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## Comparing dry-run and delivery modes for dynamic trajectory radiotherapy

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### Purpose

Dynamic trajectory radiotherapy (DTRT) extends VMAT with dynamic table and collimator rotations during beam-on. Dry-runs are needed for safety purposes, as for example to check treatment plans for potential collisions. This study investigates if DTRT dry-runs accurately simulate the machine motion of DTRT via log-file analysis.

### Methods

Eight DTRT treatment plans for clinically motivated head-and-neck cases were created for a TrueBeam system. Trajectory data were recorded every 20 ms during dry-runs and deliveries (with beam-on) and log files were retrieved after each run. Collimator rotation speed was used as a surrogate for application speed as it is rarely restricted by its maximum rotation speed but modulated down to wait for slower dynamic axes. Deviations between expected and actual values for gantry, table and collimator angles were determined.

### Results

Three measurement sessions were available for analysis with 56 dry runs and 23 deliveries of 20 different trajectories. Dry-runs were faster, as indicated by a larger median absolute collimator rotation speed of 2.27°/s compared to 1.51°/s for deliveries.

Overall, deviations of the analyzed axes were within clinical and interlock tolerance. Maximum gantry-angle deviations were larger in dry-runs (root-mean-square (RMS) 0.06°, max. 0.59°) than in deliveries (RMS 0.06°, max 0.33°). The same was found for table-angle deviations in dry-runs (RMS 0.11°, max. 0.26°) vs. deliveries (RMS 0.10°, max. 0.22°) and collimator-angle deviations in dry-runs (RMS 0.04°, max 0.43°) vs. deliveries (RMS 0.03°, max. 0.17°).

A high correlation was found between speed and deviations of the table-angle (Spearman correlation coefficient 0.85 for dry-runs and -0.96 for deliveries,  $p < 0.05$ ) as well as for collimator-angle (-1.00 for both,  $p < 0.05$ ). Correlation was weaker for gantry-angle (-0.71 for dry-runs and -0.75 for deliveries, both  $p < 0.05$ ).

### Conclusion

The analyzed machine uncertainties are highly correlated to speed. Due to higher speed, deviations are larger in dry-runs than in deliveries, but overall small and still within interlock tolerance, indicating that dry-runs can be used for mechanical simulations of DTRT deliveries.

### Disclosures

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**Primary authors:** MACKEPRANG, Paul-Henry; BERTHOLET, Jenny (Division of Medical Radiation Physics and Department of Radiation Oncology, Inselspital, Bern University Hospital, and University of Bern, Bern, Switzerland); LOEBNER, Hannes Anton (Division of Medical Radiation Physics and Department of Radiation Oncology, Inselspital, Bern University Hospital, and University of Bern, Bern, Switzerland); Dr WESSELS, Claas (Varian Medical Systems Imaging Laboratory GmbH, Baden, Switzerland); MÜLLER, Silvan; GUYER, Gian (Division of Medical Radiation Physics and Department of Radiation Oncology, Inselspital, Bern University Hospital, and University of Bern, Bern, Switzerland); VOLKEN, Werner (Division of Medical Radiation Physics and Department of Radiation

Oncology, Inselspital, Bern University Hospital, and University of Bern, Bern, Switzerland); FIX, Michael Karl (Division of Medical Radiation Physics and Department of Radiation Oncology, Inselspital, Bern University Hospital, and University of Bern, Bern, Switzerland); MANSER, Peter (Division of Medical Radiation Physics and Department of Radiation Oncology, Inselspital, Bern University Hospital, and University of Bern, Bern, Switzerland)

**Presenter:** MACKEPFRANG, Paul-Henry

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