

during radiation therapy

Purpose: To develop a real-time system to restrict gated imaging and treatment delivery to regular portions of a patient's breathing cycle thereby improving the accuracy of respiratory gated radiotherapy. **Methods and materials:** A real-time system was developed based on a first order Fourier spectral analysis of respiratory patterns from 57 lung cancer patients. An initial training length (TL) of breathing was used to establish the reference spectral parameters (full width at half maximum, peak amplitude, and peak frequency). Deviations in breathing were characterized in real-time by comparing reference spectral parameters to acquired parameters over a sliding window (signal history length SHL) and were characterized as either "regular" or irregular. The effect of different SHLs (1, 2, 3 respiratory cycles) and TLs (30, 60, 120 seconds) on the accuracy of respiratory managed radiotherapy was determined by examining the standard deviation of the extrema of motion of an external fiducial in portions of the respiratory trace during "regular" and "irregular" breathing. **Results:** Standard deviations, in cm, of values of peak inhalation for "regular" respiration were (TL30 » 0.15, 0.13, 0.14), (TL60 » 0.16, 0.13, 0.14) and (TL120 » 0.15, 0.21, 0.17) for SHL of 1, 2 and 3, respectively. Corresponding values for "irregular" portions were (TL30 » 0.16, 0.16, 0.15), (TL60 » 0.16, 0.16, 0.15) and (TL120 » 0.18, 0.18, 0.16). For exhalation the values for "regular" respiration were (TL30 » 0.05, 0.05, 0.06), (TL60 » 0.05, 0.06, 0.06) and (TL120 » 0.05, 0.05, 0.07) for SHL of 1, 2 and 3, respectively. Corresponding values for "irregular" portions were (TL30 » 0.18, 0.19, 0.18), (TL60 » 0.20, 0.19, 0.18) and (TL120 » 0.25, 0.23, 0.22). **Conclusion:** TL of 60 seconds and a SHL of 2 cycles resulted in the lowest variation in external fiducial position during "regular" respiration.