

## Cone Beam CT Software Tools (CST)

- Full CBCT reconstruction back-end with state-of-the-art algorithms to correct for scatter, detector blur, beam hardening, lag, and ring artifacts.
- Efficient filtered back projection (FDK) and iterative reconstruction algorithms.
- Workbench R&D application to construct and optimize easily deployed pipelines with minimal number of API calls.
- Full geometric calibration suite including software and phantoms.

### OVERVIEW

Varex Imaging has developed an easy-to-use Cone Beam CT Software Toolkit (CST) to speed up development times and produce high-quality 2D images or 3D reconstructions for industrial applications.

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

CST is Windows-based and designed for use with all Varex Imaging X-ray flat panel detectors.

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 pipeline library, which manages the available plugins and acts as the single interface between an OEM host application and the CST plugins.

### 3D IMAGE PROCESSING PLUGINS

#### 3D VSHARP™ Scatter Correction

Estimates and corrects for scatter by rapidly simulating x-ray transport through a volumetric model of the scanned object. It is generally more accurate than 2D VSHARP but reconstruction time is longer (This package includes 2D Image Processing Plugins)

#### Multi-material Beam Hardening

Corrects for the effects of hardening of the X-ray spectrum in multiple materials, as the beam passes through the object.

### 2D IMAGE PROCESSING PLUGINS

#### 2D VSHARP™ Scatter Correction

De-convolves scatter from the raw projection data using a model that is customized for the user's CBCT system.

#### Beam Hardening Correction

Corrects for the effects of hardening of the X-ray spectrum as the beam passes through the object. (Single Material)

### DETECTOR CORRECTION PLUGINS

#### Lag Correction

Corrects for the lag, or residual signal, on the detector, from one frame to the next.

#### Resolution Enhancement (REA)

Reduces the impact of scintillator light spread on spatial resolution.

### RECONSTRUCTION PLUGINS

#### Normalization

Normalizes the input data based on either a previous static or dynamic air calibration scan.

#### FDK Filtering and Back Projection

A configurable anti-aliasing filtering plug-in as well as two back-projection plugins: one highly optimized for multi-core CPU's, and the other, supporting a 12-DOF (Degrees Of Freedom) geometry designed for an NVIDIA GPU.

#### Iterative Reconstruction

The GPU plug-in uses a maximum-likelihood estimation algorithm with customizable noise models, ordered subset acceleration, and multiple regularization options.

#### Forward Projection

GPU step generates 2D Projections from 3D Images.

### CT IMAGE BASED CORRECTION PLUGINS

#### Ring Correction

Corrects for ring artifacts, caused by small gain linearity differences across the detectors.

#### CT Number Scaling

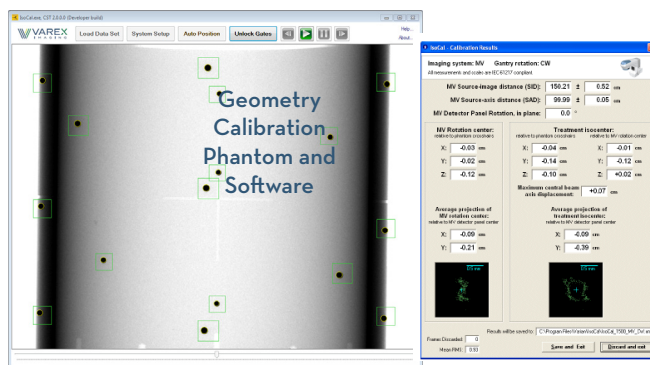
Scales the output image to their desired CT numbers from air to the material being scanned.

# CBCT SOFTWARE TOOLS

## GEOMETRIC CALIBRATION AND OPTIMIZATION

An optional feature of CST is a geometric calibration package that includes software and precisely machined phantoms.

- The phantoms are available in small and medium sizes as appropriate for the geometry of the CBCT system.
- The calibration software comes with a graphical user interface or it can be run from the command line.
- The software measures both “static” and “dynamic” geometries by analyzing projection data obtained by scanning the phantom over a range of rotational angles.
- This 12-DOF dynamic geometry can be used to correct for repeatable gantry wobble and jitter.

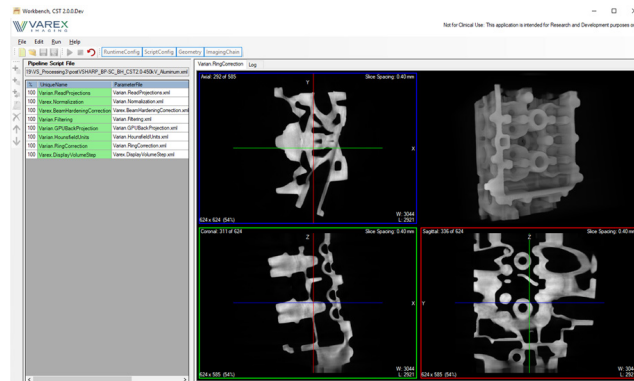


CST WORKBENCH

## CST WORKBENCH

The CST Workbench application (not intended for system use) is an example application that allows OEMs to easily set up and run the CST pipeline. It provides:

- A flexible interface to experiment with the pipeline and optimize it for customer applications.
- 2D and 3D visualization of images.
- An interface to easily examine log files.



A command-line program is also provided to allow the user to run the pipeline independently of the Workbench.

## PIPELINE AND PLUGIN API'S

The xml file-driven pipeline can be launched with only two calls to the Pipeline API.

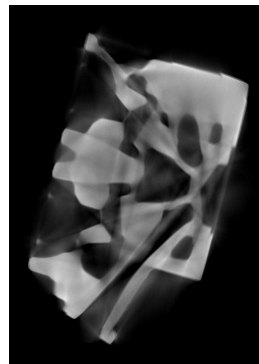
The Plugin API allows OEMs to write their own custom processing steps, to either replace a CST-provided plugin or to provide additional processing.

## DOCUMENTATION

All aspects of CST are fully documented. The Workbench's parameter editor contains descriptions of each variable as well as targeted HTML links to reference manuals.

There is a hands-on tutorial to enable users get started quickly, and source code examples (in both C# and C++) are provided demonstrating how to use the APIs.

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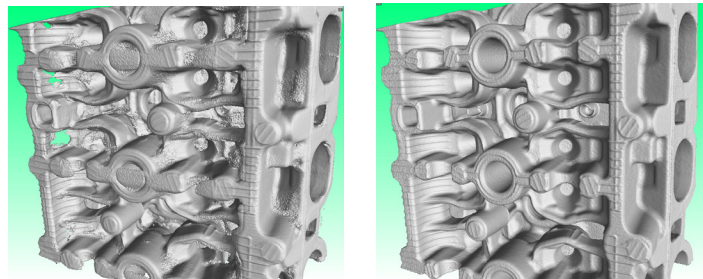
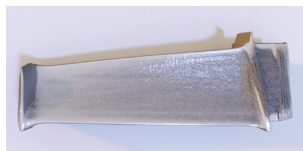
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ACTUAL PART



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