projection images per respiratory phase with spatial and/or temporal regularization(s). This presentation will review these techniques, discuss the pros and cons of each and report on a recent attempt to evaluate them from the same dataset.

SP-0241 Deep image formation algorithms for CT and CBCT

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Abstract text
Purpose
To give an overview of the potential of deep learning in the field of x-ray CT and CBCT image formation.
Methods
With the introduction of deep learning in general, and with deep convolutional neural networks (CNNs) in particular, machine learning has spread into many medical areas with great success. In particular medical imaging may benefit from the new technology. Important applications such as image analysis, image segmentation and object recognition are well-known and start to become widely available.
The applications of machine learning to the field of image formation, which describes the process of data acquisition, preprocessing, image reconstruction and post processing, however, are less known, not as mature and not always available, yet. In CT and CBCT, which are the focus of this lecture, the use of machine learning can be mainly categorized into the categories 1) replacement of time-consuming computations (image reconstruction, scatter prediction, material decomposition, …), 2) replacement of missing data (sparse view acquisition, limited angle tomography, …), and 3) incorporation of a priori knowledge (non-contrast CT from contrast-enhanced CT, pseudo CT from MR, …). This lecture discusses the underlying technology and application examples.
Results
Methods that promise to fill in missing data need to be taken with care because they are just another way of inter- or extrapolating data: Claims that a reduction of x-ray dose or of the number of x-ray projections, when combined with CNNs, yields the same image quality as high dose imaging are not proven and, if at all, demonstrated using simple phantoms or smooth CT images. In contrast, applications to replace time-consuming computations by real-time CNNs have the potential to provide accurate results even for a great input data variation because their output is typically a smooth but non-local function of the data input. Successful examples are networks that replace Monte Carlo calculations and compute deep scatter estimations (DSE) and deep dose estimations (DDE) in real time. Even more important are deep learning-based image reconstruction algorithms which also vendors have started to implement into their products. Such deep recons (DR) have the potential to outperform the conventional analytical reconstruction (AR) and iterative reconstruction (IR) algorithms, by far.
Conclusions
Deep learning has the potential to significantly improve CT and CBCT image formation. However, not all proposed methods may keep their promises. Care has to be taken in all cases because due to the large number of open parameters the behavior of neural networks is difficult to analyze or predict and it cannot be foreseen how they react to data that are not adequately represented by the training set.

SP-0242 Hounsfield corrected CBCT images – dose calculation and potential for bio-markers

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Abstract text
CBCT scans are part of the daily clinic in many institutions. Quite often the 3D/4D CBCT information are reduced to three numbers indicating the patient translation needed in order to place the iso-center in the correct position. However, the CBCT images do contain much more information than just the positional uncertainty. An obvious use of the CBCT images is to validate that the overall patient anatomy is unchanged during a fractionated treatment schedule. Typically the RTT's will, as part of their online assessment of the images, notice whether anatomical changes are present. If there are anatomical changes the next question is whether these differences impact the planed dose distribution. Since grey levels in standard CBCT images are not representing the Hounsfield Units, the patient is often referred for a validation CT that can be used for dose calculation. If the CBCT images could be made to match Hounsfield Units it would be possible to use the CBCT images for dose validation directly. This would make it much faster to obtain information of the potential dose impact and also spare the patient for an additional visit to the CT scanner. Such a procedure is introduced as clinical practice for some of our local lung trial patients. During the talk different methods to obtain Hounsfield units from standard clinical CBCT images will be discussed. The potential of CBCT images are however even larger than just the ability to be used for dose calculation. CBCT and other medical images do have the potential to be used as early bio-markers that during RT could indicate the potential outcome of the patient. This could be used as a way to performed patient specific correction to the treatment plan based on the radiation sensitivity of the individual patient. However, the image noise is still a partly hindrance for obtaining valuable bio-markers. Some of the methods to reduce image noise will be discussed and some of the results related to bio-markers and CBCT images will be discussed during the talk.

Symposium: New technology and modalities

SP-0243 How to secure the right competencies when new modalities are implemented - a clinical aspect in proton therapy

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Abstract text
In late autumn 2018 The Christie Foundation Trust in Manchester, United Kingdom, opened the first high energy proton therapy centre in England for National Health Service (NHS) patients.

In the opening of a new proton therapy service a new modality of radiation therapy was implemented with the intent of treating a wide range of complex and challenging cases. Key safeguards needed to, and have been, built into the service to ensure safe treatment of patients. One of these key safeguards was the training and education of the workforce. Such considerations started early in the project with a number of senior team members visiting operational proton therapy departments to gather as much information as possible to guide service development. We employed staff early and implemented extensive training packages. Clinical Oncologists, senior physicists and therapists have all undergone an extensive programme of training which included overseas education programmes and practical placements in established proton centres. This was complimented by bringing expertise to our site to discuss site specific treatment planning solutions, exercises in comparative planning, as well as discussion of the issues and challenges that are particular to proton therapy.

Overseas experience was backed up by on site applications training and a significant amount of time was incorporated into the commissioning schedule for end to end testing/patient treatment dry runs. During this time a comprehensive competency based in house training was developed and incorporated into an accredited quality system.

SP-0244 Personalized treatment planning and automation in modern radiotherapy

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Abstract text

Treatment planning for dynamic radiotherapy techniques (e.g. IMRT, VMAT, Tomotherapy), needs high knowledge of the planner to ensure high plan quality. Different level of knowledge and practical skills of planners can lead to variability in the quality of treatment plans and the time efficiency of productions of the plans.
The control of the realization is the additional aspect of the treatment plans and their potential modification during radiotherapy.
To standardize the planning process, the planning approaches with automation support were intensively developed in last years.
There are also a lot of new technical solutions to control the accuracy of the dose delivery according to the prepared treatment plans.
This study critically reviews the body of publications up to the end of 2018.
The review is described for (i) automated planning - different types of automation algorithms and for (ii) the dose delivery - inaccuracies for the displayed doses caused from the actually implemented tools.

SP-0245 Advanced practice role in breast cancer radiation therapy

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Abstract text

Implemented in 2007, the Clinical Specialist Radiation Therapist (CSRT) project is a model-of-care to develop advanced practice radiation therapy in Ontario, Canada. The breast-site CSRT is one of the first advanced practice roles piloted at the Princess Margaret Cancer Centre. The goal of this role is to enhance radiation therapy practice and patient-focused outcomes for patients requiring breast radiotherapy. The breast-site CSRT is an integral part of an inter-professional team and practices within the radiotherapy new patient clinic, follow-up clinic, and “on-treatment reviews” to provide clinical care and performs cavity target delineation for radiotherapy planning. As part of a multi-disciplinary team, the CSRT leads a rapid process for same-day breast radiotherapy. This session explores the breast-site CSRT role and evaluates the accumulated 10-year evidence in advanced practice role development.

Symposium: Combining research and (clinical/ professional) training/ practice

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SP-0246 Taking time off for full-time research - is it worth it?

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Abstract text

For health practitioners, taking a break from clinics to undertake full-time research could be seen as an opportunity and/or a disadvantage. In this session, pros and cons of taking time off for full-time research will be discussed.

SP-0247 Why do we need to be trained in statistics ? Need and pitfalls

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Abstract text

Evidence based medicine is necessary for routine clinical practice. Understanding and taking into account large amount of data should permit to predict accurate outcome and tailoring the best individual treatment. However, clinicians need to understand statistical and data analysis in order to take the best decision and better criticize published studies. This need is also reinforce by the