



MotionSim^{XY/4D}™

Target Motion, Gating & Imaging QA

The only treatment simulator that reproduces actual target motion obtained from a 4D CT

Introduction

MotionSim XY/4D works with the MapCHECK / MapCHECK 2 as the only treatment simulator that can reproduce actual target motion (projected to BEV motion for each beam) obtained from a 4D CT (or other methods). The MotionSim XY/4D table incorporates patient 4D-CT tumor trajectories allowing the prescription dose to be delivered to the “in motion” MapCHECK array.

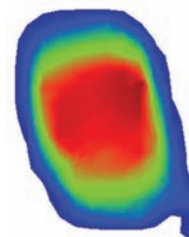
Applications

- Assess the interplay effects in MLC based IMRT QA
- Determine the effects of intra-fractional target motion on dose distribution
- Commission and test gating systems
- Commission 4D CT imaging systems
- Qualitative comparison of gated versus non-gated delivery
- Optimization of duty cycles to minimize delivery variations
- Precise reproduction of patient specific and BEV specific 4D-CT respiratory traces
- Integration with all gating surrogate methodologies (markers, pressure belts, etc.)
- Remotely position MapCHECK during the measurement process to increase detector density when desired
- Remotely position MapCHECK for MapCHECK’s precision MLC QA procedure

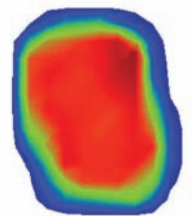
Case Study: Gating versus Non-Gating

In this example the MapCHECK array was used to quantitatively compare the effects of a gated versus non-gated delivery of an SBRT field. The non-gated delivery exhibited a larger dose map with a different dose distribution to the target than the gated delivery. Target motion was then introduced using 4D-CT derived tumor trajectories. Quantitative analysis such as this can aid in determining when gated treatment is desired.

Non-Gated



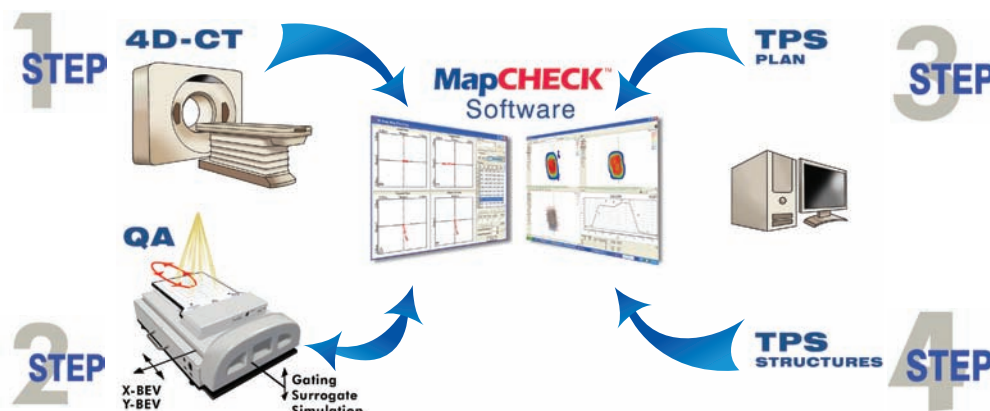
Gated



Now add Structure Analysis...

You may import the DICOM RT structure file into the MapCHECK software to selectively analyze dose delivery to the moving target. 3D structures and 3D motion trajectories are projected for each specific beam orientation. This allows you to analyze dose variation to the target caused by motion and interplay effects.

MotionSim XY/4D Workflow



Use Case 1: Commission a gating system

A non-gated delivery is delivered to an in-motion MapCHECK which is driven by a pre-selected motion kernel. A duty cycle is then defined for the gated beam and the same dose is delivered to the in-motion MapCHECK. The non-gated delivery should yield a blurry motion with a poor comparison to the TPS, whereas the gated results should be significantly more desirable if the system is functioning correctly.

Use Case 2: Dose QA for moving targets (with gating)

Prescription dose to the target (PTV) can be compromised due to the effect of internal target motion. The PTV travels along a motion path which defines the internal target volume (ITV.) MotionSim XY/4D simulates the ITV, so that true dose to the PTV can be assessed. PTV dose may appear to pass with stationary QA, however adding MotionSim XY/4D provides true ITV motion, and the confidence to be sure.

Use Case 3: Access interplay effects in MLC-based IMRT

Determining the “interplay effect” in MLC-based IMRT is significant for a given patient plan and target motion. Not taking the interplay effect into consideration during treatment can lead to significant non-uniform fraction-to-fraction dose delivery to the target, further putting the integrity of delivery at risk. The MotionSim XY/4D can be used to assess the interplay effect by comparing gated and non-gated fraction-to-fraction results against the TPS to determine delivery variances.

Specifications

Table	Dimensions	22.7 x 19.12 x 9.0 in (57.7 x 48.5 x 22.9 cm)	Gating Surrogate	Type	Independent linear positioner
	Weight	33.4 lb (15 kg)		Maximum travel	2 inches (5.08 cm)
	Power	100-240 V, single-phase, 47-63 Hz, 4A		Motor	2 phase bipolar stepper
	Communication	RS-232, 19,200 kbps		Maximum Velocity	0.5 inches/second (1.27 cm/second)
X-Y Axes	Maximum travel	X-Axis: 4 inches (10.2 cm); Y-Axis: 4 inches (10.2 cm)		Resolution	0.02 μ m
	Motors	2 phase bipolar steppers		Repeatability, bidirectional	5.0 μ m
	Maximum velocity	2 inches/second (5.08 cm/second)		Trigger device platform	<ul style="list-style-type: none"> • Supports Varian RPM marker block • Fits Siemens and Elekta belts
	Resolution	0.13 μ m			
	Repeatability, bidirectional	0.13 μ m			

All data used is best available at time of publication. Data is subject to change without notice.