Imaging and AI/ML Opportunities

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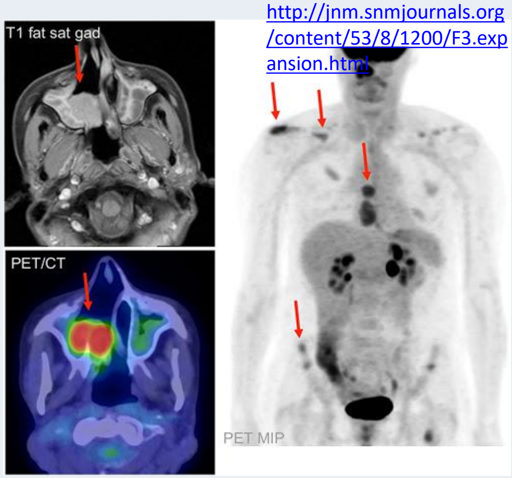
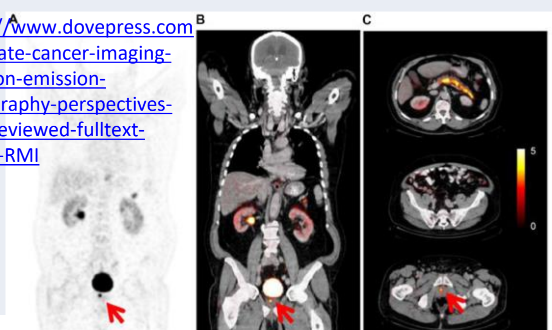
Background

Imaging in Radiotherapy

Diagnosis (and follow-up)

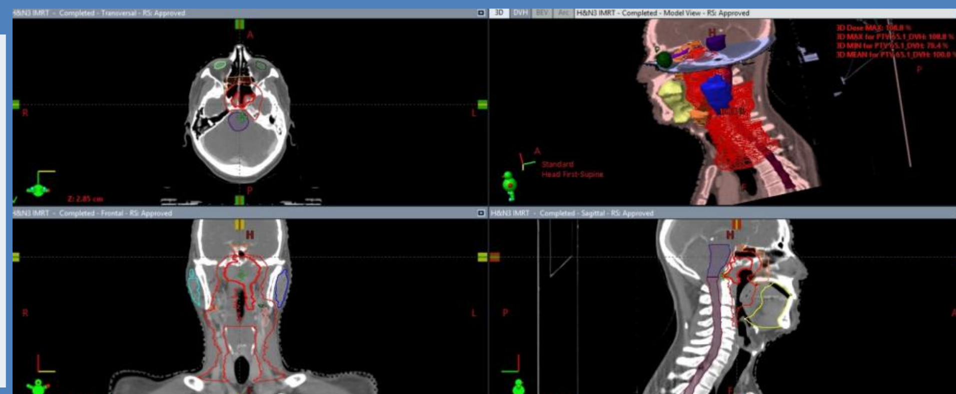


http://jnm.snmjournals.org/content/53/8/1200/F3.expansion.html

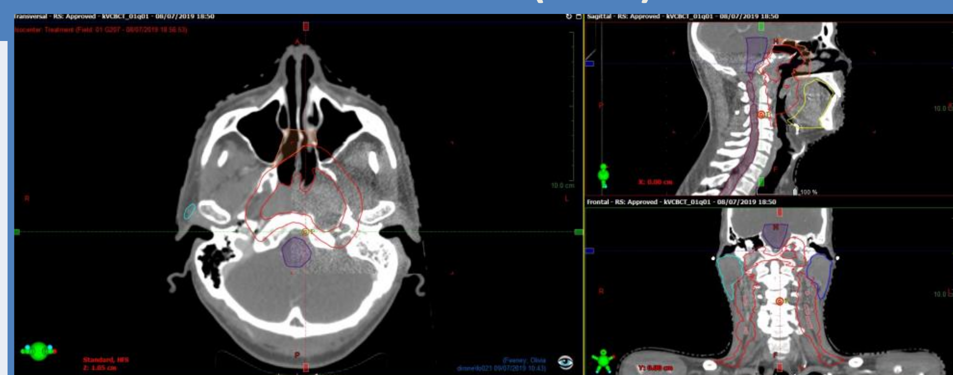


https://www.dovepress.com/prostate-cancer-imaging-positron-emission-tomography-perspectives-peer-reviewed-fulltext-article-RMI

Planning

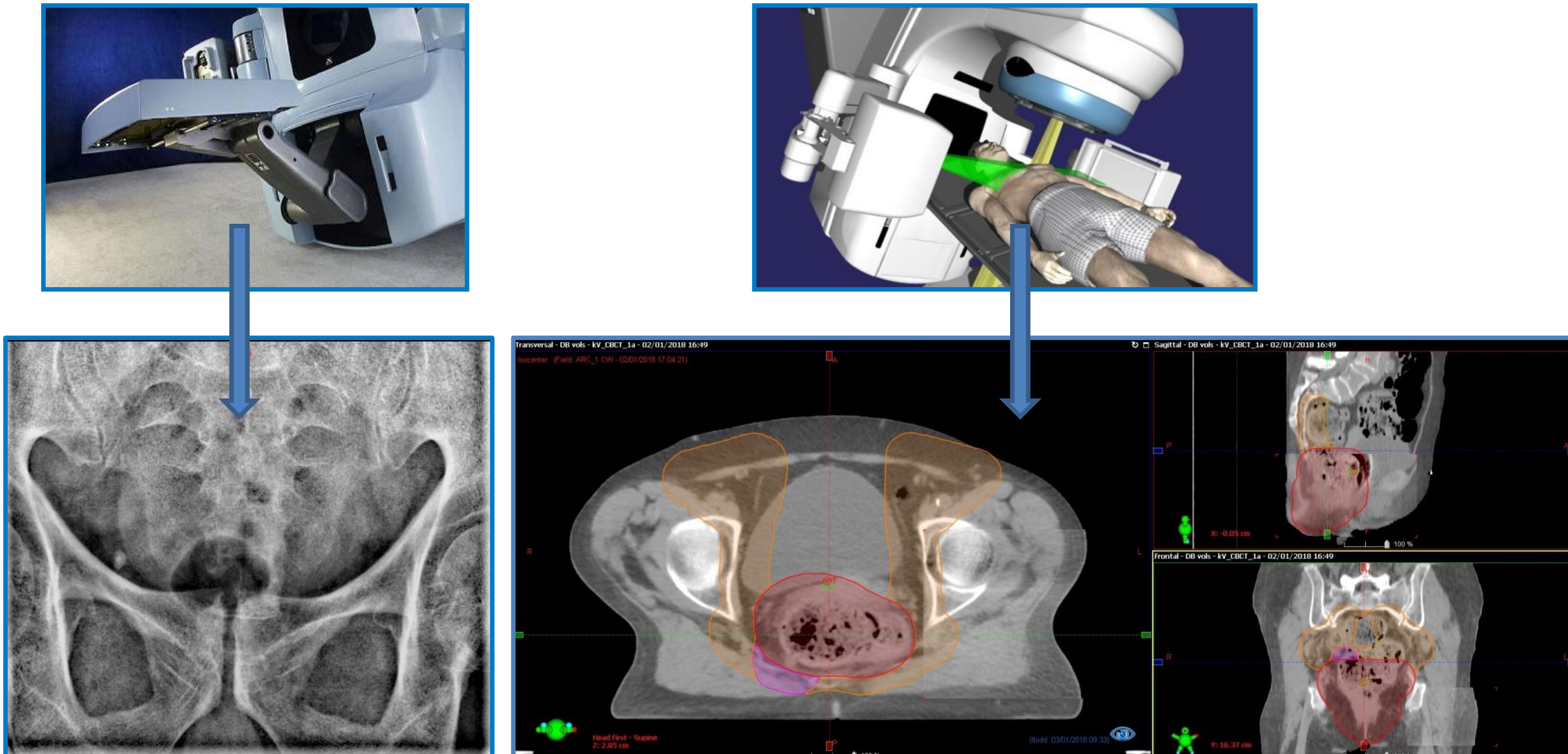


Verification (IGRT)



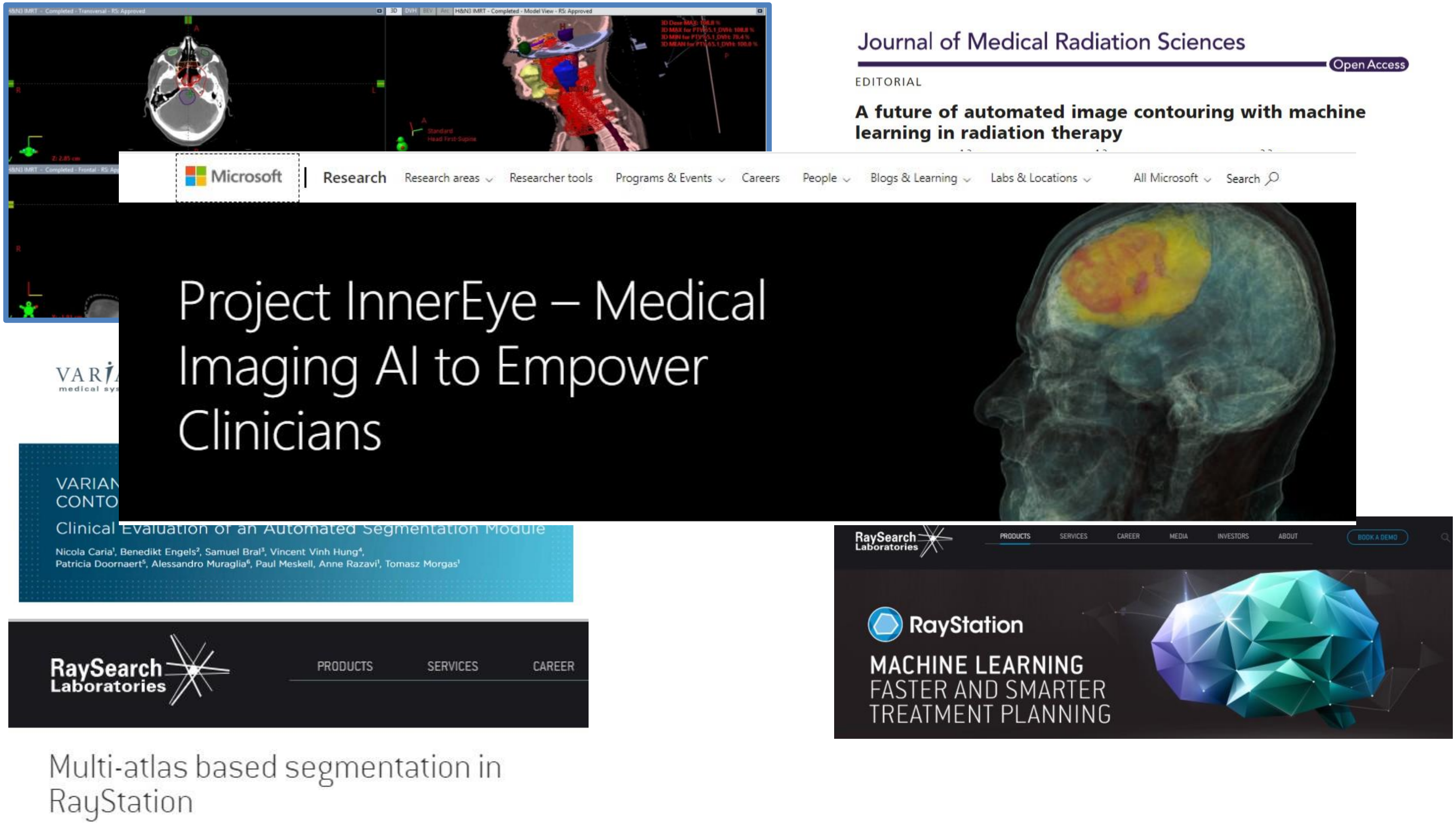
Background

Advances in volume definition and IGRT capability



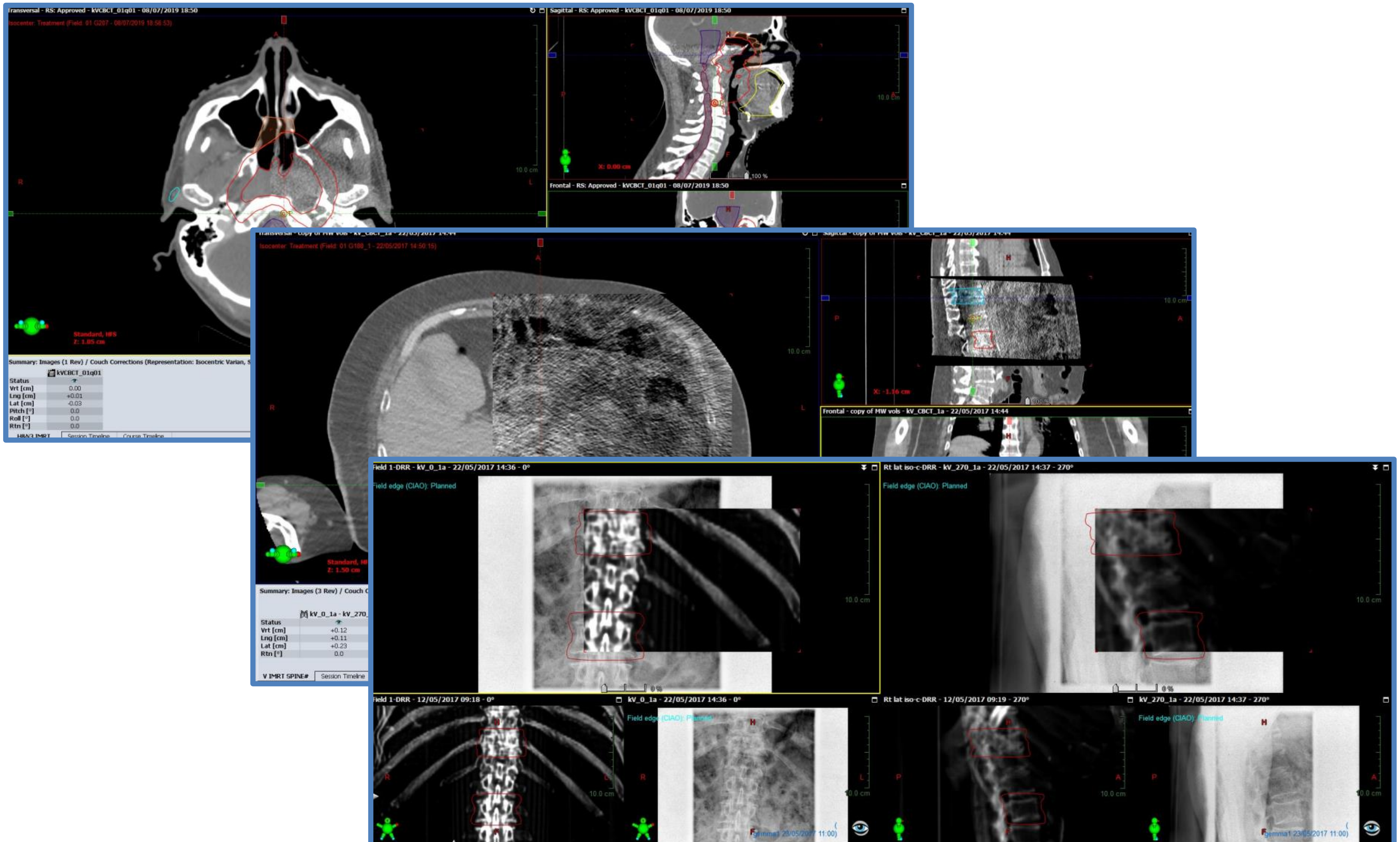
Radiotherapy Planning

Auto-contouring: Atlas vs Machine Learning



Radiotherapy Verification (IGRT)

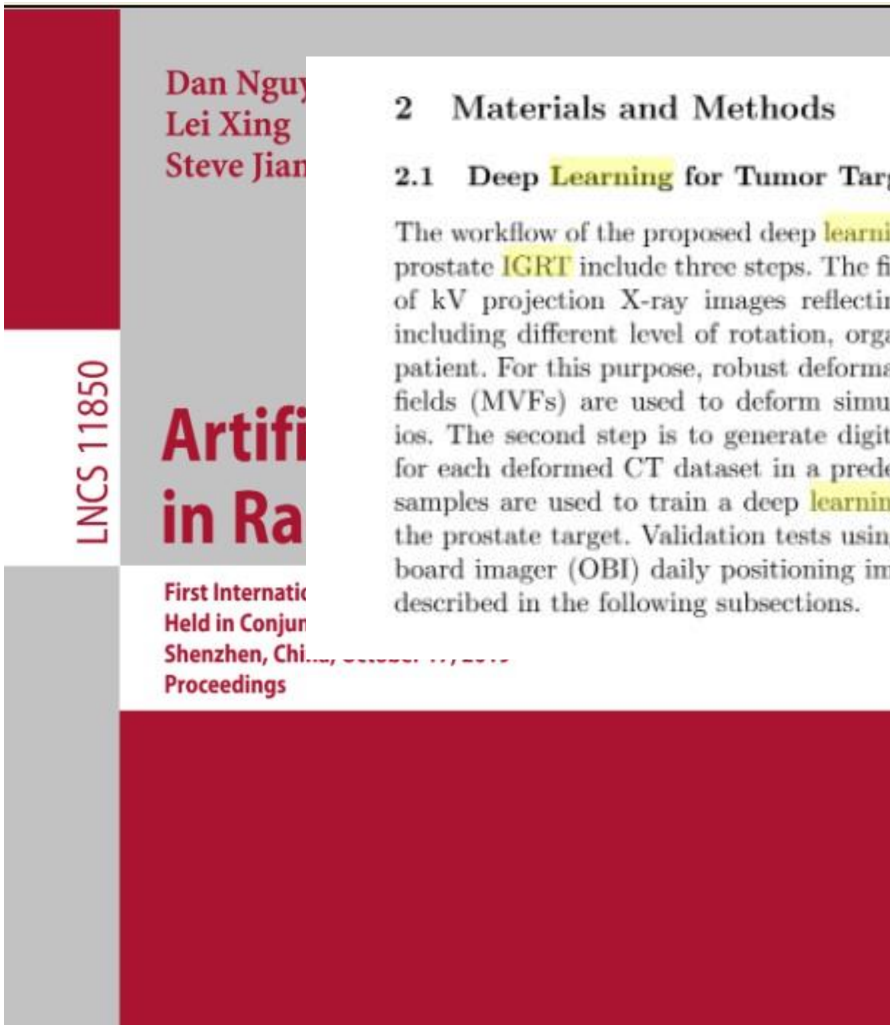
Matching & Decision Making



Imperial College Healthcare NHS
NHS Trust

Radiotherapy Verification (IGRT)

Matching & Decision Making



2 Materials and Methods

2.1 Deep Learning for Tumor Target Localization

The workflow of the proposed deep learning-based target localization process for prostate IGRT include three steps. The first step is to generate training datasets of kV projection X-ray images reflecting various situations of the anatomy, including different level of rotation, organ deformation, and translation of the patient. For this purpose, robust deformable models described by motion vector fields (MVFs) are used to deform simulation CT to different clinical scenarios. The second step is to generate digitally reconstructed radiographs (DRR) for each deformed CT dataset in a predefined direction. Finally, the annotated samples are used to train a deep learning model for subsequent localization of the prostate target. Validation tests using both simulated DRR and clinical on-board imager (OBI) daily positioning images were performed. More details are described in the following subsections.

nage-Guided
ep Learning for
ıcer

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radiotherapy often relies on
s) or transducers for target
ı requires an invasive proce-
infection and discomfort to
rkerless prostate localization
odel to interpret routine pro-
r daily cone-beam computed
el was first trained by using
images. The trained model
prostate target for a given
input X-ray projection image. To assess the accuracy of the approach, six patients with prostate cancer received volumetric modulated arc therapy (VMAT) were retrospectively studied. The results obtained by using the deep learning model and the actual position of the prostate were compared quantitatively. Differences between the predicted target positions using DNN and their actual positions are (mean ± standard deviation) 1.66 ± 0.41 mm, 1.63 ± 0.48 mm, and 1.64 ± 0.28 mm in anterior-posterior, lateral, and oblique directions, respectively. Target position provided by the deep learning model for the kV images acquired using OBI is found to be consistent that derived from the implanted FMs. This study demonstrates, for the first time, that highly accurate markerless prostate localization based on deep learning is achievable. The strategy provides a clinically valuable solution to daily patient positioning and real-time target tracking for image-guided radiotherapy (IGRT) and interventions.

Opportunities for CCAP?

CCAP
Centre for the Clinical Application of Particles

- Computing
- Imaging
- Machine Learning