

Title: Respiratory motion management from MD consultation to Radiotherapy

Authors: Zhen Ji, Nels Knutson, Matthew Schmidt and Taeho Kim

Zhen Ji <jizhen@wustl.edu> Washington University School of Medicine

Knutson, Nels <nknutson@wustl.edu> Washington University School of Medicine

Schmidt, Matthew <matthew.schmidt@wustl.edu> Washington University School of Medicine

Taeho Kim <taehokim@wustl.edu> Washington University School of Medicine

Purpose: Respiratory motion management is a key component in thoracic and abdominal radiotherapy. In this project, we developed a respiratory motion management program from MD consultation to treatment including respiratory trace acquisition, respiratory motion evaluation and visual-guided radiotherapy.

Methods: MRI/CT-compatible respiratory sensor and corresponding software were developed in our departmental respiratory motion management program. Respiratory trace can be acquired at MD consultation by clinical staff, analyzed and reported by Physics team, and visually utilized during CT/MRI simulation and treatment (visual guidance).

Results: Hardware includes an air pressure sensor (Venier Barometer), placed on patient abdomen using a Velcro belt. The Barometer measures the pressure changes from patient abdominal displacement against the velcro belt. An USB device (Venier Go!Link) interfaces with the air pressure sensor for data-collection via developed software. Software has two components. 1) Real-time data collection and display, which can be switched between wave mode and bar mode. Wave mode shows the breath signal as a continuous wave, while the bar mode displays a horizontal bar moving up down corresponding to the patient's breath cycle. The real-time data collection part also includes a breath-holding timer function to guide the patient during breath-holding period. 2) Breathing pattern analyzer. Analysis for breath includes selections of breath time range and automatic breath period detection. Parameters such as Global Amplitude Variation (GAV), Period Variation (PV) are calculated. Local Amplitude Variation (LAV) is calculated using an adjustable window, suggesting a range of the gating window. Breath-holding analysis also includes time range selection. An adjustable window is also laid on the breath-holding analysis plot to calculate AV.

Conclusion: We successfully developed the respiratory motion management from MD consultation to Radiotherapy. It is an efficient clinical solution for patient respiratory trace acquisition, patient training, breathing pattern analysis and corresponding respiratory motion management determination for radiotherapy.