AbstractID: 13038 Title: Geometric accuracy of real-time tumor tracking with the gimbaled linac system of the novel VERO SBRT system

Purpose: The VERO system, a novel platform for image guided stereotactic body radiotherapy, is a joint product of BrainLAB and MHI. A new type of 6MV linac with attached MLC is mounted on an O-ring gantry. Orthogonal gimbals hold the linac-MLC assembly, which allows pan and tilt motions of the therapeutic beam. This offers the possibility to perform tracking of moving tumors. A prototype is currently installed in our hospital which can actively track an IR marker with the beam using the gimbals system. The purpose is to determine the geometric accuracy of the tumor tracking.

Methods and Materials: A video camera based detection unit was developed to simultaneously acquire the position of the tracked object and of the tracking beam using the light field of the linac system, at a 30fps frame rate. An assessment was made of the tracking capabilities in terms of tracking errors, system lag and the equivalence of pan and tilt motion performance. To determine the tracking error, an IR marker was placed on a 1D moving phantom. A sinusoidal motion was produced by the phantom with different frequencies from 0.085Hz to 0.5Hz, and a fixed amplitude of 20mm. The tracking error was characterized in terms of systematic error, root mean square error (RMSE) and 90% percentile of the absolute tracking error ($E_{90\%}$).

Results: Systematic tracking errors were below 0.21mm. The system lag was 47.7ms (2.3ms) and 47.6ms (2.0ms) for the pan and tilt respectively. The system can track the IR marker sinusoidal motion accurately, with an $E_{90\%} < 0.82$mm, up to frequencies of 0.5Hz with similar performance for pan and tilt. Additionally, the tracking is demonstrated for representative patient signals.

Conclusion: The accuracy is considered adequate for real-time tracking of tumors. The performance for pan-tilt is equivalent.

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