

Vision RT: CORE TECHNOLOGY

An overview of the key principles of the underlying imaging technology used by *AlignRT[®]*, *GateCT[®]* and *GateRT[®]*.



3D Surface Reconstruction

Vision RT's imaging technology employs stereo vision techniques in the same way as the human visual system perceives depth in 3D. By viewing an object through two eyes (cameras) from different perspectives, the brain is able to derive depth information of a scene from the disparity between the two retinal images.

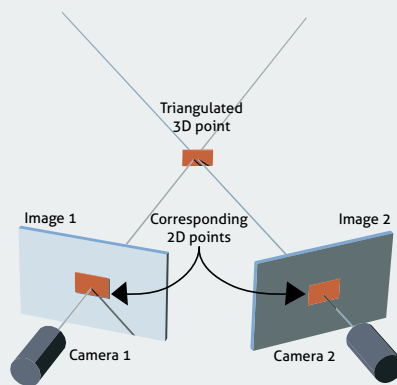
Computer vision algorithms are able to adopt this approach in order to derive 3D surface information of an object. To accomplish this, the positions, orientations, and optical properties of two different cameras viewing the same object, must be computed. This is achieved through a process known as camera calibration.

This involves imaging an object on which a precise pattern has been produced, the dimensions of which are known.

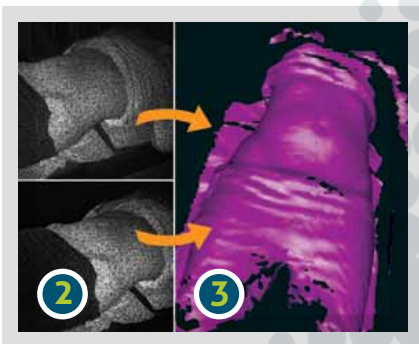
The calibration process then derives the orientation, position, and optical properties

for each respective camera, with respect to a known reference point.

Once the two cameras are calibrated, sets of corresponding 2D points may be determined between the images acquired from both cameras. Through a process known as triangulation, the actual 3D position of each set of corresponding points may be computed.



In order to compute the 3D surface model of a patient, all possible corresponding points as seen from each data camera (*figure 1*) must first be identified.



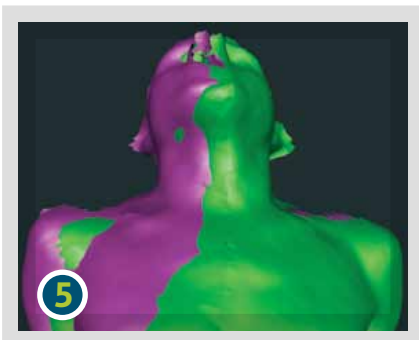
This is achieved by projecting a pseudo-random optical pattern via a speckle projector onto the patient in order to provide uniqueness to all points on the imaged surface (figure 2).

By utilising an advanced matching algorithm, all visible corresponding points may be determined between the two data camera images and a 3D surface model may be computed (figure 3).



AlignRT® employs two or three camera units (figure 4), each housing two stereoscopic cameras. 3D surface data can be acquired from each of these pairs of cameras and may be combined to produce a complete model which extends all the way around the patient.

Vision RT's proprietary* technology employs specially designed and configured cameras and high speed 3D reconstruction algorithms which together provide the combination of speed, precision, versatility and robustness, unique to the Vision RT product range.



3D Surface Alignment

High speed surface matching techniques* have been developed for the purpose of aligning two surfaces together. These compute the full six degree of freedom transformation and generate the associated rotations and translations which define the movements required to align the two surfaces (figure 5). Optimised algorithms enable surface registration to be performed at several frames per second. These facilitate real time tracking of patient motion in all six degrees of freedom.

Miscellaneous

The following are some of the other technologies utilised by AlignRT®, GateCT® and GateRT®:

- Isocalibration: Proprietary* technique for calibrating the cameras precisely to the treatment iso-centre.
- Gated capture technology: Utilisation of markerless point tracking technology* for gating 3D data capture to a reproducible point in the respiratory cycle.
- Phase detection: Proprietary methods for detecting phase in real time to enable phase based gating.
- Abnormal breathing detection.
- Independent tracking of respiratory motion and general patient movement.

* AlignRT®, GateCT® and GateRT® are protected by granted British and US patents (GB2390792, GB2407466, and US7348974). Further patent applications relating to Vision RT's other technology are pending worldwide.