IM-RealART™ Solution

Replan on the spot.
Fighting cancer – fast and focused.

www.siemens.com/healthcare
Fighting cancer – fast and focused.

The philosophy behind.

We’re convinced that successful radiation therapy calls for the optimal resultant of speed and precision. Because speed alone at the cost of precision means to unacceptably increase the chance of affecting healthy surrounding tissue. And precision alone at the cost of speed means to lose short treatment times, high patient throughput, and a convenient patient experience out of sight.

That’s why our radiation therapy solutions aim to incorporate the optimum of both, an intelligent balance of speed and precision – to help you fight cancer fast and focused.
When anatomy changes, you should be prepared.

Replanning with IM-RealART.

If your patient’s anatomy, like tumor and organ-at-risk volumes, changes during radiation therapy, how can you adjust the original therapy plan – without imaging and without drastically delaying the treatment in course?

IM-RealART is Siemens’ unique solution designed for Adaptive Radiation Therapy (ART). Leveraging the capabilities of advanced key technologies from imaging to radiation, IM-RealART enables fast and precise on-the-spot replanning: You get up-to-the-minute information about the current tumor shape and position, related to the surrounding healthy tissue, right in the therapy room; it is possible to adapt the treatment plan prior to treatment within around seven minutes; and make sure you reliably hit a target that has changed and spare healthy tissue.

Do you want to stay focused on the tumor and arrange fast treatment without compromising patient safety and comfort? Then IM-RealART should be your solution of choice.

*Source: Any clinical contribution in this brochure is based on “An online replanning scheme for interfractional variations” Medical College of Wisconsin, Milwaukee, and University of Maryland School of Medicine Baltimore, Maryland, USA – Med.Phys. 35(8), August 2008
CTVision Day 1: Original planning CT and CTVision image show overlap of only 85%. A significant deformation of the rectum observed, which occurred during the course of treatment, changing tumor form and position. Using current treatment techniques, a larger area is irradiated in order to help ensure tumor coverage, often with the risk to give overdose to healthy tissue. IM-RealART helps ensure the right dose plan and the correct treatment for the patient.
More than the sum of its parts: IM-RealART – adapt treatment to interfractional changes in anatomy.

Accurate imaging for precise treatment – pre-treatment imaging on the spot
Don’t waste time – don’t demand additional ways from your patients. With a SOMATOM™ CT scanner on rails, the unique CTVision System provides imaging with the highest resolution and quality directly in the treatment vault, making it the gold standard imaging solution. CT scans right before scheduled fractions show interfractional changes in anatomy and lead to:
- Fast comparison between original planning CT and current CT
- Fast and secure decision making if replanning is necessary

Intelligent planning – seven minutes to adjust therapy
IM-RealART uses a sophisticated treatment and replanning software that enables adjustments to the treatment plan, according to movements and deformations of tumor and organs, within around seven minutes – without any changes in the patient position.
- Fast and accurate modification of contours
- Immediate creation of a new treatment plan by aperture morphing and dose recalculation
- Fast data transfer of new treatment plan to ARTISTE

Treatment – personalized and focused on each patient
ARTISTE, our integrated imaging and therapy workflow solution, is designed specifically for ART.
- Comprehensive portfolio of image-guided and advanced treatment delivery tools
- Choose the appropriate treatment technique for each patient
- Make critical adjustments on the spot

Tumor shaping – turning accurate plans into precise treatment
With 160 leaves over the full-field, each leaf only 5 mm wide at the isocenter, our 160 MLC Multileaf Collimator provides high conformity to the actual tumor shape and position. This helps optimize treatment delivery, reduce patient-on-table time, and minimize dose to surrounding healthy tissue.
- High leaf speed for quick adaptation to modified treatment plan – up to 4 cm/second

*Panther RealART, a product of PROWESS Inc.
IM-Real ART – fast and easy

Patient verification

- Take a new CT image
- Compare new image with reference image

Approx. 1 minute

Day 2: Original planning CT and CTVision image show overlap of only 74%.
and focused all the way.

Intelligent treatment planning software*

Real-time treatment planning – on the spot

- Fast contour generation
  - Existing contours assist to identify shape changes of anatomical structures
  - Delineate new contour using drawing tablet and pen

- Aperture morphing
  - Stretching apertures based on relative distance from edge of tumor projection
  - Leaf shift based on beam’s eye view (BEV)

- Dose distribution adaptation
  - Segment weight optimization to enhance plan quality
  - Recalculation of dose distribution and dose-volume histogram (DVH)
  - Dose review

- New leaves
  - Transfer new plan and MLC apertures to ARTISTE
  - Beam conforms to changed tumor shape

Contour generation is done quickly and easily through dropping from the original planning CT, decimating/interpolating slides with drawing tablet and pen, moving in sagittal/coronal view. Redrawing contours every day reduces delineation errors.

*Panther RealART, a product of PROWESS Inc.
IM-RealART – process and the physics behind

Using IM-RealART, five steps lead to accurate on-the-spot replanning.

CT scans with CTVision
CT scans are done to compare shape and position of the anatomical structures to the original planning CT.

Contouring
Contour generation is very fast and easy through dropping from the original planning CT, decimating and interpolating slides with drawing tablet and pen at every fraction to reduce delineation errors.

Segment aperture morphology (SAM)*
SAM algorithm calculates MLC morphing based on the Beam’s Eye Views (BEVs) of the new and old tumor shape. The SAM process divides the old aperture shape into a number of boundary points, each coordinate of these boundary points will then be linearly transformed from the old to the new tumor shape according to a specific formula. The new leaf position is obtained by averaging all new boundary points that are within the width of the leaf. The jaw positions are also adjusted.

Segment weight optimization (SWO)*
Based on dose constraints and user objectives, SWO modifies the segment weights using a unique optimization algorithm. As the total dose at a voxel for a number of segments is a function of segment weights, the optimization tool is looking for a set of segment weights which fit the given objective function (dose constraints). Because it only uses dose distributions from the original plan, optimization can be done very fast – including dose scaling and DVH updates.

Data transfer to linear accelerator
The new MLC segments are transferred via Oncology Information System (OIS) to ARTISTE.

*Description based on „An online replanning scheme for interfractional variations“, Medical College of Wisconsin, Milwaukee, and University of Maryland School of Medicine Baltimore, Maryland, USA – Med.Phys. 35(8), August 2008
IM-RealART benefits at a glance:

Replan on the spot
• adapt therapy to anatomical changes
• significantly improve dose distribution to target
• save time

Hit the tumor, save healthy tissue
• accurate tumor control
• superior sparing of healthy tissue

Treat all disease sites with high precision
• wide spectrum from head and neck to lung, breast, prostate...

Provide better patient experience
• no cumbersome transport to CT room
• no additional waiting time
• reduced overall treatment time
CT scan and Planning
In preparation for treatment, the patient is positioned on the treatment table according to three skin marks made prior to CT acquisition. Based on the original CT images (planning CT), the IMRT treatment plan is developed using a Direct Aperture Optimization (DAO) algorithm. The prescription dose for target volume is determined for the prostate, 70.2 Gy. With seven coplanar beams, three to four segments per beamlet, whereby the beamlet setup is done uniformly over the whole gantry area.

Patient verification
Using CTVision System, interfractional CT scans are taken right in the treatment room to verify location and shape of tumor. Comparing these images to the original ones used in developing the treatment plan, variations are quantified by calculating the percent volume overlap (PVO). A small PVO indicates low overlapping of images and higher deformation of organs. In this case, PVOs between 85% and 74% are calculated. Depending on the scenario, a decision needs to be made – to replan or not.

Replanning
Once the decision to replan has been made, the intelligent software** rapidly adjusts the contours and apertures into a new treatment plan by optimizing the segment weights, recalculating the dose, and creating a new dose-volume-histogram (DVH).

DVHs show different behavior for different fractions and PVOs. In this case, the prescription dose for the prostate target volume is 70.2 Gy. Depending on interfractional organ movements and deformations, respectively the PVO values, dose coverage might differ from 77% to 95%.

Clinical case – prostate cancer*

* Source: Description based on “An online replanning scheme for interfractional variations”, Medical College of Wisconsin, Milwaukee, and University of Maryland School of Medicine Baltimore, Maryland, USA – Med.Phys. 35(8), August 2008

** Panther RealART, a product of PROWESS Inc.
IM-RealART is Siemens’ integrated clinical solution that taps the full potential of Adaptive Radiation Therapy (ART). Taking daily and interfractional changes in patient anatomy into account, it helps to optimally target the tumor throughout the complete treatment cycle – while sparing healthy surrounding tissue.

IM-RealART can be combined with Siemens' IM-Confident Plan, which reduces IMRT treatment time possibly to less than 5 minutes. The overall effect when combining these two clinical solutions is remarkable. On one hand, the tumor is optimally targeted every day. On the other hand, the treatment process, including replanning, requires as little time as possible. Both aspects – increasing treatment precision and accelerating workflows – are just logical parts of our mission: fighting cancer – fast and focused.

**IM-RealART – integrated from planning to treatment**

You can achieve the highest possible precision and speed when combining CTVision with ARTISTE including the 160 MLC and the Panther RealART software. Other combinations for IM-RealART are possible but fall behind in performance.

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<td>ARTISTE with 160 MLC Multileaf Collimator</td>
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<tr>
<td>CT Vision</td>
<td>ONCOR™ Linear Accelerator with 160 MLC* or OPTIFOCUS™ Multileaf Collimator</td>
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With some restrictions, IM RealART is possible with a stand-alone CT.

* ONCOR Linear Accelerator with 160 MLC is pending 510(k) review and is not commercially available in the U.S.
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