

# Delta<sup>4</sup>

by ScandiDos

## Delta4 HexaMotion 6D Motion Management QA



Pre-treatment

CONFIDENCE | SAFETY | ACCURACY | EFFICIENCY



# Your Ideal Solution for Motion Management QA

**HexaMotion** is a motion platform that recreates the movement of the tumor in six dimensions\* and independently simulates patient breathing motion. Together with Delta4 Phantom+, it ensures tumor control in moving targets and answers the vital questions:

- Am I hitting the target?
- What do I gain with tumor tracking or gating?

\*Longitudinal, lateral, height, roll, tilt, and time.



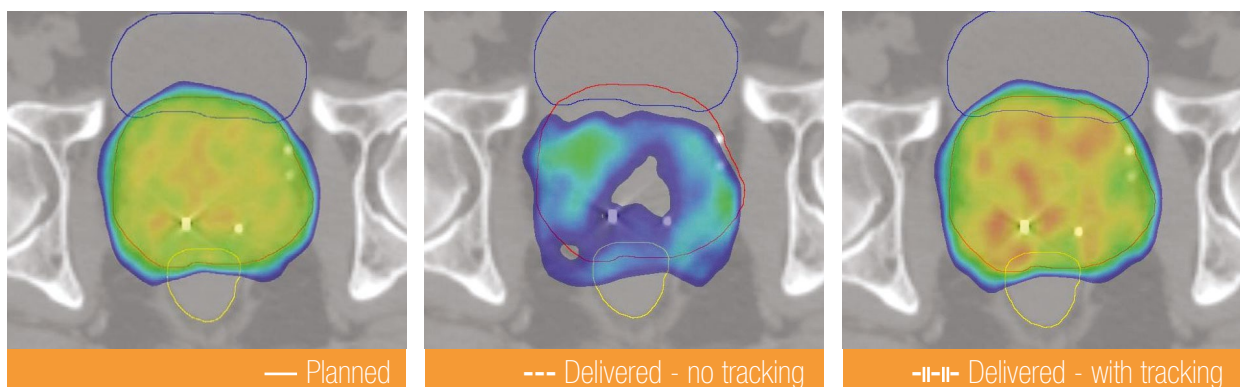
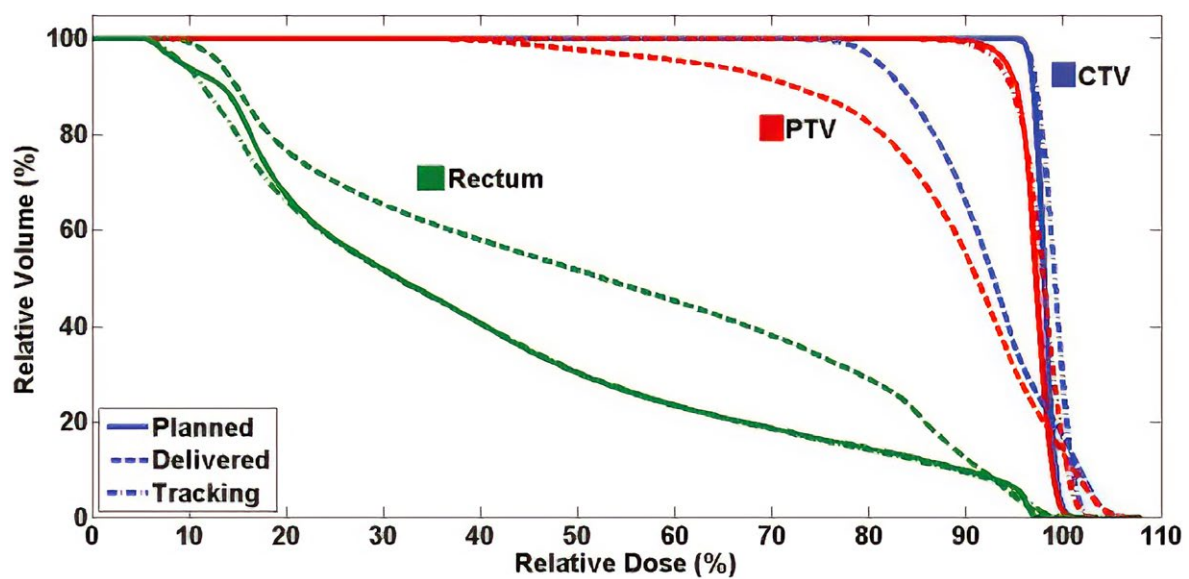
With HexaMotion, you can check and verify the effects of intra-fractional motions of the tumor and OAR.

## THE TUMOR MOVES AND SO DOES THE HEXAMOTION

Intra-fractional movements of the tumor can cause large geometrical errors. This is especially true for tumors in the lung and the liver, it has been shown that even the prostate can move considerably during the treatment. If these geometrical errors are not handled correctly they can result in critical dosimetric errors. This may result in the tumor volume receiving too little dose to achieve tumor control whilst organs at risk can receive too high dose.

Techniques such as gating and tumor tracking are good at addressing these issues. However, to ensure the best possible treatment outcome, they require a special QA system that can recreate target movements. With HexaMotion, you can check and verify the effects of intra-fractional motions of the tumor and OAR.

## TREAT WHAT YOU INTEND TO TREAT



Graph, images, and data courtesy of the University of Sydney and the Royal North Shore Hospital, Sydney, Australia.



# Use Real Tumor Motion

The **HexaMotion 6D motion platform** accurately replicates the actual tumor motion. The QA is based on how the real tumor is moving. The motion patterns both for the tumor and the patient can be imported from your motion management system and the same movement cycle is then exactly reproduced with the Delta4 Phantom+. The phantom is positioned quickly and within sub-millimeter accuracy.

The new Independent Motion Platform option for the HexaMotion is developed in close collaboration with linac manufacturers, and its purpose is to mimic the breathing of the patient independent of the motion of the tumor.

## FIND OUT WHEN MOTION MANAGEMENT IS REQUIRED

The HexaMotion 6D motion platform is used together with the Delta4 Phantom+ to provide a full analysis of the dosimetric effect of tumor respiratory motion. The true delivery of the prescription dose can be studied in detail for each patient and critical structure, allowing the clinician to easily identify which patients or which groups of patients require motion management.

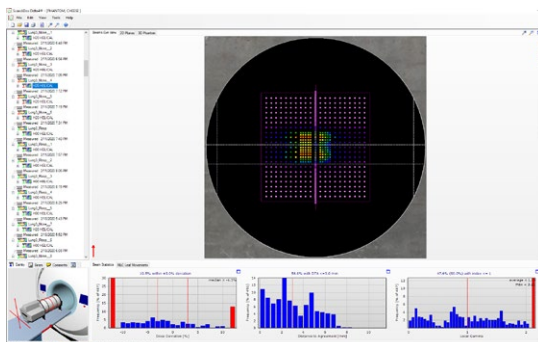
## VALIDATE THE COMPLETE DELIVERY CHAIN

The complete motion management QA process shall examine the entire delivery system, including accelerator, MLC control, the motion detection and the gating or tracking system. The Hexamotion system allows the user to scrutinize:

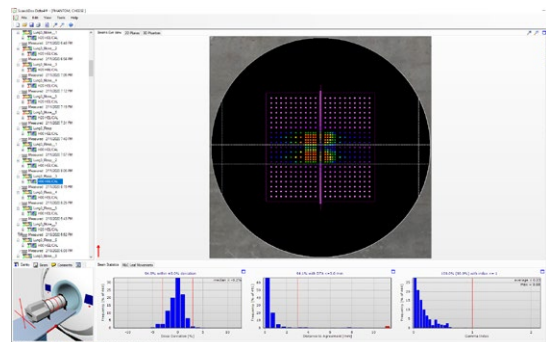
- Monitor system start and stop
- Latencies in the delivery system
- Beam hold for anomalous conditions
- Beam hold if target exceeds threshold
- Correctness of the coordinate systems
- Baseline shifts
- End-to-end dosimetric effect



## MOTION RESULTS



Absolute dose and gamma index without motion compensation.



Absolute dose and gamma index with motion compensation.

# Streamlined Workflow

## HexaMotion together with the Delta4 Phantom+

The system is placed on the treatment table, where it measures the same geometric points throughout the entire delivery. It only takes one measurement and the complete delivery sequence is acquired—becoming immediately available for analysis. The measured dose is then compared to the calculated data from the treatment planning system (TPS). With customizable acceptance criteria and an instant display of results, it's easy to see whether the verification of the delivery has passed or failed.

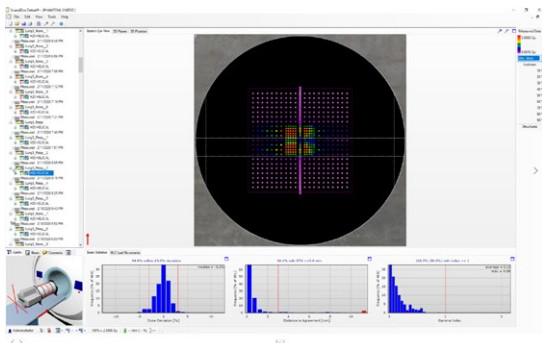
Next, the motion pattern from the patient is imported into the HexaMotion software. The motion pattern can come from 4D-CT, ExacTrac or similar. The HexaMotion then mimics the movement of the actual target.

Delta4 Phantom+ measures the 3D dose distribution during the delivery of the plan, and shows exactly where the dose ends up.



### Quick and easy setup

- Trolley eliminates all lifting
- System slides from trolley to treatment table
- Remote-controlled alignment of the system
- Delivery verified with one measurement



### Easy analysis and intuitive software

- Fully automated
- Instant results in one place
- Powerful analytic tools
- Clear and modifiable reporting



The Delta4 Phantom+ with Hexamotion helps me feel assured that my machine can deliver the dose that is promised to the patient, that it is done safely, and I get fantastic results from it.

Aaron A. Kempenich  
MSc, DABR, Medical Physicist and radiation safety officer,  
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A photograph of a woman with long, wavy brown hair carrying a young child on her shoulders. The woman is wearing a grey t-shirt and has her eyes closed, looking up towards the bright sun. The child is wearing an orange t-shirt and a red wristband. The background is a blurred outdoor setting with a paved area and some greenery. The overall mood is warm and positive, with a strong golden-hour light effect.

**We drive the  
development  
of solutions  
for safer  
radiation therapy**



# Technical Specifications

## HEXAMOTION

<b>Positioning accuracy</b>	Better than 0.5 mm
<b>Movement range</b>	<b>X:</b> +/- 40 mm, <b>Y:</b> +/- 40 mm, <b>Z:</b> +/- 40 mm <b>Roll:</b> +/- 10° @ origin, <b>Tilt:</b> +30/-60° @ origin
<b>Refresh rate</b>	50 Hz
<b>Total weight</b>	17 kg

Trolley provides easy and ergonomical handling of the system eliminating heavy lifts



## INDEPENDENT MOTION PLATFORM (optional)

<b>Positioning accuracy</b>	Better than 0.5 mm
<b>Movement range</b>	<b>Z:</b> +/- 40 mm, vertical movement only
<b>Total weight</b>	3 kg



## DELTA4 PHANTOM+

### Cylinder Phantom

<b>Material</b>	PMMA
<b>Diameter</b>	22 cm
<b>Length</b>	40 cm
<b>Total Length</b>	71 cm
<b>Total Weight</b>	27 kg

Ion chamber insert in cylinder Inserts for common cylindrical ion chambers available

### Detectors

<b>Type</b>	p-Si
<b>Total number</b>	1069
<b>Layout</b>	Distributed on coronal and sagittal plane
<b>Max field size</b>	20 x 38 cm <sup>2</sup> (when merging two consecutive measurements, otherwise 20 x 20 cm <sup>2</sup> )

### Distance between detectors

<b>Central area</b>	(6 x 6 cm <sup>2</sup> ) 5 mm (or 2.5 mm in longitudinal direction with merging of two consecutive measurements)
<b>Outer area</b>	10 mm
<b>Size (radial x axial)</b>	1 x 0.05 mm <sup>3</sup> = 0.00004 cm <sup>3</sup>
<b>Detector stability (6MV beam)</b>	Better than 0.1% per kGy, typically 0.04%/kGy

### Wireless Communication

<b>Wireless data communication protocol</b>	Wi-Fi 802.11n
<b>Battery operation capacity</b>	>4 hours Rechargeable Li-ion battery – power supply for charging included

### Compatibility

<b>Modalities</b>	Photon beams, with and without flattening filter
<b>Treatment plan import</b>	Any treatment planning system that can export DICOM RT plan, RT Dose, and RT Structure





The HexaMotion platform allowed for accurate phantom positioning and motion for a wide range of simple and realistic patient motions. The Delta4 Phantom+ was found to be very reliable, easy to setup and allowed for easy analysis of dose delivery accuracy.

Lee Goddard

Medical Physicist, DABR, Montefiore Medical Center, Bronx, NY

# Innovative and Efficient QA

[delta4family.com](http://delta4family.com)

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