

AbstractID: 11825 Title: A real-time target positioning method using combined kV/MV imaging and external respiratory monitoring for DMLC target tracking

Purpose:

To (1) develop a target position estimation method combining occasional kV/MV imaging of fiducial marker and continuous monitoring of external respiratory signal, (2) integrate the estimation method with a real-time DMLC tracking system, and (3) quantify the tracking accuracy of the integrated system.

Method and Materials:

The experimental tracking system employed a Varian Trilogy system with kV/MV imaging systems and RPM. A 3D motion stage with a gold marker reproduced three different patient-measured lung tumor traces, while a separate 1D motion stage with an external marker reproduced the associated external surrogate signal acquired by a Cyberknife system. Occasional kV/MV imaging measured the gold marker position, while the RPM system continuously detected the external marker position. A state augmentation-based correlation model between the gold marker position and the RPM signal was established in real-time and used to estimate the marker position from the RPM signal. The estimated marker position was used to drive the MLC leaves to follow the marker. The tracking accuracy was evaluated at different imaging intervals (0.15, 10, and 180s), corresponding to the update interval of the internal/external correlation model.

Results:

For 3-min tracking of the lung traces, the tracking RMS error in each axis was ~1mm for 10s imaging intervals, and was not affected by the imaging interval significantly. Tracking reduced motion error more effectively for large motion excursion and large systematic error.

Conclusion:

For the first time, a real-time target position estimation system combining kV, MV and respiratory signal has been developed and integrated with a DMLC tracking system. The system accuracy is typically within 1mm for patient tumor motion. This sub-mm accuracy system has potential for broad application in managing respiratory motion for thoracic and abdominal tumors.

Conflict of Interest:

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