

Organ Motion Prediction in MR-Guided Radiotherapy

Seyed Ali Mirzapour¹, Thomas Mazur², Gregory Sharp³, and Ehsan Salari¹

¹Department of Industrial, Systems, and Manufacturing Engineering, Wichita State University; ²Washington University in St. Louis, St. Louis, MO; ³Massachusetts General Hospital, Boston, MA

According to the American Cancer Society, it is estimated that around 15,000 cancer cases will be newly diagnosed in the state of Kansas in 2019, from which around 4500 will be lung and abdominal cancers. Radiotherapy is a major treatment modality for cancer with more than half of all cancer patients receiving radiotherapy as part of their treatment. The goal of radiotherapy is to deliver a therapeutic dose of radiation to the clinical target volume while sparing the surrounding healthy tissue to the largest extent possible. However, internal organ motion during radiation delivery may lead to under dosing of the target volume or overdosing of the normal tissue, potentially causing treatment failure or normal-tissue toxicity. Organ motion is of particular concern in the treatment of lung and abdominal cancers, where breathing induces large tumor displacement and organ deformation. A new generation of radiotherapy devices is equipped with on-board MRI scanners to acquire a real-time movie of the patient's anatomy during radiation delivery. The goal of this research is to develop, calibrate, and test motion predictive models that employ real-time MRI images to predict the short-term trajectory of anatomical motion during radiation delivery. These motion predictive models have direct applications in motion-intervention strategies to control and correct for any dose discrepancy that may occur as a result of organ motion during the radiation delivery process.