MRI-Guided Target Motion Assessment using Dynamic Automatic Segmentation

Daniel Saenz

Under the supervision of Bhudatt Paliwal PhD

At the University of Wisconsin-Madison

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Motion significantly impacts the radiotherapy process and represents one of the persisting problems in treatment delivery. In order to improve motion management techniques and implement future IGRT tools such as MRI-guidance, automatic segmentation algorithms hold great promise. Such algorithms are attractive due to their direct measurement accuracy, speed, and ability to assess motion trajectories for daily treatment plan modifications. We developed and optimized an automatic segmentation technique to enable target tracking using MR cines, 4D-MRI, and 4D-CT. This algorithm overcomes weaknesses in automatic contouring such as lack of image contrast, subjectivity, slow speed, and lack of differentiating feature vectors by the use of morphological processing. The software is enhanced with predictive parameter capabilities and dynamic processing. The 4D-MRI images are acquired by applying a retrospective phase binning approach to radially-acquired MR image projections. The quantification of motion is validated with a motor phantom undergoing a known trajectory in 4D-CT, 4D-MRI, and in MR cines from the ViewRay MR-Guided RT system. In addition, a clinical case study demonstrates wide-reaching implications of the software to segment lesions in the brain and lung as well as critical structures such as the liver. Auto-segmentation results from MR cines of canines correlate well with manually drawn contours, both in terms of Dice similarity coefficient and agreement of extracted motion trajectories.