Purpose: High quality IGRT is only practical when robust tools are available for accurate and fast deformable registration and segmentation of the treatment images. We have implemented such a toolkit for the male pelvis using a class of statistically trainable deformable models (SDMs) of anatomical structures, called medial representations (m-reps). The aim of this study is to evaluate its capabilities and performance in clinical prostate cancer IGRT applications.
Methods: An image collection for prostate cancer patients treated with IGRT using a CT-on-Rails (CTORs) system was studied retrospectively with this toolkit to determine the actual delivered dose throughout the treatment course. The patient-specific planning models of the male pelvic organs, including the prostate, bladder, rectum, and femoral heads, were constructed via user-guided autosegmentation of the planning CT. The planning CT was then automatically registered to the CTORs images via a rigid-body, soft-tissue-based registration method. The planning models were then transformed into initialized treatment models to segment the CTORs images. The essential tissue-voxel correspondence across treatment images was established by this model-based segmentation process. The dose delivered to the same tissue elements can, therefore, be accumulated for adaptive planning and/or outcome assessment.
Results: Preliminary results show that the m-rep-based planning image segmentations are clinically acceptable to the physicians and can be readily constructed from the planning CT with nominal user guidance. The automatic image registration with the treatment-day image, occasionally followed by manual refinement, also considered acceptable by clinical staff. Treatment image segmentation with intrinsic tissue-voxel correspondence used substantially less time (5 ± 1.3 minutes) in comparison to manual contouring.
Conclusions: Our clinic-oriented toolkit is effective in segmentation of treatment images of the male pelvis. Application for dose accumulation and adaptive IGRT is in progress.