Docket #: S20-106

Radiotherapy Treatment Plan Verification Algorithm

Stanford researchers have used deep learning to create a radiotherapy treatment plan verification algorithm. Patient specific dose verification is traditionally done by checking the dose in a patient-mimicking phantom or by using an independent dose calculation algorithm. Drawbacks include measurements that do not truly reflect clinical treatment, and patient-specific dose errors. To efficiently improve the quality assurance (QA) process, researchers in the Xing Laboratory used a generative adversarial network (GAN) based, deep learning approach to estimate the MultiLeaf collimator (MLC) aperture and corresponding monitor units (MUs) from a given 3D dose distribution. Data from 199 patients, including nasopharyngeal, lung and rectum, treated with intensity-modulated radiotherapy (IMRT) and volumetric-modulated arc therapy (VMAT) techniques, trained the network. An additional 47 patients were used to test the model prediction accuracy. Leaf position prediction accuracy is around one pixel, and corresponding MU prediction accuracy is within 2% (figure 1). It takes about a week to train the model, but executing the trained model takes only seconds. A physicist can check MLC and MU settings and verify the plan right away after treatment planning. This technique has the potential to significantly improve efficiency, safety, and accuracy of the patient plan QA process.

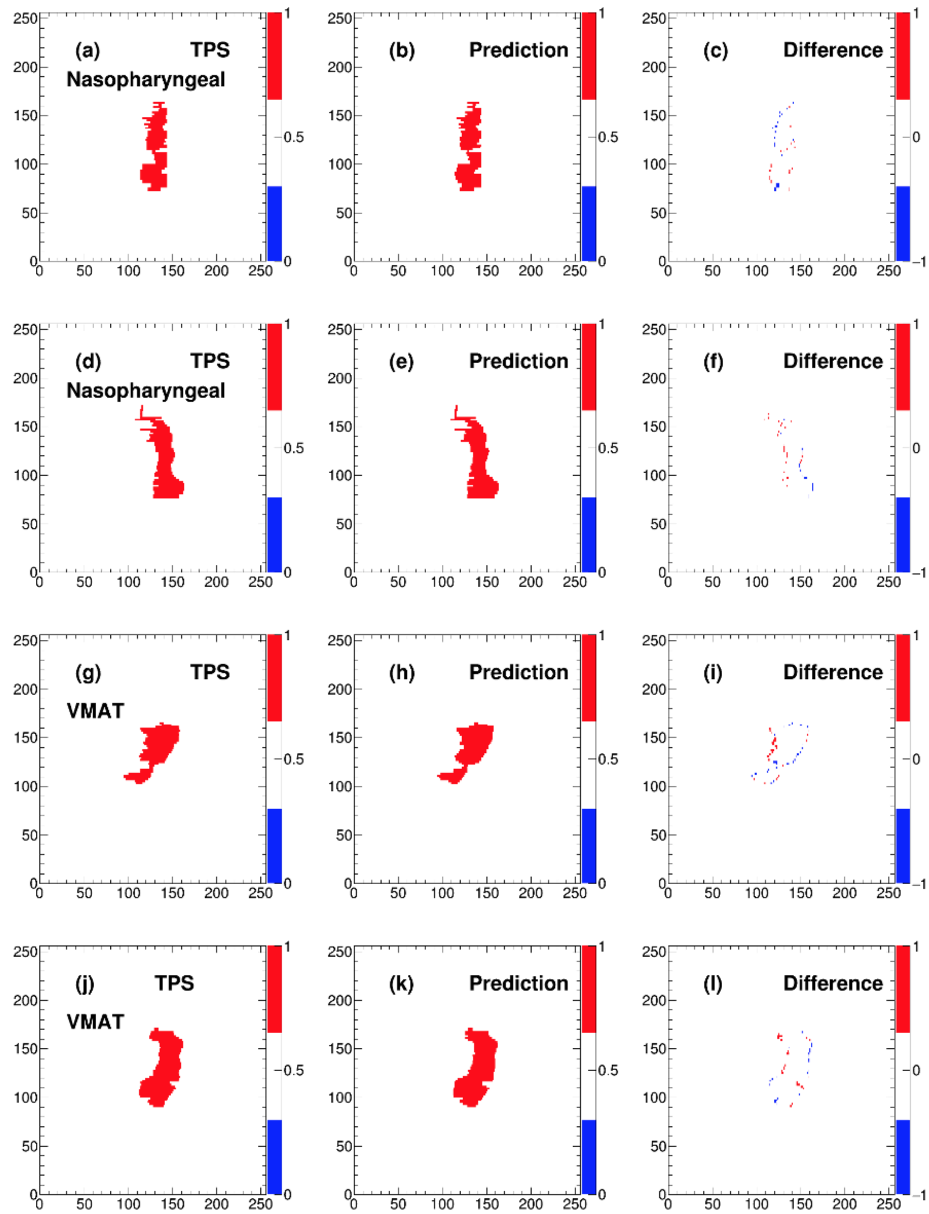

Figure 1 - Comparison of treatment plan and deep learning derived plan verification

Planned (left), deep learning derived MUs/MLC maps (center), and the pixel-wise differences between the two (right) of four segments from a nasopharyngeal IMRT case and a rectum VMAT case. The respective DSC (Dice Similarity Coefficient) for the four segments are 0.97, 0.98, 0.95 and 0.97

Stage of Development – Prototype

Researchers continue to optimize the verification algorithm using more treatment sites to train a more comprehensive model, and explore different neural network architecture.

Applications

- Plan verification for radiation therapies, including IMRT, VMAT, SBRT, SRS

Advantages

- Accurate, intuitive, and efficient
- Reduces experimental measurement burden in Quality Assurance process

Publications

- Fan, Jiawei, Lei Xing, Ming Ma, Weigang Hu, and Yong Yang. "Verification of the machine delivery parameters of a treatment plan via deep learning." *Physics in Medicine & Biology* 65, no. 19 (2020): 195007. DOI: 10.1088/1361-6560/aba165

Innovators

- Lei Xing
- Yong Yang
- Jiawei Fan

Licensing Contact

Evan Elder

Senior Licensing Associate

Email