

AbstractID: 3404 Title: Image-guided respiration-gated treatment

Purpose: Respiratory gating based on external surrogates may have large uncertainty due to the unstable correlation between external and internal signals. The purpose of this work is to use the image guidance techniques to improve the precision of external gating.

Method and Materials: The image-guided gating procedure developed in this work including the following key components: 1) Varian RPM system for monitoring patient's respiration, 2) breath coaching technique to produce a reproducible breathing pattern intra- and inter-fractionally, 3) 4D CT simulation to acquire the accurate tumor geometric information in the gating window, 4) gated on-board kV x-ray imaging to align the target position in the gating window, 5) gated treatment delivery, and 6) kV or EPID fluoroscopy for treatment verification.

Results: This procedure has been applied to liver and lung patients. Here we use a liver patient with implanted fiducial seeds as an example. The patient had a peak-to-peak motion of 2 cm under free breathing, which was reduced to less than 5 mm when gated at 30% duty cycle. The patient's breathing pattern was greatly improved with the coaching technique. The fiducial seeds detected in the gated on-board x-ray images were used for patient alignment, which indicated a 5 mm systematic error and ± 5 mm random error in all three directions. The treatment was verified using the EPID in cine mode and it was found that the intra-fraction residual seed motion was about 5 mm and the inter-fraction seed motion was within +8.3/-4.5 mm in the SI direction.

Conclusion: The utilization of image guidance techniques in simulation, patient setup, and treatment verification, along with breath coaching technique, can greatly increase the precision of the gating treatment based on external surrogates.

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