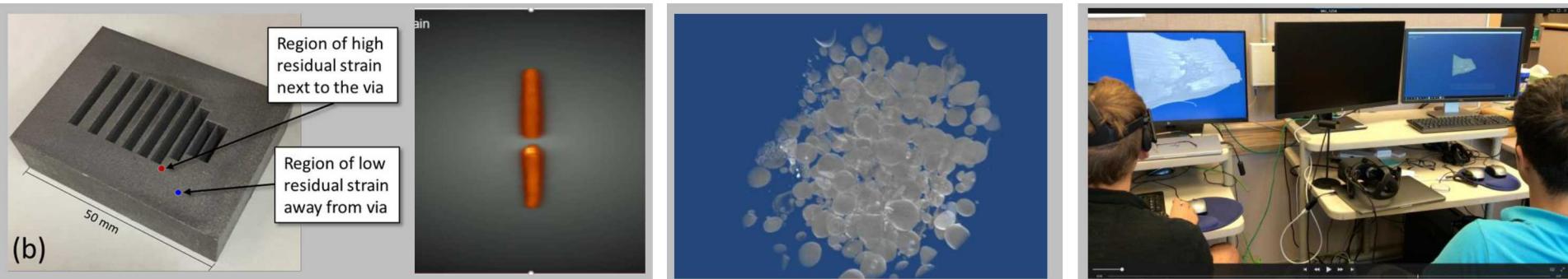


Exceptional service in the national interest



SV3D: From 3D Interrogation to 3D Collaboration

Mark A. Rodriguez, Jonathan Madison, Tod Amon, Aaron Comen, Timothy Dropps, Thomas Ivanoff, and John J. Jones

Our Enhanced Surveillance Project Goal

Develop an **Intuitive and Immersive Diagnostic** for μ -CT and other 3D datasets to improve the speed and efficiency by which these massive files are explored and evaluated.

We employ a **Virtual Reality** environment and powerful **GPUs** to realize this goal

It's Free!

It is currently available to Sandians via our Wiki site on the SRN!

We have a Wiki link to our site

<https://snl-wiki.sandia.gov/display/view3D/Sandia+Virtual+Volume+Visualization+Diagnostic>

Screenshot of a Confluence page titled "Sandia Virtual Volume Visualization Diagnostic". The page includes a dashboard, a sidebar with links like "Getting Started", and two images: a grayscale 3D volume rendering and a 3D visualization of spheres with a green wireframe mesh and the text "50.2 μm".

Sandia Virtual Volume Visualization Diagnostic

Created by Tod T Amion, last modified by Jonathan D Madison about 13 hours ago

SV³D – The Sandia Virtual Volume Visualization Diagnostic is a free, lightweight tool similar to Volume Graphics with three unique special capabilities:

- Using a GPU rapid exploration of your data is possible. The viewer's texture-based approach allows users to fly around their data using a game controller or keyboard to make instantaneous adjustments to lighting, density/opacity, transparency, and more. No geometry is constructed, instead shading and lighting algorithms in the GPU are used to facilitate rapid exploration of the volume.
- The software supports virtual reality headsets such as the Oculus Rift, HTC Vive, and Windows/Samsung Odyssey. We are working to gain approval for use of headsets inside the limited area. Headsets are available for you to use with the viewer in T-55 (near the Thunderbird Cafeteria)
- Collaboration – the software supports a collaborative experience, where individuals in different locations can all examine the same dataset with the same settings from the same location in virtual space; permitting discussion (over the phone) of hypothesis, conclusions, and discussion of next steps.

Data consisting of image stacks (jpg, png, tiff) is processed using a desktop application – the SV³D Volume Processor, that packages data into a format the viewer knows how to display. Many of our users use it to view computer tomography data (e.g., for non-destructive evaluation) but other uses are possible, e.g.,

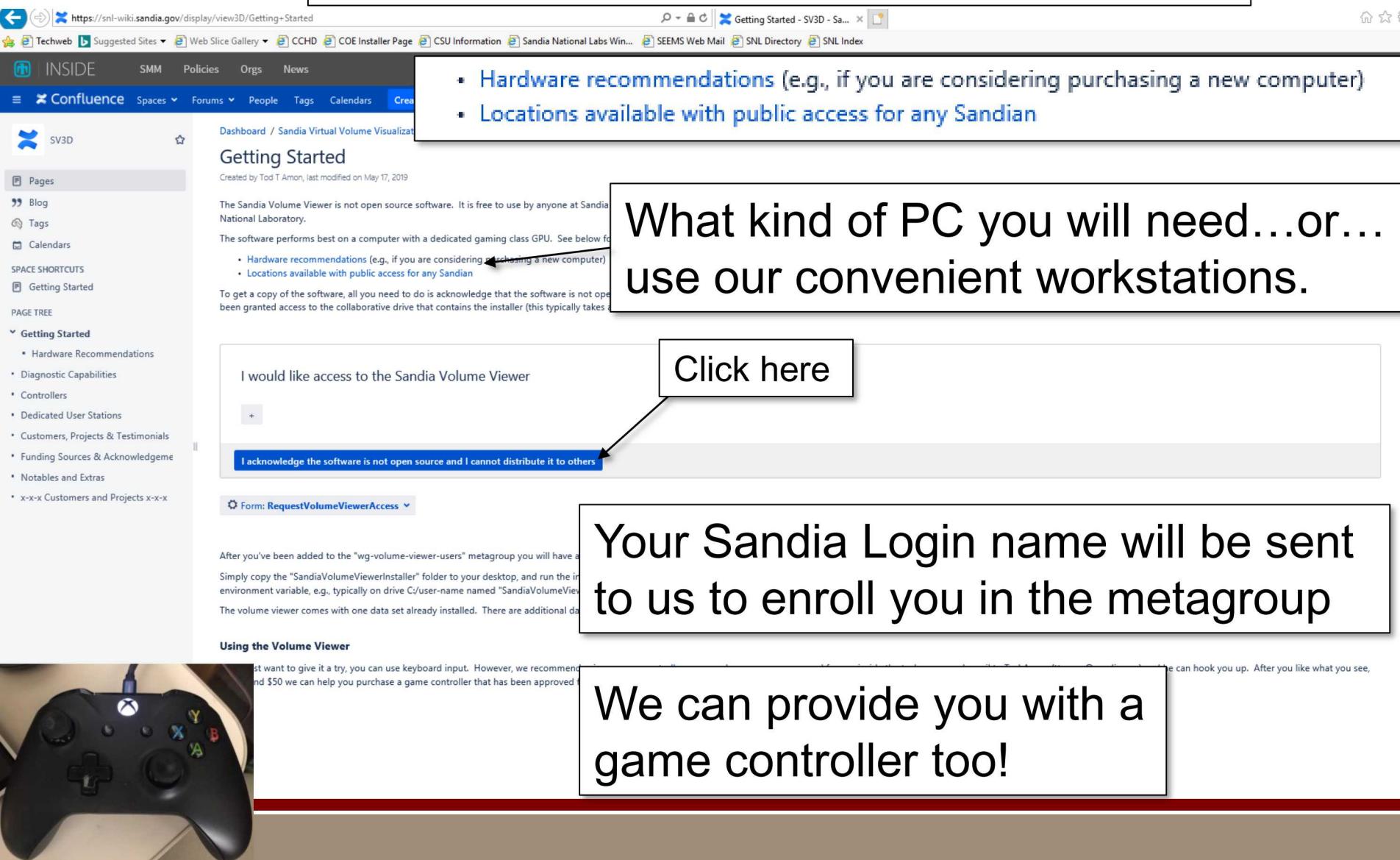
Click here

Getting Started ←

- Getting Started
- Diagnostic Capabilities
- Controllers
- Dedicated User Stations
- Customers, Projects & Testimonials
- Funding Sources & Acknowledgements & Acknowledgements
- Notables and Extras

How would I get started?

<https://snl-wiki.sandia.gov/display/view3D/Getting+Started>



Hardware recommendations (e.g., if you are considering purchasing a new computer)

Locations available with public access for any Sandian

What kind of PC you will need...or... use our convenient workstations.

I would like access to the Sandia Volume Viewer

Click here

I acknowledge the software is not open source and I cannot distribute it to others

Form: RequestVolumeViewerAccess

After you've been added to the "wg-volume-viewer-users" metagroup you will have a

Simply copy the "SandiaVolumeViewerInstaller" folder to your desktop, and run the in

environment variable, e.g., typically on drive C/user-name named "SandiaVolumeView

The volume viewer comes with one data set already installed. There are additional data

Using the Volume Viewer

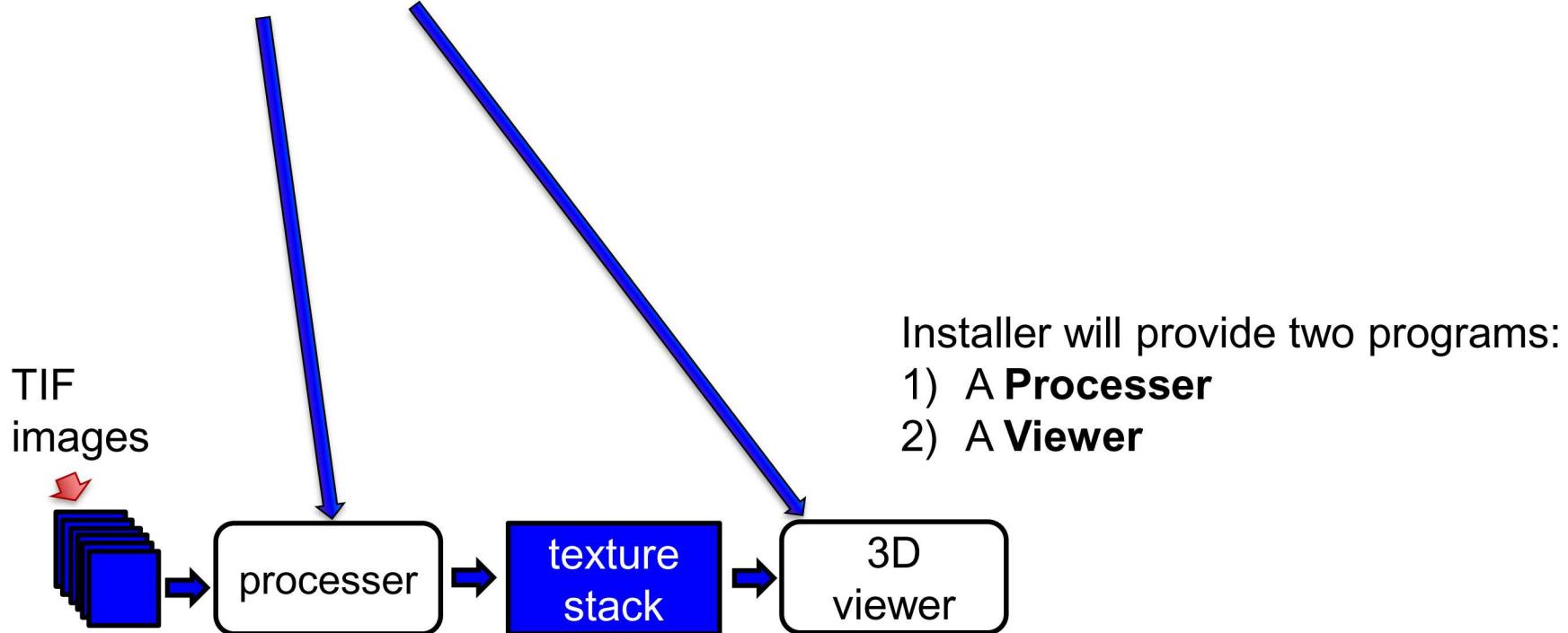
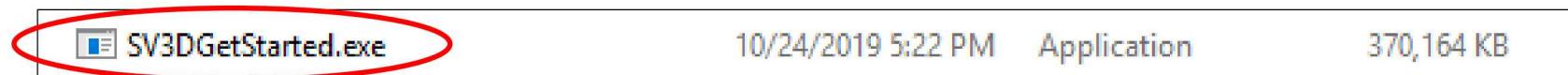
We can provide you with a game controller too!



You need two programs to get going.

\snl\collaborative\view3D

\snl\collaborative\view3D\sv3Dinstall



Where are your fast PCs to view my data?

Dashboard / Sandia Virtual Volume Visualization Diagnostic 

Dedicated User Stations

Created by Tod T Amon, last modified by Jonathan D Madison yesterday at 10:44 PM

In addition to downloading SV³D for use on your own workstation, if desired, personnel may use one of our dedicated user stations to view your data. These stations are located in Building 701, Room 1207, Building T55, Room 1, and Building 897, Room 2475. The purpose of visualizing 3D data within the diagnostic. If downloading the diagnostic is your preferred route, then you can skip this section.

Building 701, Room 1207 – (s# -

this is your best option for very large datasets

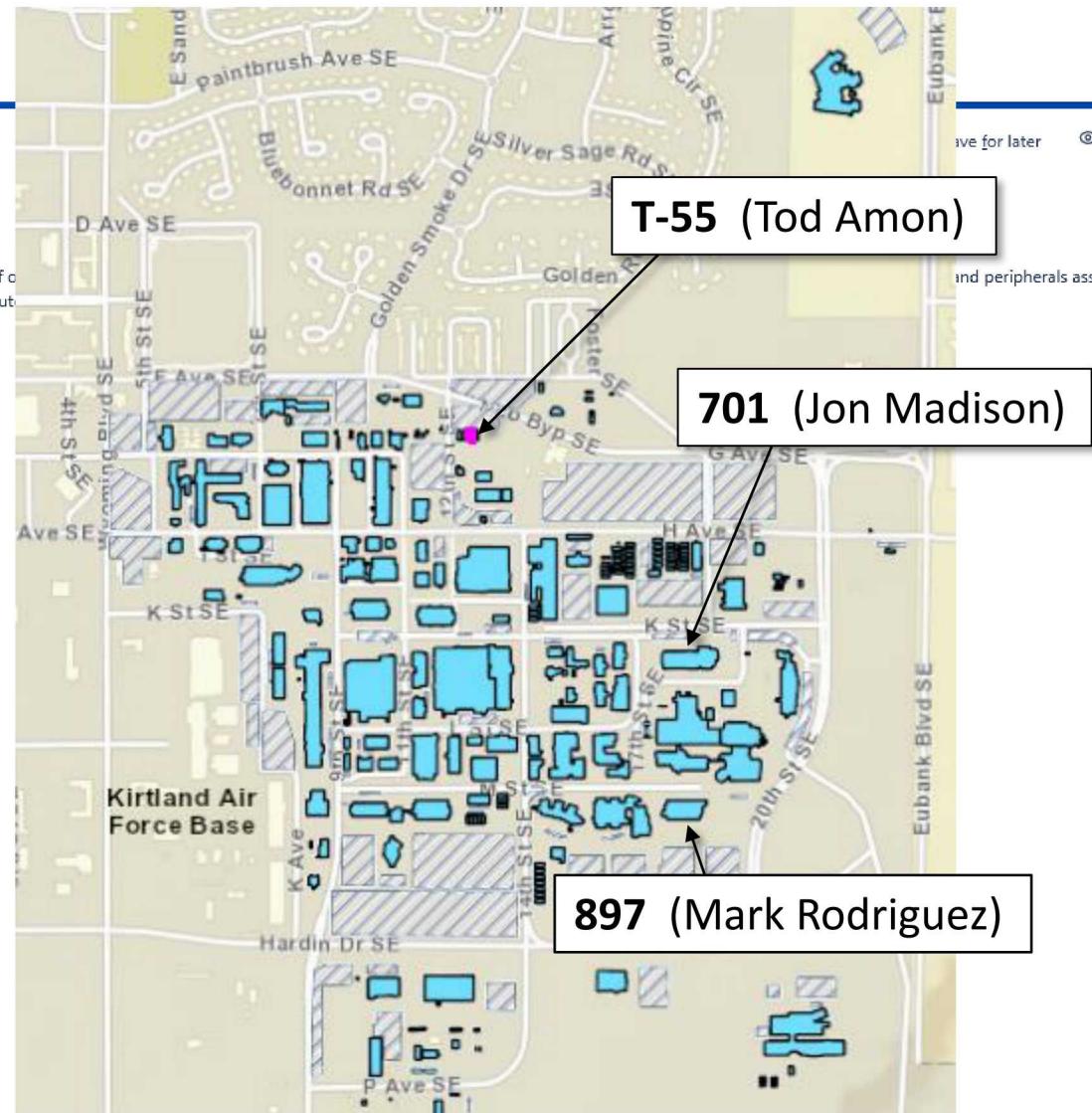
- OMEN X 290 PC; 512SSD; 3TB Hybrid Drive, 22GB RAM; GEFORCE RTX 2080 Ti Graphics Card
- Windows 10 Home
- HP Business Z32 32.1" LCD Monitor
- (1) HP standard keyboard
- (1) Dell scrolling mouse
- (1) Xbox One Controller Model 1708 (approved for use inside LTA)
- primary contact: [Jonathan Madison](#) (Org. 1851)

Building T55, Room 1 – (s# -

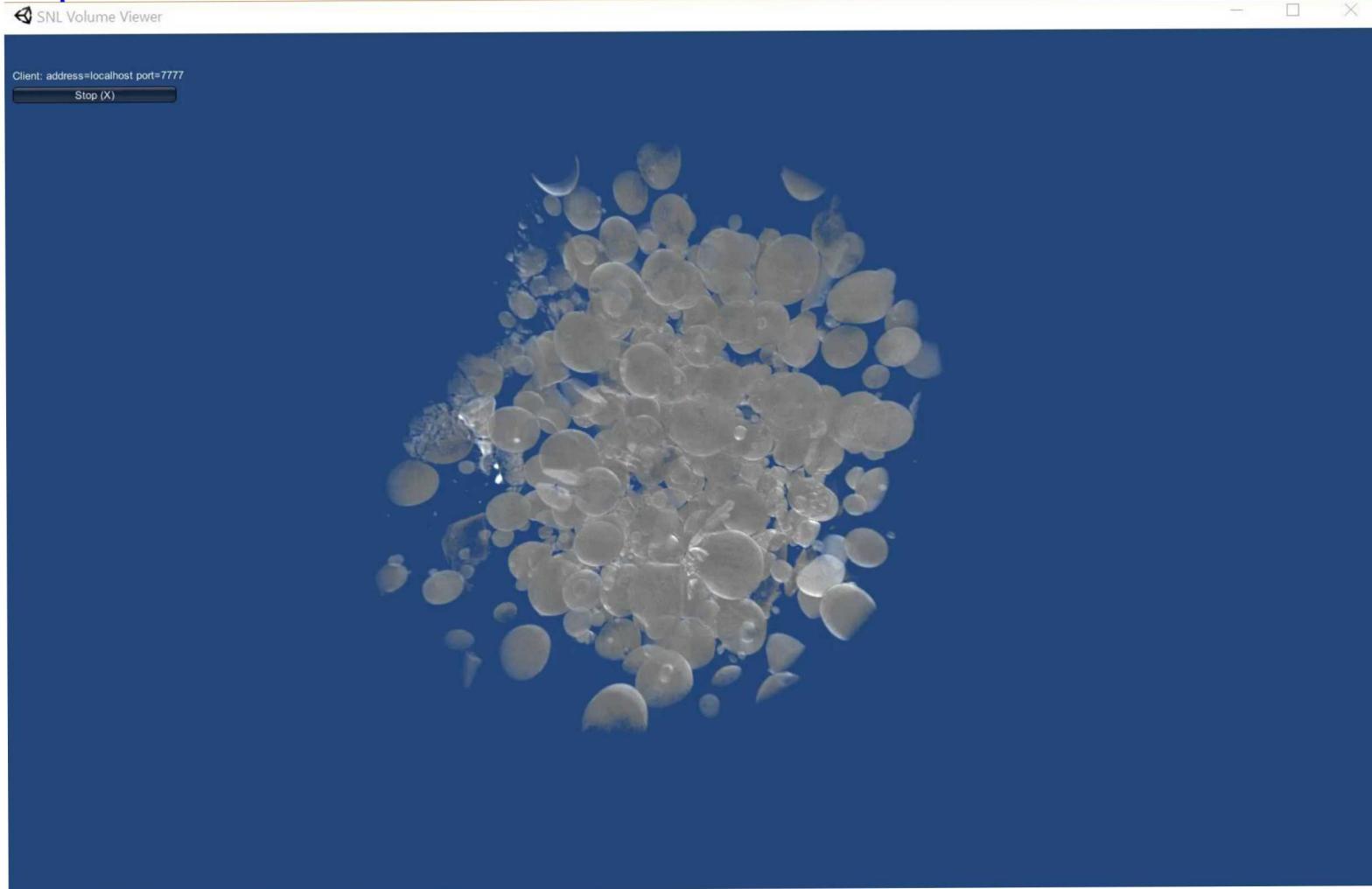
- Desktop PC, 2 mobile laptops, all with 1080 Graphics Card
- Windows 10 Home
- Specify Monitor Type here.....
- (1) HP standard keyboard
- (1) Dell scrolling mouse
- (1) Xbox One Controller Model 1708 (approved for use inside LTA)
- primary contact: [Tod Amon](#) (Org. 9368)

Building 897, Room 2475 – (s# -

- Desktop PC, with 1080 Graphics Card
- Windows 10 Home
- Specify Monitor Type here.....
- (1) HP standard keyboard
- (1) Dell scrolling mouse
- (1) Xbox One Controller Model 1708 (approved for use inside LTA)
- primary contact: [Mark Rodriguez](#) (Org. 1819)



Glass beads in Epoxy: fly-through video of μ -CT data with contrast level adjustment

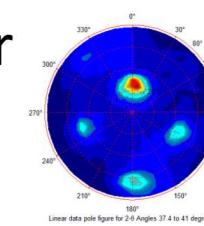


Collaborative Viewing over the Network

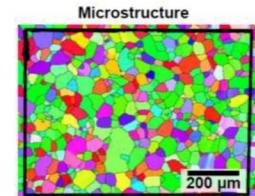


We have looked at other times of multi-dimensional data using Virtual Reality

- X-ray Diffraction (XRD) is used for characterizing material structure and composition.
- XRD often is employed to measure the degree of polycrystalline orientation (via pole figures)
- XRD can ***also detect*** residual strain in materials
 - residual strains, resulting from materials processing can result in failure modes
- Pole figure data is multidimensional and sometimes hard to visualize
- Why not use VR to look at pole figure data to try and detect strain visually?

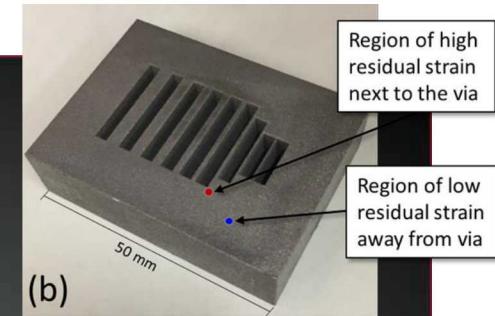
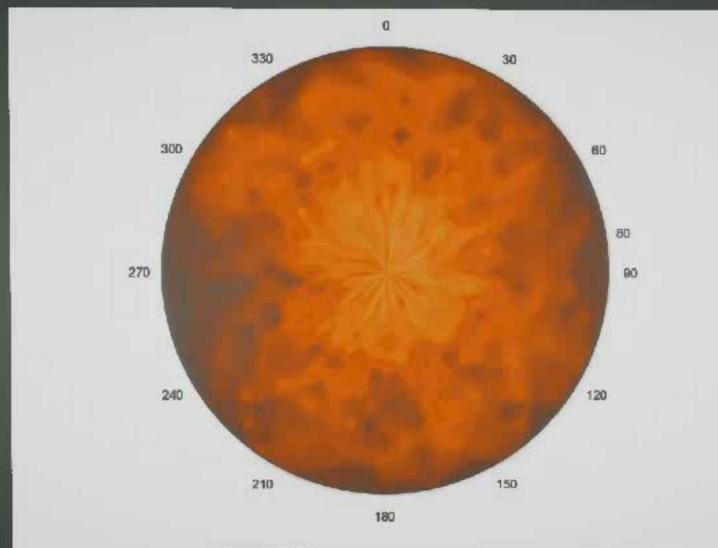


courtesy
Jay Carroll



We have diagnosed residual strain in XRD datasets via distortion of intensity distribution in pole figures

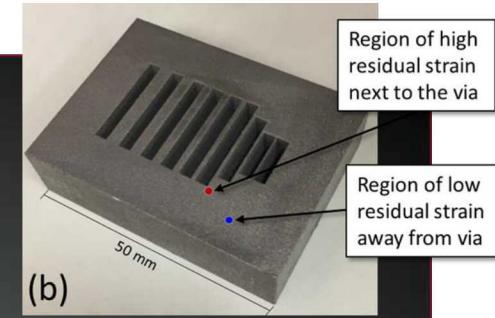
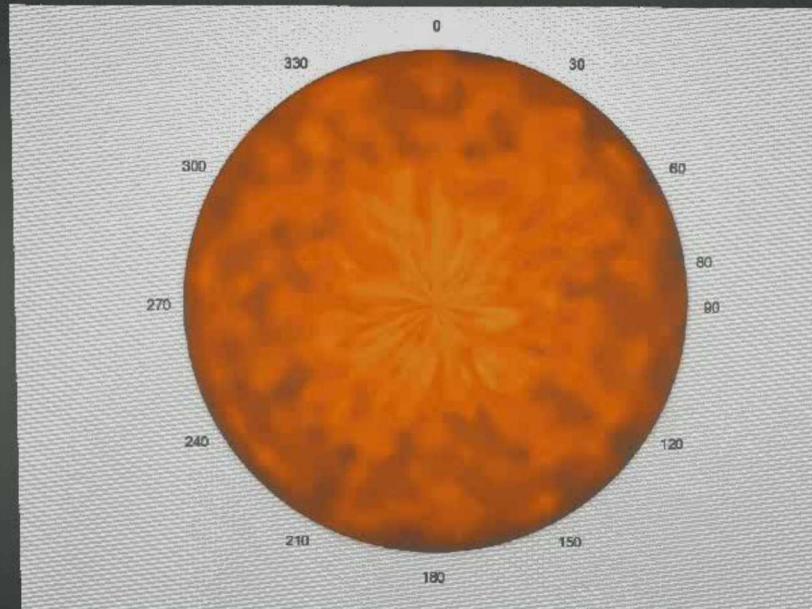
- high residual strain



Σ^-

Unstrained region in AM part shows uniform intensity distribution in pole figure

- Low residual strain



Σ^-

Summary

- Virtual Reality visualization allows for fast and flexible diagnosis in an immersive 3D environment.
- Tool is available now (help us test it!).
- Visualization can be performed on-screen or with VR headset.
- Works in Tech Area (buildings T-55, 701, 897, more to come).
- VR tools and options are available for data manipulation, marking, and measurement.
- Software is network capable for collaborative and interactive viewing via the internet.
- Generic TIFF stack format translates easily for viewing 3D data from additional diagnostics.
- Project plans for FY20 include collaborative viewing via SCN network.

Acknowledgments

- A special thanks to James Griego for creating the XRD videos.
- Thanks to student interns Devon Oberdan and Bao-Loc Trinh for demonstrating the collaborative VR experience.
- Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC., a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA-0003525.