

Advanced X-ray Software

GigaRecon™

For EclipseXRM and Apex XCT

Sigray has developed an advanced software suite to complement its breakthrough 3D x-ray systems. A key feature is GigaRecon™, the fastest reconstruction algorithm on the market with reconstruction speeds of <45 seconds for a 8B voxel dataset. GigaRecon™ also incorporates iterative reconstruction, enabling the same outstanding image quality with data acquired at just a fraction of the time as a full dataset.

This white paper reviews the capabilities of Sigray's XRM software suite.



Advanced 3D X-ray Software GigaRecon™

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The Importance of Software: Software complements hardware. The best CT software speeds up not only the analysis time, but also optimizes data acquisition time and the quality of the data collected. Sigray systems are packaged with advanced algorithms to dramatically accelerate acquisition times to a fraction of the time that would otherwise be required.

GigaRecon™: Accelerated Reconstruction

At the heart of Sigray's reconstruction environment is GigaRecon: the fastest and most computationally-efficient 3D reconstruction package on the market.

Key features of GigaRecon include:

1. Fastest Recon - Pixels to Voxels in Seconds

For ultrafast tomographies (such as the minutes-long scans achieved on Sigray's breakthrough Apex XCT), it is not the physical scanning of the sample but the software reconstruction that becomes the primary bottleneck.

Sigray's GigaRecon™ is by far the fastest in the market for reconstruction, providing reconstruction times of **seconds** while other systems take **minutes**:

Data Size	GigaRecon™
1024 x 1024 x 1600 1B Voxels	4 seconds
2048 x 2048 x 2200 8B Voxels	45 seconds

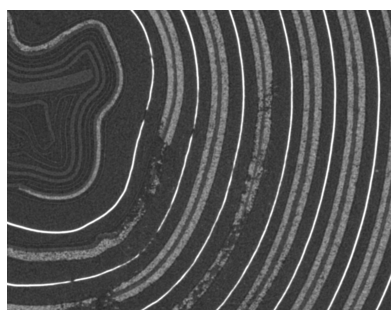
Figure 1: Reconstruction times for typical dataset sizes.

GigaRecon™ allows Sigray instruments to use 8B voxel datasets, while most other vendors only use 1B voxel datasets (thus losing a lot of information from binning the data!). Furthermore, GigaRecon detects and adapts to the hardware available, automatically scaling as machines or clusters are upgraded.

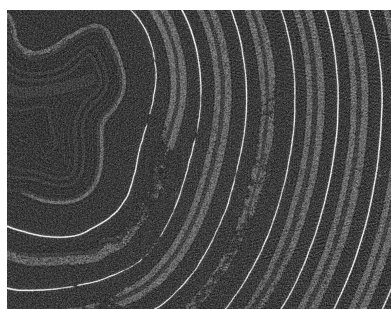
2. Faster Tomographies - Fewer Views Required

Not only is the reconstruction fast, but GigaRecon™ also enables faster **physical acquisition of data**. Its reconstruction algorithms require only 1/5th the number of projections for the same quality of data as conventional reconstruction approaches, significantly lowering the cost-per-scan on Sigray's systems.

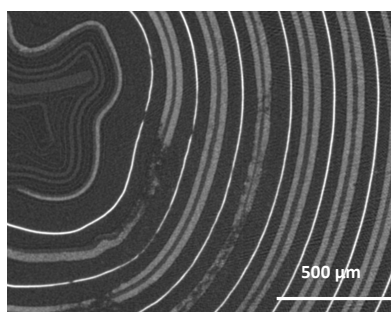
An example of how data quality is preserved, even at a fraction of the projections (and thus scan time) is shown in the figure below:



3600 Projections
Conventional
Reconstruction (FDK)



700 Projections
Conventional
Reconstruction (FDK)



700 Projections
Giga Recon™

Figure 2: GigaRecon provides the same quality of data with fewer projections, enabling dramatically faster scan times. Image shown of the interior of a failed battery

3. Integration with Sigray3D - Intuitive Acquisition

GigaRecon is integrated with Sigray3D, Sigray's intuitive image acquisition software. Setting up a tomography can be complex, with many knobs to turn (e.g., x-ray source accelerating voltage, choice of filter, source-sample distances, magnification, etc.).

Sigray3D features a simplified workspace that focuses on what's important: the sample image. The workspace was designed to take new users from setup to acquisition in as few steps as possible and with the capability to save and load scan recipes for automated operator-less imaging.

Key features of Sigray3D include:

- Intuitive image-focused workspace
- Automated acquisition routines
- High throughput, large data collection routines, including helical, offset, and fly scan (continuous rotation) scanning
- Load and save **open file formats** such as HDF5 (other vendors lock the user into proprietary file formats, which hides metadata and limits the ability to create custom workflows and use external toolkits)

4. For New Users - AI Workflow Assistant

Artificial intelligence built into the Sigray software supervises and guides the user through the reconstruction and viewing process. New users can achieve the same high quality results that experienced operators achieve **every time**. GigaRecon provides access to standard FDK reconstruction methods using a choice of several Fourier filters, as well as five iterative reconstruction routines. GigaRecon also provides basic 3D image viewing capabilities, with an interactive slice viewer and essential features, including contrast scaling and screenshot export.

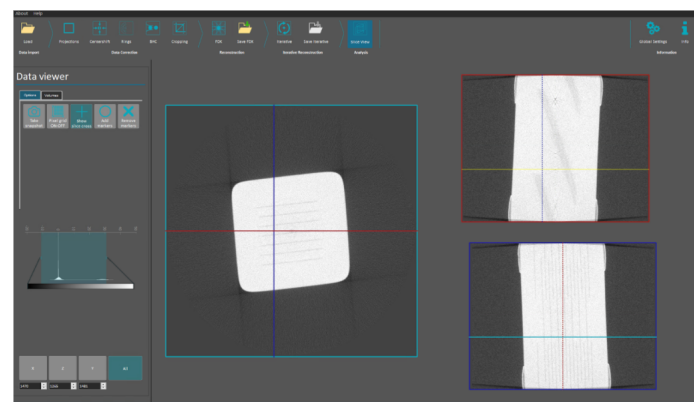


Figure 3: Data visualization in Sigray GigaRecon

5. For Power Users - An Open Environment

Advanced power users enjoy programmatic access to all functions of Sigray's software suite, from acquisition through reconstruction and analysis. All software routines can be naturally extended using python scripting, including motorized motion, image capture, and data analysis. Hardware may be called using PyEpics, an open controls package with libraries of ready-made callback methods for monitoring and controlling individual system components. GigaRecon may be also called from a python terminal, enabling the user to run stack correction routines programmatically and initiate reconstruction. Resulting TIF data stacks can then be immediately processed with packages such as SciPy, Scikit-Image, Scikit-learn, Numpy, etc. TIF stacks may be opened in software such as Avizo or Dragonfly, which offer additional python scripting access through public APIs.

Summary

Sigray's 3D x-ray software suite comprises intuitive data acquisition and fast data processing, enabling maximum data quality at minimized acquisition and reconstruction times. The software is designed to enable new users with minimal training to acquire data comparable to veterans with easy-to-use interfaces and workflow assistants.

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