In-Line kView Imaging

The new standard in Image-Guided Radiation Therapy.
Fighting cancer – fast and focused.

www.siemens.com/healthcare
The philosophy behind

We are 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.
Why not use one source for both pretreatment imaging and treatment?

The new standard in Image-Guided Radiation Therapy with In-Line kView.

Right before treatment, you have to ensure that your patient is **exactly positioned**. Is it possible to obtain a high-quality image of your patient without the need of additional equipment? And with your imaging system having the same perspective as your treatment system?

Siemens’ answer is as simple as it is ingenious: by **using the treatment beam, modified for imaging**. In-Line kView™ Imaging* is a unique imaging solution from Siemens that helps you confidently **verify patient positioning** right before treatment – in a fast, automated, and integrated way. It offers exactly the image quality you need for almost any requirement in treatment imaging. Using the modified treatment beam, you can obtain a **kV-like image** and low dose imaging. Intelligent tools support you in comparing it with the planning CT and to adjust the treatment table if necessary.

From an **in-line point of view** to low dose, In-Line kView offers many benefits for fast and precise image-guided radiation therapy.

* In-Line kView is work in progress, requires 510(k) premarket review, does not have a declaration of conformity, and is not yet commercially available.
Discover In-Line kView

...and experience kV-like images with high soft-tissue contrast for precise patient positioning.
In-Line kView – an in-line perspective.

Verifying patient positioning right before a radiation therapy treatment is daily routine. In-Line kView helps you improve your routine by providing a better point of view – and better image quality.

The image quality you need for IGRT

In-Line kView is our unique imaging solution for image-guided radiation therapy (IGRT) to support you in your daily routine. Using the existing treatment beam, modified and optimized for imaging, it provides kV-like images with high 2D and 3D soft-tissue contrast that allows you to quickly verify patient positioning right before treatment – and precisely adapt it to any anatomical changes if necessary.

The big plus: As the same source is used for treatment as well as for image acquisition, you don’t need any additional imaging equipment, such as for example a X-ray tube, an additional detector, or a generator.

A telling name

The name In-Line kView says it all. First of all, you obtain kV-like images. Second, it provides the same view, an in-line view, on the tumor and its surrounding area as the treatment system. As a result, you have only one isocenter for both imaging and treatment – which means you don’t have to adjust any additional isocenter. You see, In-Line kView makes patient position verification highly efficient and precise.

How it works

To ensure that treatment dose is delivered to the target and not to the healthy surrounding tissue, you can acquire pretreatment images with our sophisticated ARTISTE™ Solution using In-Line kView.

When the gantry rotates around the patient, ARTISTE acquires 2D projection images at every degree with the modified treatment beam. This set is then reconstructed into 3D. The gantry rotates in a 200° to 360° arc around the patient and you can select the starting point and adapt the region of interest to the tumor area. If needed, you can even cover the entire patient.

Select image quality and dose needed

With In-Line kView, you can even select the ideal balance between dose and image quality, for individual radiation therapy. Choose from double the contrast to only one-third of dose. For example, low dose is especially important in pediatrics – for obese patients, however, you need higher contrast and thus higher dose. Moreover, the dose used for pretreatment imaging can be incorporated into the treatment plan, allowing you to accurately monitor the dose delivered to your patient.

Head of a child, 1.3 cGy dose CBCT
See what’s important
... and simplify your workflow with fast, integrated, and automated processes.
In-Line kView – based on a well-established, elegant workflow.

In-Line kView is an integrated solution that streamlines your workflow. It provides all the tools you need on one console, saving you workflow steps.

One console, one workflow

With In-Line kView, your image-guided radiation therapy routine will become faster and more efficient. From patient setup and imaging to verification and treatment delivery, everything happens on one console – your syngo® RT Therapist workspace. This means that you have less monitors and less control equipment. Instead, you benefit from a reduced, consistent, and highly ergonomic operating concept. So you don’t have to concentrate on your equipment, but you can focus on what really matters – your patient.

Adaptive Targeting – the key for precise treatment

In addition, everything happens automatically at your workplace – thanks to the integrated syngo Adaptive Targeting™ software. Combining powerful image fusion and 3D visualization tools, it supports you in correcting patient positioning right at the time of treatment. Imaging and reconstruction take place during the same workflow step. The software quickly and reliably compares the pretreatment image with the planning CT image. It then evaluates the correct patient position. In case the treatment table has to be moved, the software calculates the offset and proposes the new values right away. You simply have to verify the new table values and acknowledge them with a single click – for precise radiation treatment.

A patient-friendly concept

Using our ARTISTE with In-Line kView, you don’t need any additional imaging hardware. This drastically increases patient comfort, as patients do not feel crowded in or even frightened by additional devices moving around them.

Another benefit for your patients: You can select between maximum image quality and minimum dose, according to a patient’s individual needs. As the modified treatment beam is used for imaging, the dose can be incorporated into the overall treatment dose.

Prostate, 10 cGy dose CBCT compared with planning CT
Learn more about In-Line kView

...and the technical principle behind this imaging solution.
In-Line kView – the physics behind.

Our innovative In-Line kView solution for image-guided radiation therapy uses the modified treatment beam for pre- and posttreatment imaging of patients. It's a matter of course that the dose used for imaging can be incorporated into the treatment plan.

**The technical principle**

For treatment purposes, a flattening filter is used to achieve uniform dose across the field. This flattening filter absorbs low-energy photons, which are essential for high-contrast images. By removing this flattening filter for imaging purposes, In-Line kView allows to utilize exactly those low-energy components in the beam. In-Line kView uses a beam of around 4 MV.

In addition, the special carbon target used for imaging further shifts the energy spectrum toward the kV range which is more suitable for imaging. This energy range also optimally matches the response window of the OPTIVIEW™ 1000ART flat panel.

The result: With In-Line kView, you need less dose for imaging and you receive images providing enhanced soft-tissue contrast.
The imaging beam compared to the treatment beam

Generally, a beam contains photons with a wide range of different energies from kV to MV. The kV spectrum is optimal for imaging, while the MV spectrum of the beam is mainly used for treatment. The proportion of kV photons depends on the target — and increases if the target material has a low Z number. For treatment purposes, a flattening filter is often used. Using an unflattened beam in combination with a low Z target, the soft-tissue contrast can be improved due to the enhancement of low-energy photons. In combination with a highly sensitive detector, convincing image quality can be achieved for soft-tissue depiction.

In-line imaging means less effort

One source, one beam, one detector — this also translates into simplified maintenance and quality assurance, as only one calibration is required.

Planar fluence energy distribution
Example: 6 MV, all photons, regardless of interaction region(s)

This graph illustrates the energy spectrum for several target materials with and without flattening filter at SSD = 100 cm.
Benefit from convincing image quality

... for precise patient position verification in daily routine without the need for additional imaging hardware.
Benefits at a glance:

**Hit the tumor, save healthy tissue**
- Pretreatment imaging to verify patient positioning for daily routine
- Convincing image quality depicting soft tissue at low dose
- Less effort needed to achieve kV-like image quality

**Deliver fast and focused treatment**
- Integrated and automated workflow with fast 2D and 3D imaging
- Every tool needed is on the syngo RT Therapist workspace
- Better patient experience thanks to open, patient-friendly design

**View soft tissue at low dose**
- Choose from double the contrast to only one-third of dose
- Simplified quality assurance due to one isocenter
- Dose used for imaging can be incorporated into treatment plan

**Create economic value**
- No investment into additional imaging equipment (e.g. generator, X-ray tube)
- Cost-efficient, reliable, low-maintenance imaging solution
- Innovative design increases attractiveness of your institution
The development of In-Line kView at UCSF is another important step for MV Cone-Beam CT (MVCBCT), showing that image quality has been improved significantly\(^1\). Effectively, images acquired with In-Line kView require 3 to 5 times less dose than conventional MVCBCT and show enhanced soft-tissue contrast\(^2\), allowing patient alignment with dose as low as 1 cGy.

Jean Pouliot, Ph.D., Professor, Vice-Chair and Interim Chief, Division of Physics, Department of Radiation Oncology, University of California, San Francisco, California, USA


\(^2\) ASTRO poster session: Improved Beam Stability And Increased Dose Rate For Low Dose, High Contrast Megavoltage Cone Beam CT, M. Lu, D. Sawley, O. Morin, M. Aubin, B. Faddegon
Obtain the right perspective – with our In-Line concept.

In-Line kView is part of our overall In-Line concept.

A direct, clear view

Our In-Line concept is all about having an in-line view on the tumor and its surrounding area when imaging patients right before, during, and after treatment to verify their positioning. It is also about having a direct and clear view on the field form in relation to the target volume and the organs at risk.

Having only one isocenter

In-Line™ Technology uses the treatment beam for pretreatment imaging. As a result, you have only one isocenter. The major benefit: Highly precise imaging and treatment. Because when using conventional imaging equipment for patient position verification, in most cases, you have two isocenters – and you might run the risk that they are not correctly aligned. In addition, our In-Line concept speeds up quality management, as only one quality assurance is necessary.

A design that improves patient experience

Our In-Line concept is a very patient-friendly solution, increasing both patient safety and comfort. As no additional imaging equipment is necessary, patients do not feel crowded in. Quite the contrary, they can experience the open design of our linear accelerators. A fact especially patients suffering from claustrophobia will appreciate. In addition, patients move less when they feel comfortable lying on the treatment table – which further increases treatment precision. You benefit from free patient access and an unobstructed view on your patients. What’s more, the innovative, open, and patient-friendly design is a clear differentiator and will increase the attractiveness of your institution.

Lung, 10 cGy dose CBCT compared with planning CT
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