AbstractID: 1542 Title: Accommodating Bowel Gas in Large Deformation Image Registration for Adaptive Radiation Therapy of the Prostate

We have been developing methods for adaptive radiation therapy of the prostate that use large-deformation image registration to automatically track organ motion between inter-treatment CT images. The presence of bowel gas in pelvic CT data can cause significant errors in image registration because no correct correspondence exists between an image that contains gas and one that does not. In order to accommodate bowel gas and improve the accuracy of image registration for adaptive radiation therapy, we propose a novel method for deriving image-to-image correspondence that includes steps for segmenting and deflating bowel gas prior to image registration. First, simple thresholding is used to create a binary image of gas present in the rectum. A non-diffeomorphic deflation transformation is then estimated by generating a flow driven by the gradient of this binary image. The gradient is only non-zero at the boundary of the binary regions, so the gas is effectively deflated like a balloon. Finally, the deflated images are accurately registered using previously developed image registration algorithms. Current research shows that for images without gas, these algorithms are accurate to within 1.5mm. Correspondence between the original images is estimated by concatenating the resulting registration transformation with the appropriate gas deflation transformations. Once this method is used to establish correspondence, delineated anatomical structures are mapped between images, allowing for the analysis of organ morphology. These correspondences are also used to accumulate inter-fraction dose in a common coordinate system. We present results of applying this method to inter-treatment pelvic CT data.