

AbstractID: 9059 Title: Dynamic internal/external correlation updates for effective gated treatment with reduced internal imaging

**Purpose:** The effectiveness of gated radiotherapy depends on the precise localization of tumor positions in real-time during the treatment. Two widely used gating approaches are *internal gating* and *external gating*. Internal gating is accurate but invasive and radiation dose to the patients is a big concern. External gating is non-invasive but less accurate. We have proposed a new gating approach to combine the advantages and minimize the disadvantages of internal and external gating.

**Method and Materials:** In our new approach, the external signal is acquired at high frequency while the internal signal is acquired at very low frequency. Algorithms are designed to decide the optimal x-ray imaging time and update the internal/external correlation in real-time, which will be used to derive the internal tumor position. A simulation system has been implemented to evaluate *hybrid gating* using the synchronized internal/external signals acquired during patient treatment.

**Results:** Two dynamic correlation updating algorithms are introduced: based on *amplitude* and a *piecewise linear model*. Two assessment metrics, *gating duty cycle* and *target coverage*, have been defined to quantitatively evaluate the simulation results. The influences of different clinical scenarios for hybrid gating, including the gating window size, x-ray imaging frequency, and the timing for internal signal acquisition, has been investigated. Our results demonstrated that dynamically updating the internal/external correlation in or around the gating window will improve the target coverage (by ~14%) with relatively diminished duty cycle (by ~10%).

**Conclusion:** The developed hybrid gating technique has higher accuracy than external gating at a cost of much lower x-ray imaging dose than internal gating. This improvement will benefit patients with mobile tumors, especially greater for early stage lung cancers, for which the tumors are less attached or freely floating in the lung with more movement.