

AbstractID: 7100 Title: Fluoroscopic tracking of multiple implanted fiducial markers using multiple object tracking algorithm

Purpose: To develop a multiple fiducial marker tracking system providing precise tumor localization for beam gating and tracking.

Method and Materials: We developed a multiple marker tracking system allowing us to track implanted fiducial markers for the treatment of mobile tumors. For each patient, LAT and AP fluoroscopic videos were acquired during the treatment. For each fluoroscopic frame, we first applied a prediction module to predict the marker positions and then a detection module to detect markers in the area around the predicted positions. Then, we applied a multiple object tracking algorithm to identify the true markers among all the detected ones. Breathing pattern information was used to improve the tracking performance. Four criteria were used to identify tracking failures, and when tracking failure happened, the system could immediately inform the user and disable the treatment beam.

Results: We compared the performance of the proposed system to a conventional tracking system. To test the robustness of the tracking system, artificial markers were added around the true markers to generate false matches. The conventional system easily misses tracking markers in the presence of artificial markers; furthermore, it cannot detect subsequent tracking failures. Our proposed system could track markers well in the presence of artificial markers, and it could also successfully detect tracking failures. Our proposed system achieved a 0% failure rate almost all the time, and it yielded a low ϵ_{95} (the maximum marker tracking error at 95% confidence level) – less than 1.5 mm.

Conclusion: The proposed marker tracking system can track multiple markers simultaneously without confusion and it is robust enough to continue tracking even when the marker is moving behind bony anatomy. It can also detect tracking failures and inform the user.

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