1046 An Internal 4D CT Sorting Method Based On Patient Anatomy

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Purpose/Objective(s): Respiratory organ motion during free breathing computed tomography (CT) scan may cause significant errors in target definition in thorax and upper abdomen. Recently, four-dimensional (4D) CT technique has been widely adopted for treatment simulation of thoracic and abdominal cancer radiotherapy. Current 4D CT techniques in clinical use require retrospective sorting of the reconstructed axial CT slices which are over-sampled at the same couch position. Most 4D CT sorting methods depend on external surrogates of respiratory motion recorded by extra instruments. However, respiratory signals obtained from these external surrogates may not always accurately represent the internal target motion, leading to significant target delineation errors, especially when irregular breathing patterns occur. We propose a new 4D CT sorting method based on multiple internal anatomical features for multi-slice CT scan acquired in the cine mode.

Materials/Methods: Four internal anatomical features were analyzed in this study, including air content, lung area, lung density, and body area. We used a measure called spatial coherence to select the optimal internal feature and to generate the respiratory signals at each couch position. A 4D CT data set was obtained using phase-based sorting.

Results: 10 cancer patients (8 with thoracic cancer and 2 with abdominal cancer) were analyzed in this study. For 9 patients, the respiratory signals generated from the combined internal features are well correlated to those generated from external surrogates recorded by the real-time position management (RPM) system (average correlation: 0.95 ± 0.02), which is better than any individual internal measures at 95% confidence level. For these 9 patients, the 4D CT images sorted by the combined internal features are almost identical to those sorted by the RPM signals. For one patient with irregular breathing pattern, the respiratory signals generated by the combined internal features do not correlate well with those generated from RPM (correlation: 0.68 ± 0.42). In this case, the 4D CT images sorted by our internal method present fewer artifacts than those obtained from the RPM signals.

Conclusions: The 4D CT internal sorting method eliminates the need for externally recorded surrogates of respiratory motion. It is an automatic, accurate, robust, and yet simple method and therefore can be readily implemented in clinical settings.

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