Methods. Triggered imaging was performed using a spherical homogeneous phantom with images acquired in 0° and 270° on a Truebeam STX linac (Varian Medical Systems, USA). The phantom contained three Gold Anchor fiducials (Naslund Medical, Sweden) and was moved 1–6 mm using HexaMotion (Scandidos, Sweden) during triggered imaging. Since Gold Anchor fiducials are flexible and may end up in various shapes in the patient, the tests were performed with both compressed (around 5 mm) and more elongated fiducials (up to 15 mm).

To evaluate how well the system could locate fiducials in patients, triggered imaging was performed during one fraction in five patients undergoing 2-arc VMAT prostate treatment, all with three Gold Anchor fiducials implanted in the prostate. Images were acquired in intervals of 30°, resulting in 24 images per patient. The fiducial tracking accuracy was visually inspected in all images.

In both the phantom and patient evaluation a position difference tolerance of 5 mm was used.

Results. During the phantom tests, the system correctly identified all fiducial positions as being inside or outside their tolerance for movements ≤ 4 or ≥ 6 mm.

Negligible prostate motion were observed during the five prostate treatment deliveries. The system correctly identified 316/360 fiducials as being inside tolerance, 36/360 could not be located and 8/360 were falsely identified as another fiducial or bone structure. The main reason for tracking failure was elongated and/or insufficiently separated fiducials.

In both the phantom and the patient situation, the system did not always identify the same point on a fiducial. This tracking variation was larger for elongated fiducials.

Conclusions. Triggered imaging seems to perform satisfactorily when used in combination with well-separated and compressed Gold Anchor fiducials.

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[OA127] Cone-beam CT intensity correction for adaptive radiotherapy of the prostate using deep learning

Christopher Kurz^{a,*}, David C. Hansen^b, Mark H.F. Savenije^c, Guillaume Landry^d, Matteo Maspero^c, Florian Kamp^a, Katia Parodi^d, Claus Belka^a, Cornelius van den Berg^c

^a University Hospital, LMU Munich, Department of Radiation Oncology, Munich, Germany

^b Aarhus University Hospital, Department of Oncology, Aarhus, Denmark

^c Umc Utrecht, Center for Image Sciences, Utrecht, The Netherlands

^d Ludwig-Maximilians-Universität München, Department of Medical Physics, Munich, Germany

* Corresponding author.

Purpose. This study investigates for the first time the feasibility of using deep learning for cone-beam CT (CBCT) intensity correction to enable accurate daily dose calculation and treatment adaptation in volumetric-modulated arc therapy (VMAT) and intensity-modulated proton therapy (IMPT). Current CBCT intensity correction approaches often show a lack of either speed or accuracy, which might be overcome by deep learning approaches.

Methods. Pre-treatment CBCTs and corresponding projections of 30 prostate cancer patients were considered. A previously validated technique for CBCT intensity correction, based on deformable image registration (DIR) of the planning CT to the daily CBCT and scatter estimation in projection space, served as reference (CBCT_{cor}) [1]. Two alternative methods were investigated: A U-shaped deep convolutional neural network (U-Net) was trained to perform scatter

correction in projection space, i.e., going from measured to corrected projections before reconstruction (CBCT_{ScatterNet}). Moreover, a generative adversarial network (GAN) was trained to perform a translation from the original CBCT (CBCT_{org}) to CBCT_{cor} in image space, generating a so-called CBCT_{corGAN}. CBCT_{ScatterNet} and CBCT_{corGAN} were compared to CBCT_{cor} in terms of mean absolute error (MAE) and mean error (ME). For eight exemplary patients, dose calculation accuracy in VMAT and IMPT was evaluated with respect to CBCT_{org}.

Results. Both, CBCT_{ScatterNet} and CBCT_{corGAN}, showed a substantially improved agreement to CBCT_{cor} compared to CBCT_{org}. Mean MAE and ME decreased from 158HU and 152HU for CBCT_{org} to 39HU and 4HU for CBCT_{ScatterNet} and 57HU and –2HU for CBCT_{corGAN}, respectively. In a 2% dose-difference test, considering only voxels above 50% of the prescribed dose, mean pass-rates were 53% and 64% for CBCT_{ScatterNet} and CBCT_{corGAN} in IMPT. In VMAT, pass-rates of 90% and 97% were obtained for CBCT_{ScatterNet} and CBCT_{corGAN} using a 1% dose-difference criterion.

Conclusions. CBCT intensity correction using two different implementations of deep learning was found feasible. For VMAT, dose calculation accuracy was high, while for IMPT further improvements may be required. Compared to the reference correction method, deep learning techniques were less affected by DIR inaccuracies and allowed considerably faster CBCT correction within few seconds instead of minutes.

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Reference

[1] Kurz et al. *Med Phys* 2016;43:10.

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[OA128] Influence of SBRT fractionation on the behavior of TCP and NTCP for prostate cancer

Evgeniia Sukhikh^{a,*}, Leonid Sukhikh^b, Igor Sheino^c, Andrey Vertinskaya^d

^a Tomsk Regional Oncology Center, Tomsk Polytechnic University, Radiotherapy, Tomsk, Russian Federation

^b Tomsk Polytechnic University, Applied Physics, Tomsk, Russian Federation

^c Burnasyan Federal Medical Biophysical Center, Laboratory for Methods and Technologies Radiation Therapy, Moscow, Russian Federation

^d Tomsk Regional Oncology Center, Radiotherapy, Tomsk, Russian Federation

* Corresponding author.

Purpose. Traditionally, radiation treatment dosimetric plans are evaluated by degree of PTV coverage by prescribed dose and the fulfillment of QUANTEC limitations on OARs. In the case of hypofractionated SBRT irradiation plans should be optimized with respect to optimal fractionation and total delivered dose. In this case one could use macroscopic radiobiological criteria, namely TCP and NTCP.

The aim of the work is to optimize prostate cancer SBRT treatment basing on TCP/NTCP criteria in the range of total doses from 33.5 Gy to 38 Gy delivered in 4 or 5 fractions.

Methods. SBRT treatment plans based on VMAT dose delivery technique (4 full arcs) were made in Elekta MONACO planning system v. 5.10. Five patients with T1 and T2 prostate cancer were