraction Motion Monitoring and Volumetric Imaging during Image-Guided Radiation Therapy*”

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Location: Los Angeles, CA, USA

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Presentation Type: Oral



Radiotherapy pioneer, Amit Sawant (centre), and myself (right) chairing and opening the first scientific session of the conference. A funny anecdote was that one of the speakers did not show up so, to fill in the intervening 7 minutes, Amit and I held an informal question and answer session for any follow ups that the audience might have for previous speakers. People really enjoyed the event (which was very well attended) and I got a lot of encouraging comments to chair future sessions.

The Annual Meeting & Exhibition of the American Association of Physicists in Medicine (AAPM Meeting) is the largest gathering of medical physicists in the world. With members in 88 countries, AAPM focusses on advancing patient care through education, improving safety and efficacy of radiation oncology and medical imaging procedures through research, and the maintenance of professional standards. There were around 4000 attendees and only the highest quality abstracts were selected for presentation.

The AAPM Meeting showcases some of the leading work on medical physics for cancer treatment, with a focus on translational cancer research, research translation and evidence-based clinical practice. In fact, AAPM task groups routinely determine clinical guidelines for radiation therapy practice that are subsequently adopted around the world. This year's task groups focussed on Applications and Quality Assurance of Multileaf Collimators, X-Ray based Online Adaptive RT: Guidelines for quality assurance and clinical implementation and Management of Respiratory Motion in Radiation Oncology among other topics, all of which are directly relevant to the clinical implementation of my work.

My supervisor, Professor Paul Keall, was a key invited speaker and gave a talk on the challenges and opportunities for image guidance during the non invasive treatment of cardiac arrhythmias with radiation therapy, highlighting some of my work along the way. The President of AAPM also gave an important address with this year's theme being embracing change, impacting patient care.

In terms of buzz, there was a lot of discussion around using a novel machine learning technique known as implicit neural representation. Briefly, this leverages some of the recent successes of transformer networks such as Chat-GPT to more easily solve challenging problems in medical image analysis.

In addition to the novel techniques from implicit neural representation, including the importance of positional encoding for high dimensional data, I met some really important people. First, Per Poulsen, has done some seminal work in image-guided radiation therapy that has led to many clinical trials in our group, including two phase 1 clinical trials of a lung tumour tracking system that combines Per's work with my diaphragm monitoring algorithm. Per chaired the session in which I delivered a presentation on real-time volumetric imaging during lung cancer radiation therapy. We had a great discussion after my talk on online uncertainty estimation to inspire clinician confidence in novel machine learning techniques. I then continued my explorations along this theme with another prominent researcher You Zhang from the University of Texas, Southwestern who provided some nice insights. On my return to Sydney I have already started developing these ideas further and both have invited further collaboration with myself.

The novel ideas I discussed (mostly with You and Per, but also with others) provide interesting avenues for me to deepen my research program while at the same time offering a more compelling package to clinical teams who may be (understandably) wary of introducing AI into the clinic. Besides, even if this particular direction isn't pursued, You, Per and I see eye-to-eye on a lot of important opportunities in image-guided radiation therapy and I am sure will be fruitful collaborations.

I hope the insights and relationships formed at this meeting will have direct application to translational cancer research or cancer patient care. First, I am already involved in phase 1 clinical trials of cancer tracking technologies and I hope that my recently developed AI framework will be clinically implemented soon.

For me the personal highlight involved one-on-one time with two important women in medical physics: Magdalena Bazalova-Carter and Dan Ruan. Magdalena was part of the organising committee for the conference this year but generously found an hour to spend with me over lunch to discuss my career and our future collaborations. Dan Ruan is an absolute hero of mine and we also spend some one-on-one time where I asked her advice on career and on some technical points. Getting to spend this time with these two researchers that I respect so much made the sleep deprivation worth it!