Report from ICCR 2019

The 19th International Conference on the use of Computers in Radiation Therapy (ICCR) was held in Montreal for the week of 17 to 21 June. This is a three-yearly conference that celebrates all things 'geeky' in the world of radiotherapy physics. It was no surprise that artificial intelligence and machine learning dominated the programme. Other sessions focused on radiomics, big data, image registration, automated planning, motion deformation and software development.

The prize for the word of the conference definitely went to UNet! Almost every session included a UNet (which can be described as a convolutional neural network that was developed for biomedical image segmentation) that was applied to data in some manner. On Monday 17 June there were two sessions focused on deep learning for outcomes, diagnosis and image processing, in which UNets were the central part of almost every talk. Deep-learning approaches were described for the creation of synthetic computerised tomography (CT) from modulated radiation (MR) images; the automation of intensity-modulated radiation therapy (IMRT) optimisation; to perform deformable registrations; to iteratively reconstruct cone-beam computed tomographys (CBCTs); to track, and to automatically classify, imaging datasets.

Elsewhere, there were interesting talks around radiomics with a focus on harmonisation of approaches and the development of robust methodologies and validation. Other sessions focused on 'big data'; these talks discussed how we can utilise the wealth of data now available in radiotherapy, including images and dose cubes, to learn how to improve treatments. The learning healthcare model is not new, but the need to develop best practice is essential. Tied into this was the concept of rapid learning, in which we continually monitor patient outcomes in order to explore fully and understand the small changes to treatment that happen in radiotherapy departments (e.g. a change in imaging protocols) without formal clinical studies.

There were three keynote speakers at ICCR this year. Yoshua Bengio, professor at the Department of Computer Science and Operations Research at the Université de Montréal, Canada, and scientific director of the Montreal Institute for Learning Algorithms, opened the conference with a review of applications of deep learning in healthcare. He argued that what had been started was only the 'tip of the iceberg' and that healthcare would be profoundly transformed by progress in artificial intelligence, if it took full advantage of the large quantities of data available. Joelle Pineau, associate professor at McGill University, Canada, and lead scientist at Facebook's Artificial Intelligence Research lab in Montreal, introduced more of the concepts of artificial intelligence and ways in which they could be used in healthcare. Finally, Ilya Shpitser, a John C.

Malone assistant professor at the Department of Computer Science at Johns Hopkins University, US, discussed his work on causal inference. He stated: "Many decisions in healthcare are phrased as a choice between competing hypothetical actions, based on retrospective data where past actions were not chosen randomly, and outcomes are systematically censored." He argued that tools of causal inference could solve these problems. He introduced these tools with examples such as the readmission of surgical patients and outcomes for HIV patients.

One of the best sessions introduced the rising star competition, which showcased the work of six PhD students who presented their latest research. Topics were broad, and five of them covered: the modelling of lymphocyte irradiation in the blood; biological uncertainties in carbon therapy; feature analysis for outcome prediction in head-and-neck cancer; a knowledge-based automated planning platform; and liver tracking for proton delivery. The winner was Angela Davey, PhD student at the University of Manchester, who discussed her work on the optimal method to extract image features from a 4D-CT scan. She had developed a model that incorporated these imaging features from 4D-CT scans of patients with early stage lung cancer, alongside clinical and tumour factors to predict distance recurrence. Ms Davey's proposed method showed the strongest performance when compared against current approaches. Those awarded first, second and third places are shown in Figure 1. Ms Davey's prize is to attend the 2020 Winter Institute of Medical Physics in Colorado, where she can discuss her PhD project with the medical physics community while learning to ski!

PhD students who were awarded top places in the rising star competition. From left to right: in 3rd place, Hans-Peter Wieser, German Cancer Research Center, DKFZ, Germany; in 2nd place, Miriam Krieger, Paul Scherrer Institute, Switzerland; and in 1st place, Angela Davey, University of Manchester, UK.

The conference meal took place at the Montreal Science Centre near the old port of Montreal on the St Lawrence River. There attendees could watch the sunset across old Montreal while enjoying the food and hospitality of the venue. Also, I think many attendees enjoyed the Francofolies de Montréal music festival. The main stages were outside the conference venue, and we could enjoy a beer at the end of the sessions while watching the bands. This was great timing by the conference organisers!

Finally, the prize for geekiest talk of the conference probably goes to Marcel van Herk, chair in radiotherapy physics at the University of Manchester, who has recently found and restored an old Data General Nova computer. This is not quite the same model that performed the reconstruction for the first CT scanner, but almost. He restored the computer by creating a new front panel to program the system and incorporating a raspberry Pi to control the computer remotely. During the presentation Professor van Herk performed a live demonstration using a webcam to watch the computer in Manchester that was being controlled live from Montreal. The system reconstructed an image of a sphere, or at least tried to; apparently one of the look-up tables had not been computed quite correctly! The presentation is available here:
https://www.youtube.com/watch?v=n7GDlJNpB8Y

The site of the next ICCR was decided by vote among the audience who had made it to the very end of the conference. A very nice pitch that included a video of pandas rolling down a hill led to a win for Beijing, China, where the next conference will be held in 2022. I look forward to seeing you there!

Alan McWilliam
Honorary senior lecturer in radiotherapy physics
University of Manchester
Manchester, UK