

Product Description

Varian Imaging Components is a leading supplier of CBCT-enabling flat panel detectors and X-ray tubes, and is now providing companion image processing algorithms and CBCT reconstruction in the form of an easy to use software toolkit: CBCT Software Tools, or *CST* for short.

CST is designed for use with all Varian X-Ray fluoroscopic flat panel detectors. It comprises a suite of Windows-based software libraries that enables OEMs to quickly develop software that produces high-quality 2D images or 3D reconstructions for medical, dental, or industrial applications.

Within *CST*, individual processing steps are encapsulated into separate *plugins*. A host application can use any or all of the plugins provided. At the heart of *CST* is the *Reconstruction Pipeline* library. This library manages the available plugins and acts as the single interface between an OEM host

application and the *CST* plugins.

Key features of the Reconstruction Pipeline library:

- Has a stable, easy to use API supporting both .NET and C++ host applications
- Supports different panels, geometries, and scan types
- Supports simultaneous acquisition and reconstruction processing

Available plugins for CST include:

- **Scatter Correction** – This pre-processing step corrects for the effects of scatter of the beam as it passes through the object (and any table or platform) being scanned.
- **Beam Hardening Correction** – This pre-processing step corrects for the effects of hardening of the X-ray spectrum as the beam passes through the object.
- **Lag Correction** – This pre-processing step corrects for the lag, or residual signal on the detector, from one frame to the next.
- **Resolution Enhancement (REA)** – This pre-processing step removes the impact of the scintillator light spread to approach the limiting pixel resolution of the detector.
- **Normalization** – This pre-processing step normalizes the input data based on a previous air calibration scan, and optionally supports position-dependent air calibration.
- **FDK Reconstruction** – This step transforms a set of 2D projection frames into a reconstructed 3D volume. *CST* is delivered with two separate plugins to perform our modified implementation of FDK. The first is highly optimized for multi-core CPUs. The second is designed to work with an NVIDIA GPU to further reduce computation time, and also supports 12-DOF dynamic wobble.
- **Ring Correction** – This post-processing step corrects for ring artifacts, caused by small gain linearity differences between adjacent detectors
- **Hounsfield Unit Adjustments** – This post-processing step converts the output image to Hounsfield units.
- **Customer-developed Plugins** – *CST* provides the tools for OEMs to write their own custom processing steps, to either replace a *CST*-provided plugin or to provide additional processing.

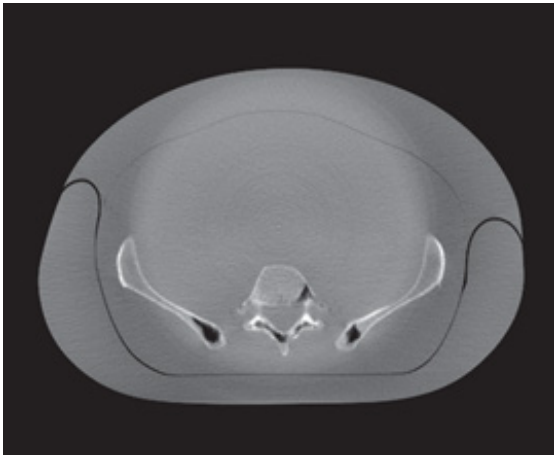


Figure 1 - Pelvic phantom; no advanced corrections

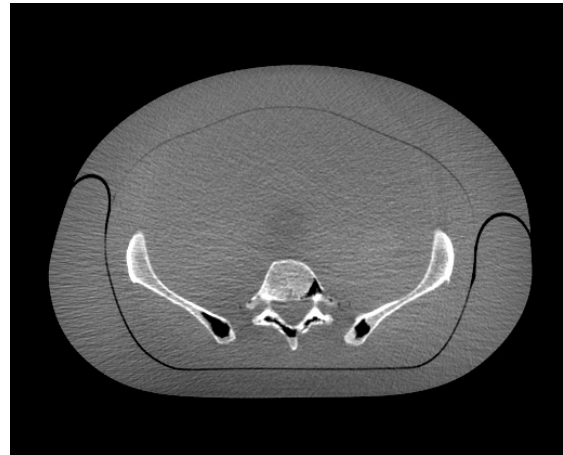


Figure 2 - All CST-provided corrections applied

The two figures above show the same slice from a reconstructed image of a pelvic phantom (both are displayed using the same window/level values). In Figure 1, no advanced corrections were applied. Figure 2 demonstrates the use of all the available CST correction plugins: the bright circular plateau has been removed by lag correction; scatter and beam hardening correction have increased contrast and uniformity; and ring artifacts have been eliminated.

CST also includes a geometric calibration package, *IsoCal*, which includes both software and accompanying calibration phantoms. The *IsoCal* phantoms are available in different sizes, depending on the size of the flat panel being used, and the geometry of the CBCT scanner being developed. *IsoCal* measures system geometry by analyzing a set of projection data obtained by scanning the phantom over a range of rotational angles. For best image quality, this process is typically repeated separately for each system. *IsoCal* accurately measures the relative locations of the source, detector, and rotation axis, and also supports 12-DOF dynamic geometry to measure gantry wobble. This information is then used by the CST plugins during reconstruction. *IsoCal* is an optional feature, and system geometry can also be explicitly specified to the CST pipeline directly by the OEM.

The *CST Workbench* application, included with the CST software (but not for clinical use), is an example end-user application that uses the Reconstruction Pipeline API. It provides 2D visualization of projection and volumetric slices, as well as 3D visualization of volumetric images. The Workbench provides in-progress images in real time, as well as status updates during a reconstruction. The OEM can use the workbench to experiment with the image processing pipeline before implementing it into their own software. Also included with the software are example host applications with source code (in both C# and C++), demonstrating how to use the Reconstruction Pipeline API.