

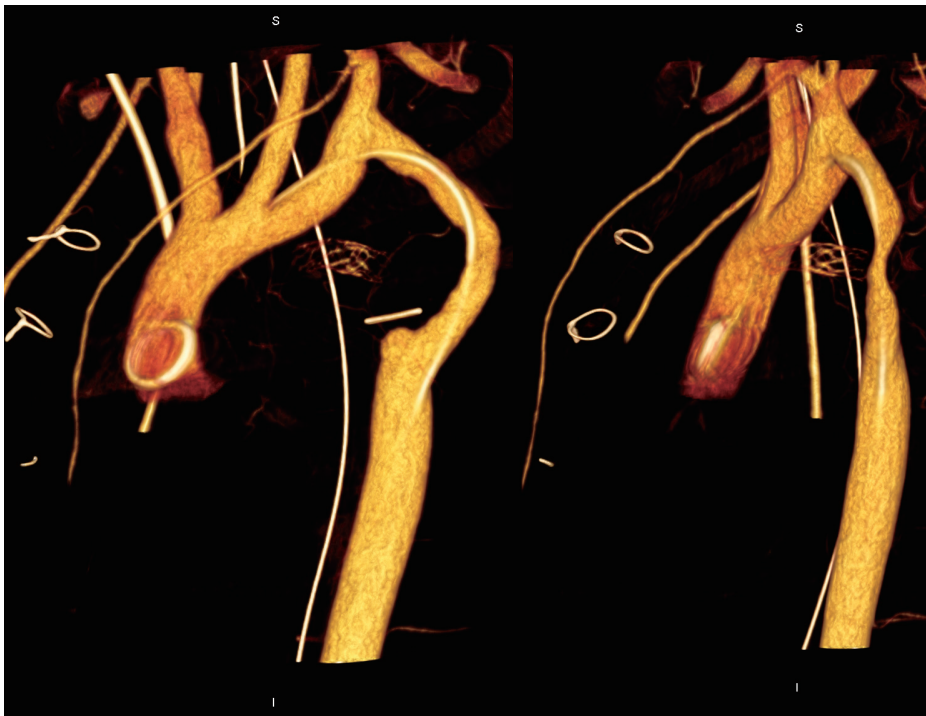
# Interventional Cardiology ImagingRite

ImagingRite, a comprehensive suite of imaging tools offered with Alphenix angiographic systems, was designed to assist clinicians in optimizing their workflow and image quality (IQ) during interventional procedures. Interventional cardiology procedures can be challenging due to the complexity of the cardiac anatomy, function, pathology, the fine size of the vasculature, cardiac motion, and the required treatment accuracy. With our ImagingRite technology, Canon Medical Systems offers optimum image quality at reduced dose. Our advanced software enables clinicians to plan, visualize, guide, treat and verify. Canon Medical Systems' ImagingRite advanced applications give clinicians the tools they want to obtain the images they need during challenging interventional procedures including angioplasty, atherectomy, valvuloplasty, and transcatheter valve placement.

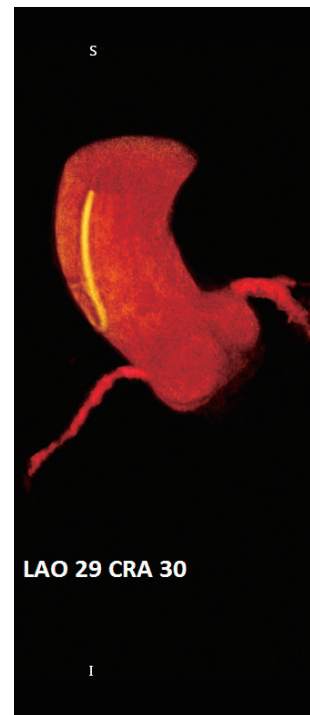
## Advanced Imaging Applications

A suite of tools, allows clinicians to plan, see and guide through the process of preparing for and conducting the patient intervention. Combined with Vital's Vitrea™ software, clinicians have the tools to help guide them through the intervention, including:

- 3D Digital Angiography (3D DA) and 3D Digital Subtraction Angiography (3D DSA)
- 3D Roadmap (3DRM) and Multi-Modality Fusion (MMF)
- Alpha CT imaging – Cone Beam CT
- Needle Guidance
- Heart and coronary Analysis Software
- Left Atrium Auto Segmentation Software



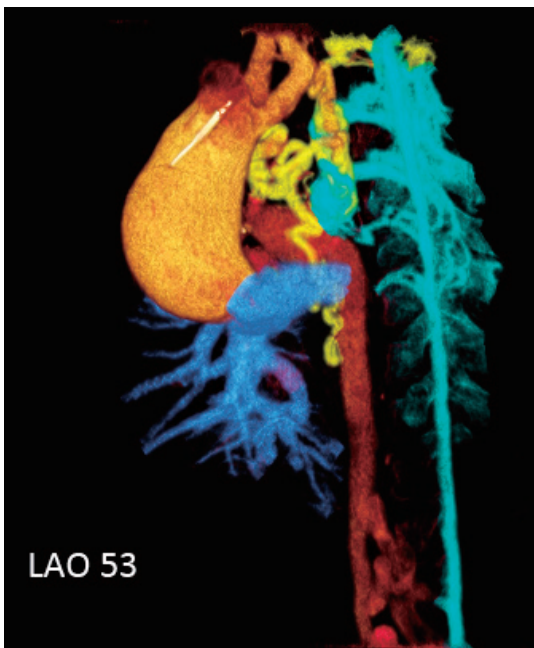
3D DA of the aorta provides unique views of pathology



3D DA of aortic root for TAVR

### Alpha CT Vessel

C-arm rotation with high acquisition rates can be used to generate 3D reconstructed volumes of vascular anatomy. The 3D vessel can be rotated in any direction to provide clinicians with additional views of vascular anatomy to aid them in their diagnosis and treatment during interventional procedures. Multiple views obtained by a 3D rotational image enable clinicians to visualize vascular anatomy such as areas of stenosis, the take-off of an abnormal vessel, the feeder vessel to a vascular malformation, as well as various other pathologies. Clinicians can use these additional views to aid them during device manipulation.



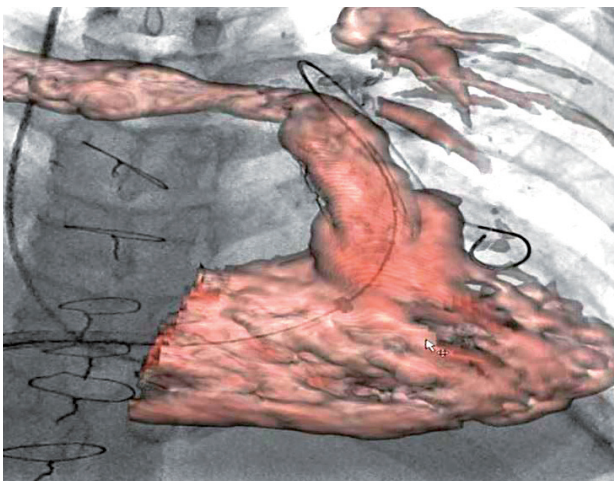
3D DA provides the ability to display complex anatomy

### 3D DSA

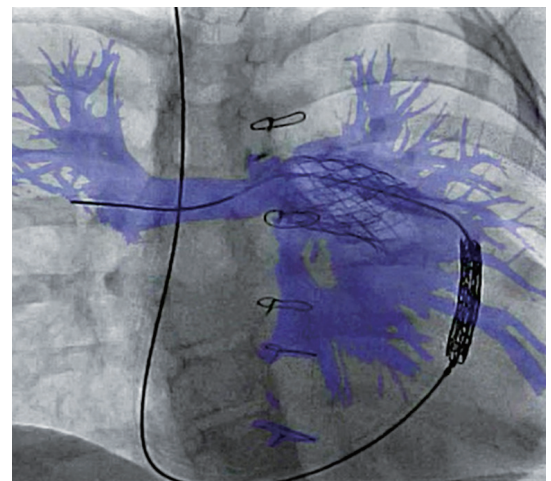
The C-arm rotates around the patient twice for 3D DSA acquisition protocols. The first spin is acquired without contrast, and the second one with the injection of contrast. The data acquired from the two spins are automatically subtracted, removing bones throughout the entire rotation. As a result, the 3D DSA reconstructed volumes depict only the contrast filled vascular anatomy. The rotational data can be reconstructed with various processing techniques to depict bones, tissue, devices, as well as vascular anatomy. In conjunction with the Vitrea workstation, multiple injections of vessels can be fused together to help clinicians outline various vascular anomalies.



Double injection of aorta and pulmonary artery



3DRM using pulmonary artery 3D DA spin



3D RM of Pulmonary artery used for stent placement

## Volume Navigation

Real-time volume navigation 3DRM with the Alphenix system links every movement of the C-arm and table position with the fused 3D volume and fluoroscopic display. Regardless of changes in table position, Source-Image-Distance (SID), Field-of-View (FOV) or C-arm angulation, the 3D overlay remains consistently aligned with the fluoroscopic image provided.

## MMF

Using Vital software analysis tools, a 3D enhanced image previously acquired by CT, MRI or an angiographic system can be superimposed and displayed with live fluoroscopy.

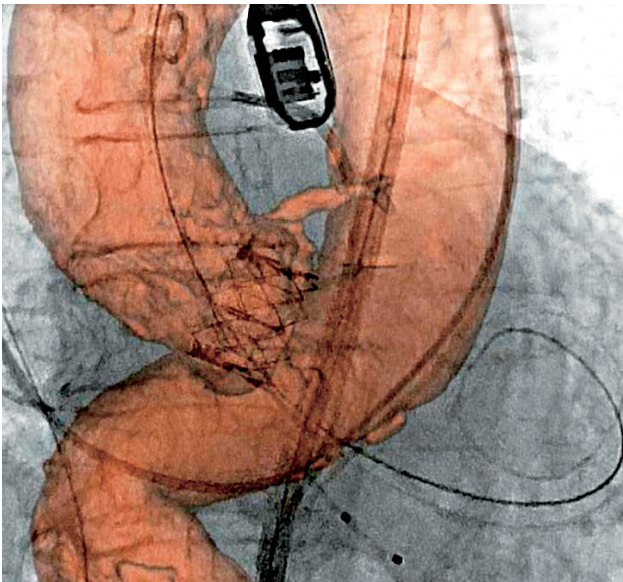
## Alphenix Left Atrial (LA) Auto Segmentation Feature

CT or MR cardiac volume data imported into the angio-work-

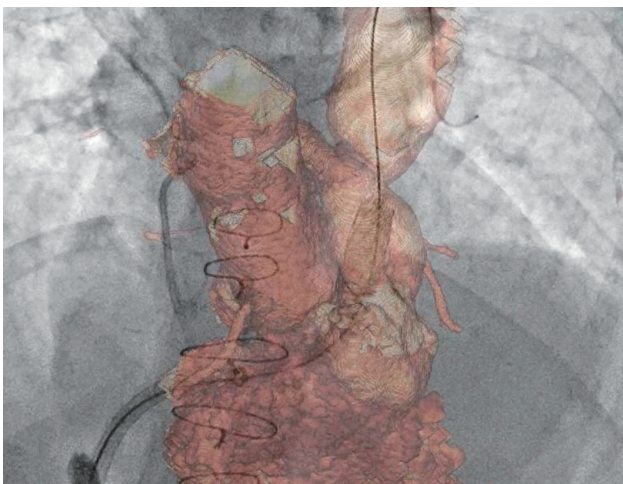
station can be automatically segmented to view the left atrium of the heart. The segmented LA image is then overlaid on live fluoro image and manually registered to the fluoro anatomy. The fused image provides clinicians with an overlay of a 3D view of the vascular anatomy and the 2D angio image displaying the catheter. When the C-arm rotates, the transparent volume image rotates as well.

## Alpha CT

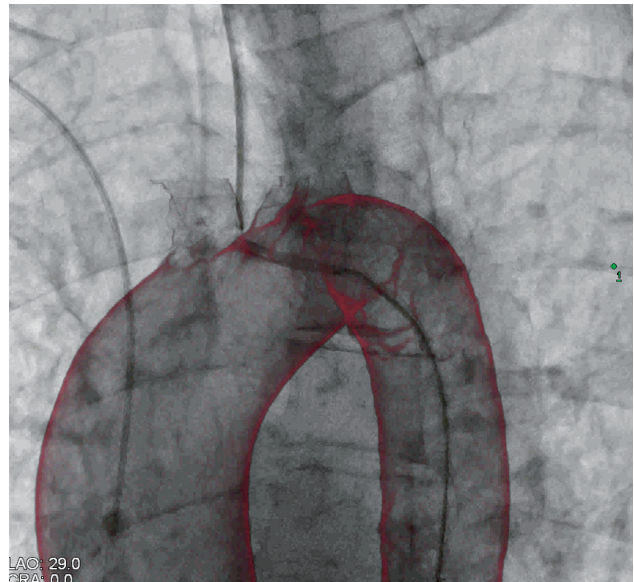
Cone-beam CT scans are derived from C-arm rotational acquisitions. The 3D reconstructed volumes can be transferred to viewing workstations. Volume Rendering (VR), Maximum Intensity Projection (MIP), Multi-Planar Reformations (MPR), axial, sagittal, and coronal views, may be used to visualize the target anatomy/pathology during interventional procedures, such as left atrial appendage, lung for pneumo- or hemo- thorax, and pericardial effusion.



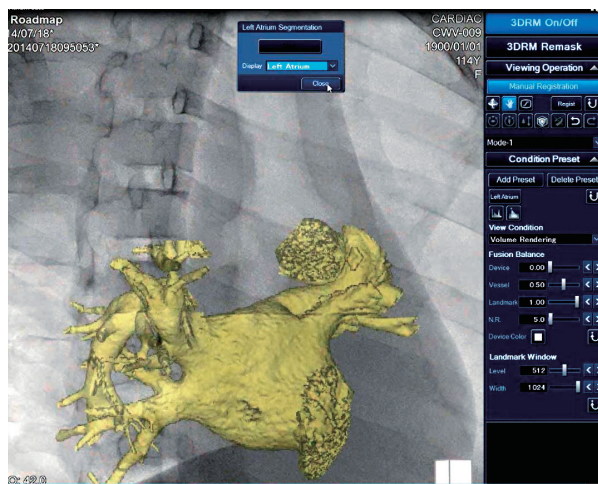
MMF: Aortic valve repair



Multi-Modality CT Fusion



MMF: CT fusion of aortic arch



Screen shot of LA auto segmentation on AWS

Alphenix includes several processing capabilities that can be used with Alpha CT:

- **Metal Artifact Reduction (MAR)\***

MAR reduces metal artifacts present in images.

- **Stent Imaging Filter**

Another filter that is suitable for visualizing intracranial stents.

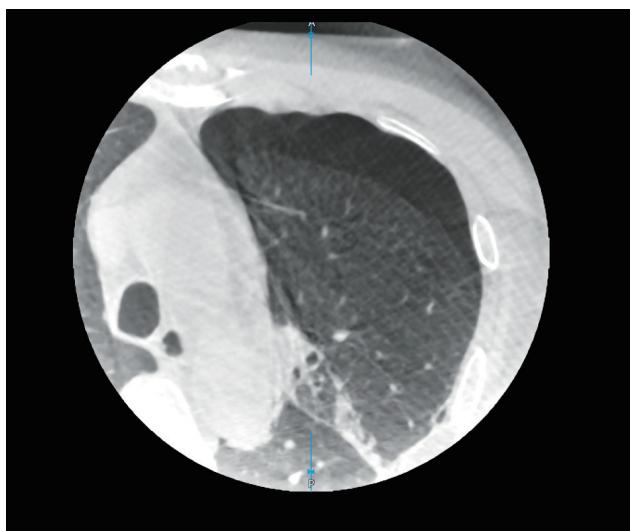
- **Device Fusion**

Device Fusion allows superimposition of a differently post-processed device on a blood vessel to help clinicians confirm accurate placement

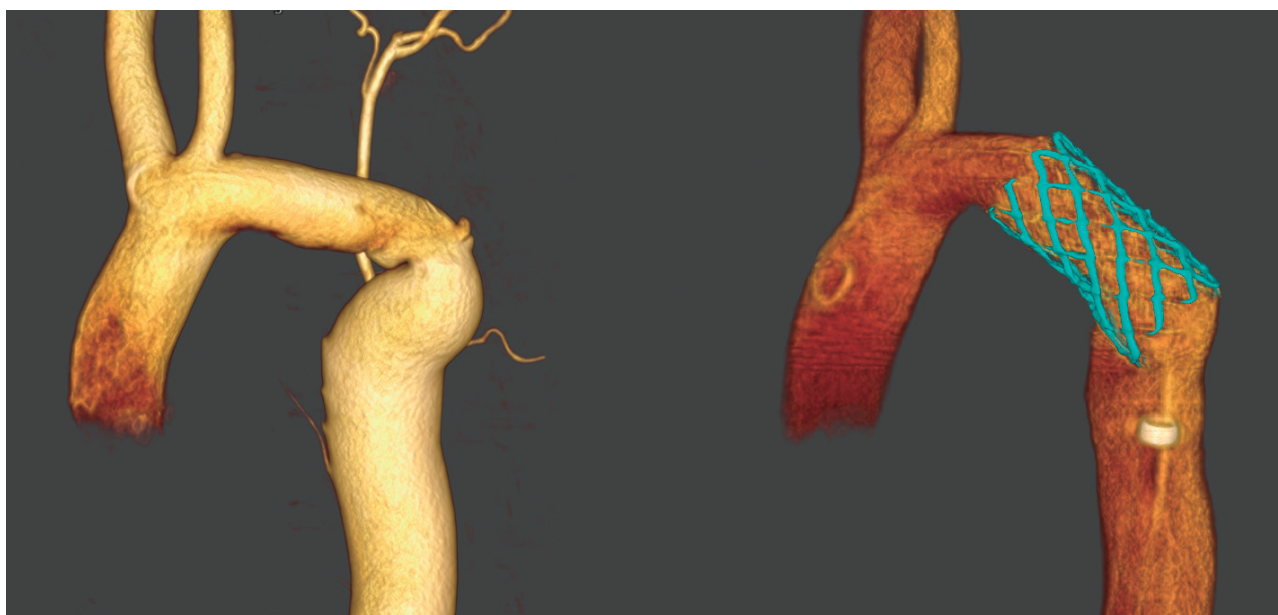
### Vitreia Advanced Visualization Software

Vitreia software enables the visualization and analysis of 2D, 3D and 4D images of anatomy and physiological functions using CT (computed tomography) and MR (magnetic resonance), PET, Ultrasound and XA Acquired data, giving medical specialists time-saving, Web-accessible tools for greater productivity. Software Applications included are: CT Liver Analysis, CT Endovascular Stent Planning (EVSP), CT Renal, CT Runoff, CT Vascular Aorta, CT Carotid, and CT Circle of Willis.

Vital post-processing tools include CT Cardiac Analysis, CT Mitral Valve Analysis, CT Vascular Aorta, LAA Analysis, CT TAVR Planning, and CT electrophysiology planning.



MPR views from a Alpha CT of lungs shows pneumothorax post biopsy



Device Fusion technique pre and post stent placement

\*:MAR software is not intended for standalone use or diagnosis.

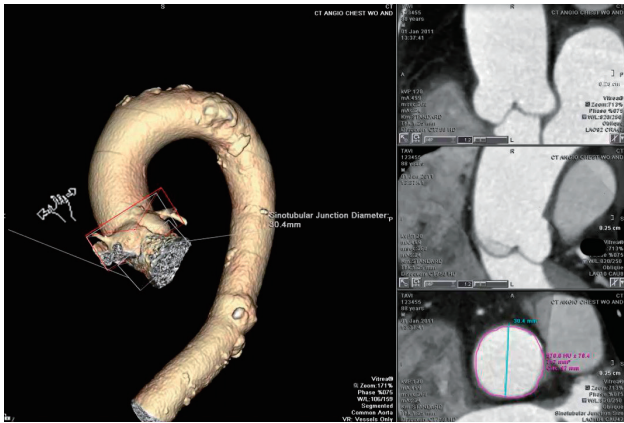
**PIE Medical Software\***

• **3mensio Structural Heart**

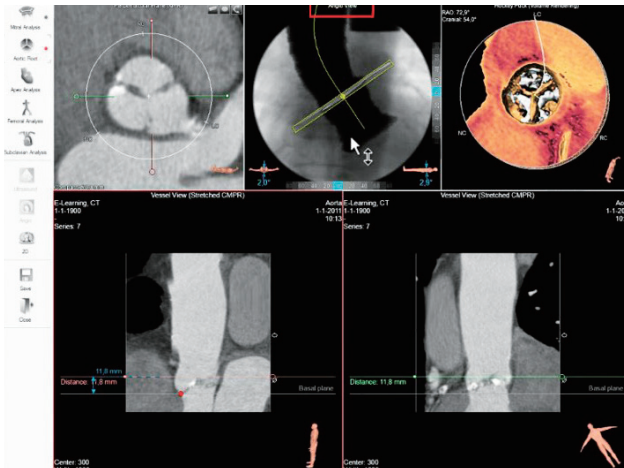
3mensio Structural Heart facilitates pre-operative planning of aortic valve procedures, mitral valve, coronary, procedures and left arterial appendage closures.

• **CAAS A-Valve™**

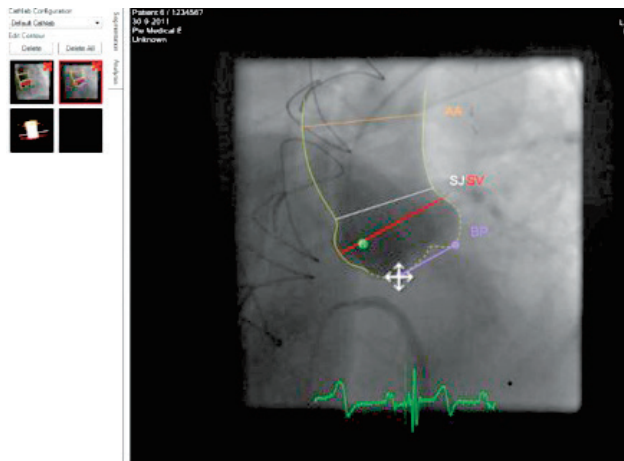
CAAS A-Valve can assist physicians during or in preparation of valve replacements as TAVR (or TAVI) procedures.



CTA TAVR planning software



3mensio aortic valve software

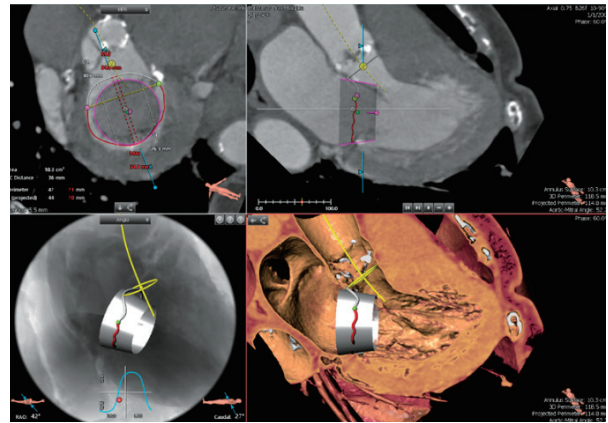


Example of CAAS S-Valve software

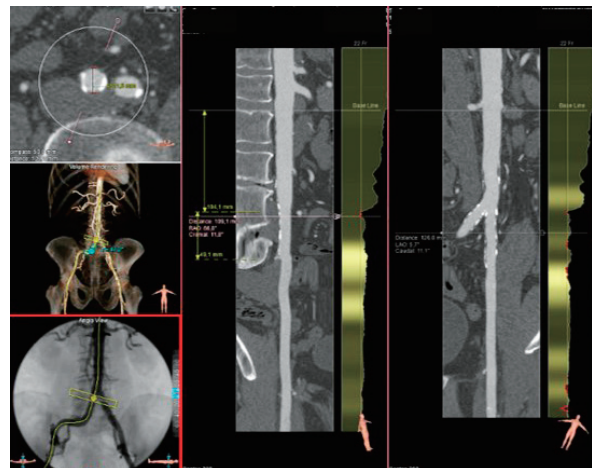
**PIE Medical Stent Enhancer**

A stent enhancement software package for use in clinical practice and research. This software supports depiction of the stent by suppressing anatomical structures and background noise in a single XA image acquired while the delivery balloon is still in place after deployment of the stent.

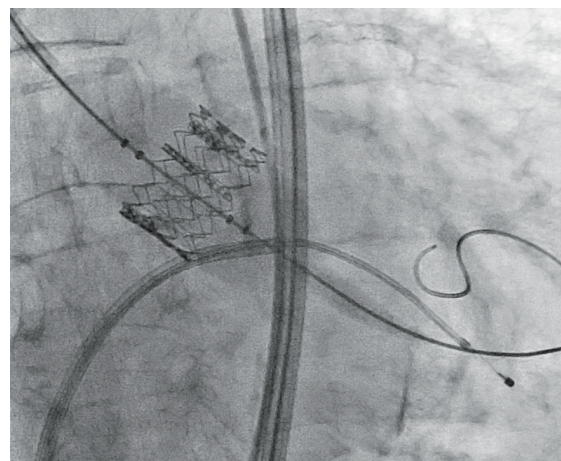
\*: Designed and manufactured by Pie Medical Imaging



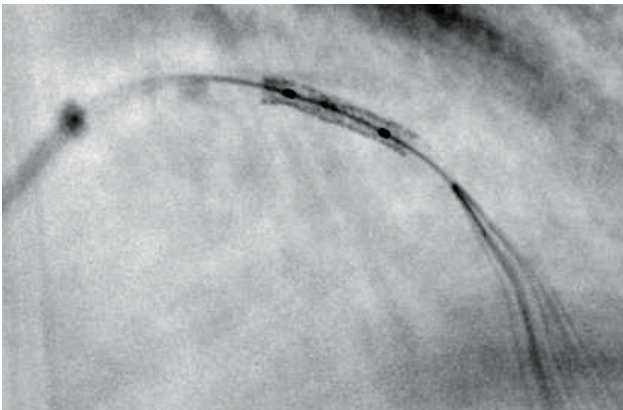
3mensio Structural Heart/Mitral Valve SW



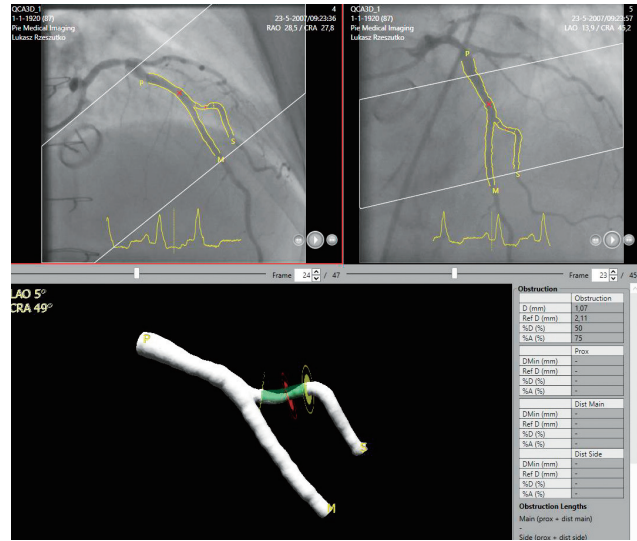
3mensio analysis of femoral arteries



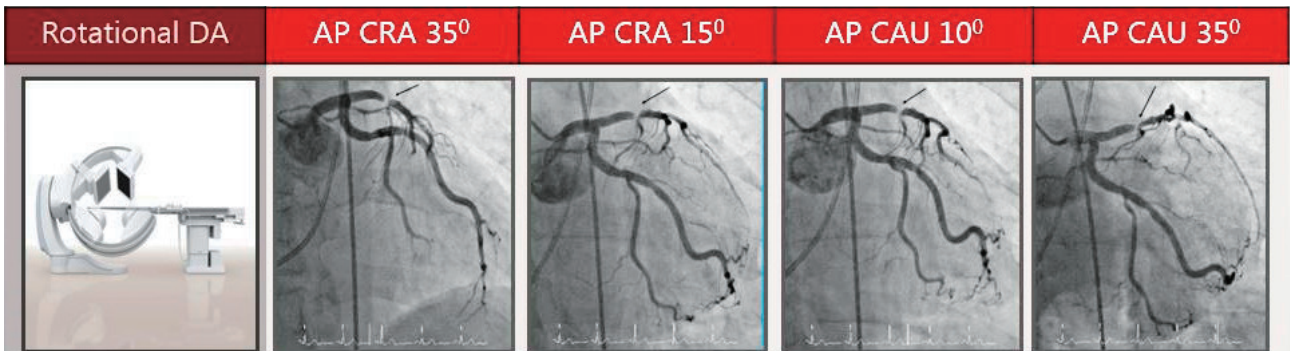
Fluoro record of TAVR procedure



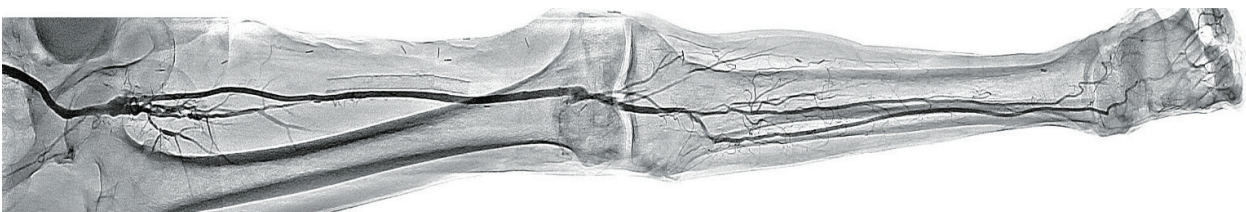
Stent enhancer software shows detail in edges of stent



3D QCA software showing 3D model of vessels



Rotational coronary angiography depicting the stenosis in the vessel at various angles obtained during the rotation of the C-arm.



Dynamic Trace gives clinicians the ability to perform a digital acquisition while panning the table following the flow of contrast. This image is an example of panning from hip to foot.

### PIE Medical 3D Quantitative Coronary Analysis (3D QCA) Software

PIE Medical's 3D QCA software package is for use in clinical practice and research. This software features reconstructions of stenotic coronary arteries and allows quantitative cross-sectional information to be displayed.

### Conventional Imaging in Interventional Cardiology

#### 2D Coronary Rotation

Imaging with 2D coronary rotation, perform a single injection and let the C-arm rotate to capture key diagnostic views of coronary arteries. Using this technology enables clinicians to obtain optimum image quality at reduced dose as compared to traditional multi-acquisition imaging to acquire similar views. Automated sequential rotational image acquisition aids clinicians in prioritizing safety and efficiency.

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### Dynamic Trace (DT)

DT is a digital acquisition method used in a panning mode to enhance vascular imaging by increasing background compression and reducing the presence of bones. Perform contrast runoffs anywhere in the body with 'DSA-like' effects.

### DoseRite

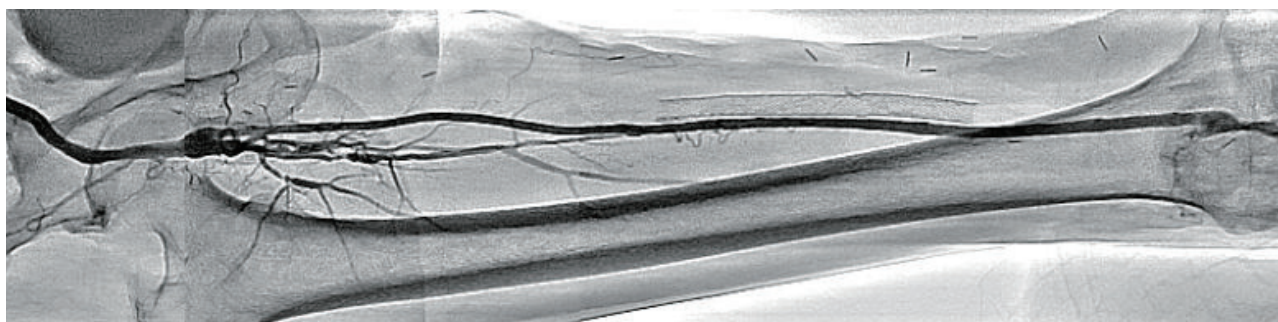
The Alphenix systems also feature comprehensive dose management tools, called DoseRite, including Canon Medical Systems' exclusive Spot Fluoroscopy, Live Digital Zoom, Advanced Image Processing (AIP) with Illuvis, variable dose modes and rates, fluoro record and store, and Dose Tracking System (DTS), enabling clinicians to obtain optimum image quality at reduced dose.

### Spot Fluoroscopy

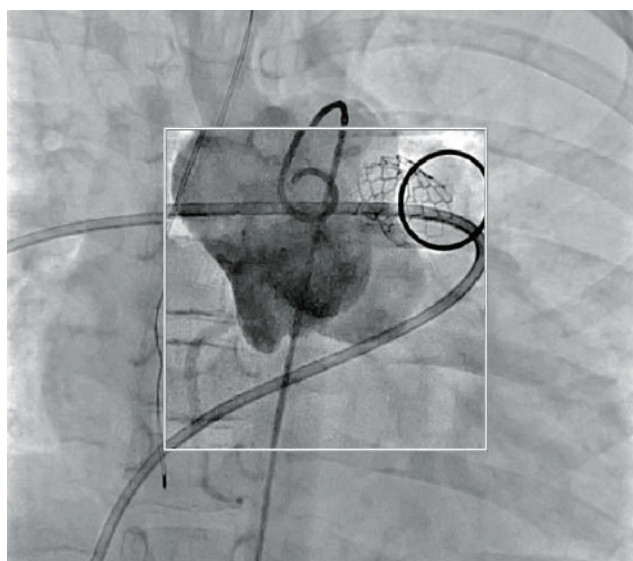
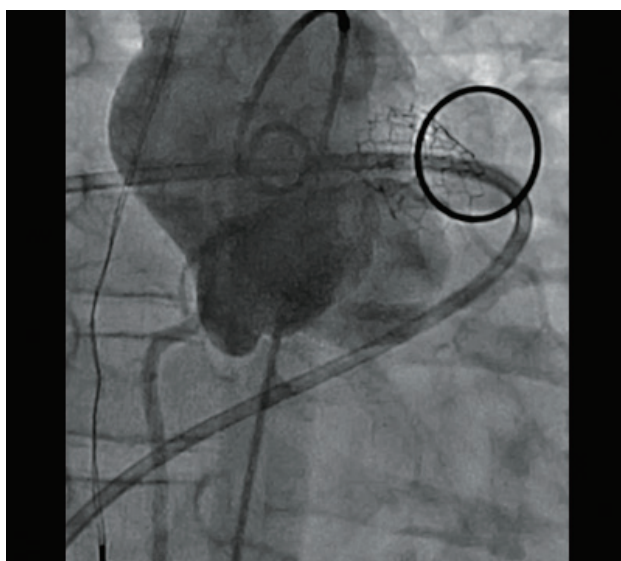
Spot Fluoroscopy provides asymmetric collimation anywhere within the field of view resulting in a lower dose than conventional collimation. The ROI can be precisely sized and positioned almost anywhere vs. just centered when using conventional collimation, providing the clinician with the exact view desired. Clinicians can observe a smaller region of anatomy while viewing the Last Image Hold (LIH) surrounding the area.

### Live Digital Zoom

Live Digital Zoom enhances image visualization by increasing image display size in real time during both fluoroscopy and digital acquisitions, offering potential dose savings compared to traditional FOV magnifications. A range of zoom modes from 1.2 to 2.4 times can be applied to any of the system magnification modes.



An example of Dynamic Trace while panning the table from hip to knee.



Spot fluoroscopy ROI can be easily sized and positioned anywhere in the FOV and provides anatomical landmarks visible in the LIH.

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## Illuvis

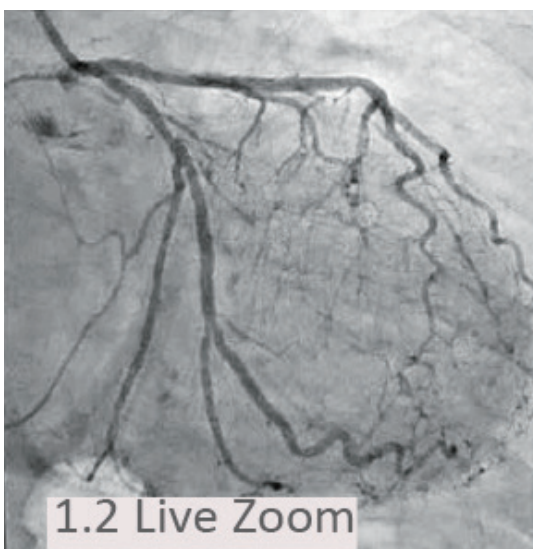
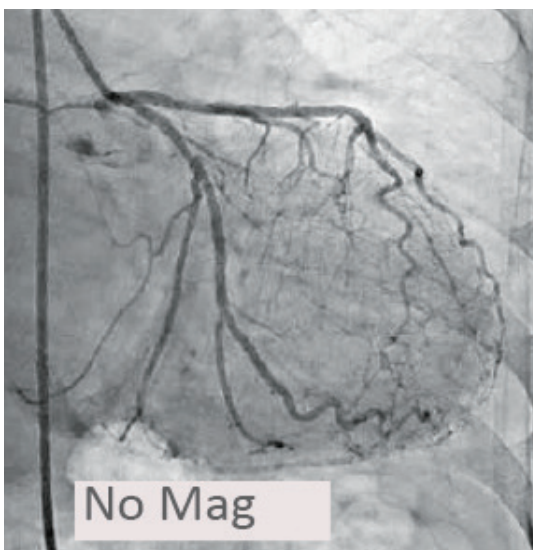
AIP uses SNRF technology to lower dose dramatically by analyzing and processing each image frame in real time during fluoroscopy.

AIP enhances visibility by increasing image contrast, enhancing small object detail and reducing halation from lung fields. SNRF reduces total noise power by up to 90 percent while maintaining sharp spatial and temporal resolution.<sup>1</sup> In concert, these unique technologies combine to provide image quality improvements greater than 200 percent.<sup>2</sup> This has resulted in demonstrated reduction to both patient and staff radiation dose levels by more than 50 percent with utilization of lower frame rates and more

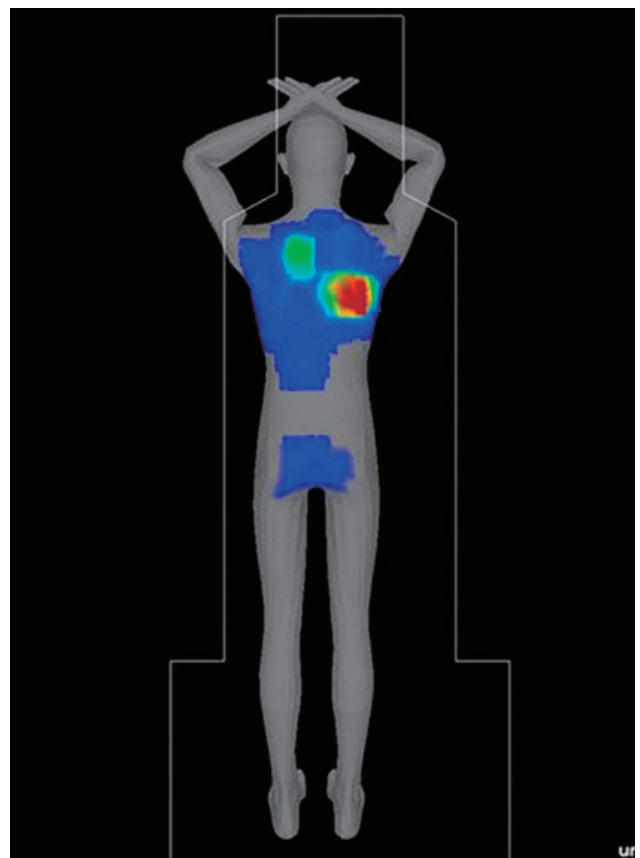
fluoroscopy as compared to higher dose digital “cine” acquisitions.<sup>3</sup>

## Dose Rates

The Alphenix makes possible industry-leading dose rates. No other system comes close to providing as much flexibility with nine variable frame rates (1, 2, 3, 5, 7.5, 10, 15, 20, 30) and four programmed fluoroscopy modes (low, middle, normal, high), which are standard on every Alphenix system. Different combinations of pulse rates, dose levels and system parameters are available to enable clinicians to optimize dose rates and image quality for various study protocols.



Applying the 1.2 zoom mode to the 8" FOV of the left coronary artery increases the display size by approximately 20%. The increase in display size is equivalent to one magnification mode.



DTS provides an estimation of peak skin dose available on cardiovascular/neurovascular procedures

## Fluoro Record

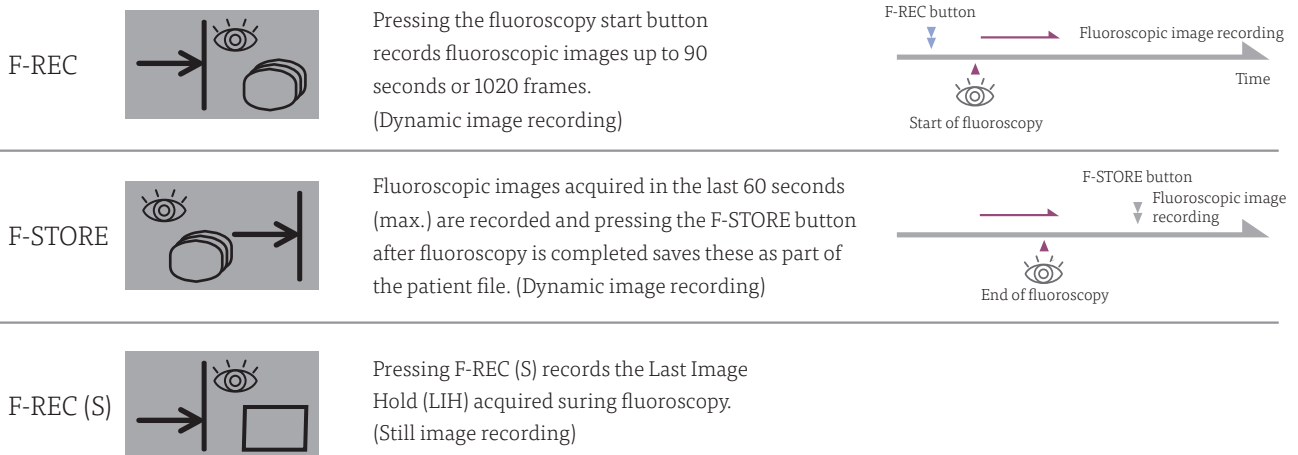
Fluoro record and fluoro store is incorporated into the standard practice and can be used to replace digital acquisition (DA) for interventions as well as groin shots resulting in significant dose reduction.

## DTS

DTS provides real-time patient skin dose estimates in an easy-to-interpret color representation of radiation exposure to the patient. Real-time feedback of radiation exposure enables the clinician to make adjustments during the procedure. //

## REFERENCES

1. Nishiki, M, Shiraishi, K, Sakaguchi, T, Nambu, K (2008). Method for reducing noise in X-ray images by averaging pixels based on the normalized difference with the relevant pixel. *Radiol Phys Technol*, 1, 2:188-95.
2. Nagesh, S, Kuhls-Gilcrist, A, Ionita, C, Bednarek, D, Rudin S (2015). Improved visualization of neurovascular interventional treatment devices by processing of images. *Accepted for publication. IEEE MIC*.
3. Sawdy, J et al (2011). Use of a dose-dependent follow-up protocol and mechanisms to reduce patients and staff radiation exposure in congenital and structure interventions. *Cath and Card Interv*, 78, 136-142.



Example of available fluoro records with Alphenix.