# User Guide

# VizLab

# VizLab Users Manual

October 12, 2021

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# 1 Introduction

The EEPS Visualization Laboratory (VizLab) was established in 2018 and is supported through grants from NSF and Chevron.

The VizLab (KWGL 306) has an eight by 14 foot visualization wall consisting of 16 Barco projectors (4 x 4) with infrared tracking for both 2D image display and 3D data manipulation and interpretation.

At the lab studio, a presenter will be able to share images with as many as 25 students or colleagues wearing special glasses or even with other facilities whose participants are represented by on-screen avatars.

"If you have a 10-dimensional data space - which is not uncommon - you can't visualize it in 10 dimensions, but you can visualize any three at a time," said Alan Levander, Rice's Carey Croneis Professor of Earth Science and principal investigator of the Data Analysis and Visualization Cyberinfrastructure (DAVinCI) project. "You can walk through complicated multidimensional space looking at what are called 'hypercubes.' You can interact with them and look for correlations in complex systems."

The 200-inch wall (measured diagonally) lets users display and analyze images of all types, from atoms to galaxies. This studio is expected to help researchers in Earth science, biomedicine, engineering, art, architecture and other fields gain extraordinarily clear pictures of their data sets, be they bacteria or bridges. The facilities in the VizLab make it possible to project 3-D data, such as seismic images, onto the 4 x 4 projection monitor wall and allow scientists to walk around inside the "data".


Figure 1: Funding sources.

The futuristic wall of 50-inch high-resolution projection monitors supports two- and three-dimensional visualization needs at extremely high resolution and clarity, Odegard said. Backed by custom graphics engines, the wall allows data to be displayed in three dimensions using modern active stereo shutter glasses, often seen in home 3-D TV systems but far more sophisticated than glasses used at a 3-D movie theater. The shutters are linked wirelessly to the graphic engines so that, in effect, only one eye is open at a time, and it matches the left or right images displayed on the screen. But this all happens very fast, at a frame rate of 120 times a second, so users see no flicker in their images.

The system allows 3-D data to float in front of the screen and allow viewers to see details that might be invisible on flat images, no matter how big they are. The system has two other advantages over standard 3-D displays. The 32-megapixel screen can track researchers with an infrared system (also tied into the glasses) and allows them to walk

around inside an image. Researchers can also interact with the data by turning them this way and that in midair to get a different perspective and interpret the data quantitatively.

## 1.1 About this manual

This user guide is designed to enable Laboratory users to take full advantage of the facilities provided by VizLab. This manual is a broad guideline to most common use of the visualization tools. However, the Vizlab team are always happy to discuss with lab users about unusual complex problems in data mining and visualization.

This Manual is stored as an electronic copy on the on the EEPS website (https://earthscience.rice.edu/research/facilities/eeps-visualization-laboratory/). The document is stored in Adobe Acrobat format, and will be updated on a regular basis. If you have any suggestions for improvements please contact Yueyang Jiang at yj34@rice.edu.

## 1.2 Location of the VizLab

The EEPS VizLab is located on the 3rd floor of the Earth Science Building, which is show in the Google Map.

**Contact info:**
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Rice University
MS-126
6100 Main Street
Houston, TX 77005 USA
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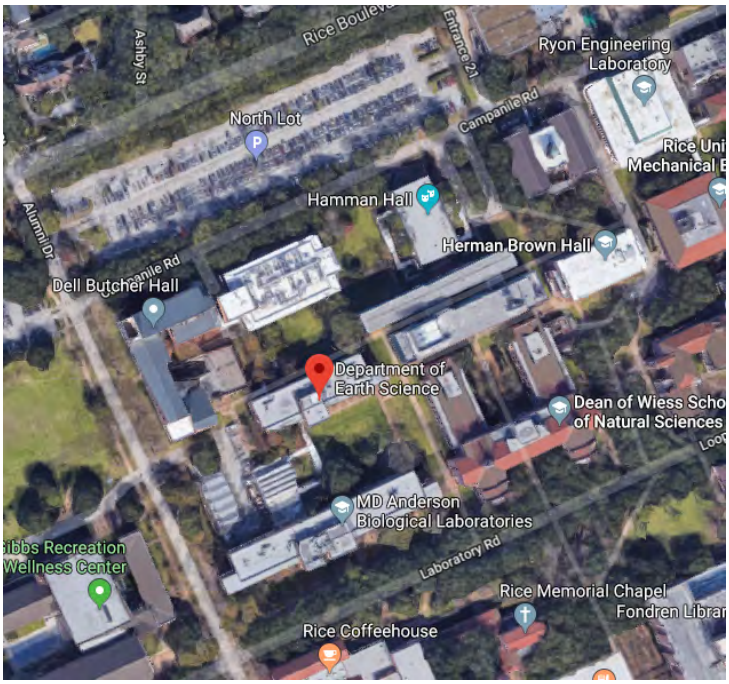


Figure 2: Location of Earth Science Building.

## 1.3 Lab reservation

The Visualization Center is available to the entire Rice community. To reserve a time spot to use the lab, please contact Bryn Dugre at bryn.dugre@rice.edu.

## 1.4 VizLab team

Alan Levander
312 Keith Wiess Geological Laboratory
alan@rice.edu
(713)-348-6064
Alan is the Carey Croneis Professor of Earth, Environmental and Planetary Sciences at the Rice University. He combines theory with active and passive source seismology to explore the structure of continents and the Earth's upper mantle. He also works on exploration and environmental geophysics.

Kirsten L. Siebach
317 Keith Wiess Geological Laboratory
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(713)348-6751
Kirsten is an Assistant Professor in the Rice University Department of Earth, Environmental, and Planetary Sciences and calls herself a Martian Geologist. She researches "source-to-sink" sedimentary processes on Mars and early Earth to interpret the history of water and surface environments early in our solar system.

Yueyang Jiang
317 Keith Wiess Geological Laboratory
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(713)-348-5169
Yueyang is a data scientist with interests in data mining, machine learning, and 3D Vision. He is also an earth system modeler focused on atmosphere-biosphere interactions, biogeophysical and biogeochemical processes in boreal and arctic regions.

Linda Welzenbach
117 Keith Wiess Geological Laboratory
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Linda is the EEPS science writer. She works with faculty, students and alumni on a variety of science communication activities. Her chief responsibility is the management of all EEPS outreach products including the annual magazine Outcroppings, the departmental website, any individual research grant websites, and photography of events, research and field trips.

Bryn Dugre
111 Keith Wiess Geological Laboratory
bryn.dugre@rice.edu
(713)-348-2558
Bryn is our Department Operations Administrator. She coordinates the administrative services of the EEPS department. To schedule appointment to use the VizLab, please contact Bryn.

# 2 Getting started

## 2.1 Signing up

Sign you name and your studio using time in the notebook, which is on the desk right side of the monitor wall, as seen in Figure 6.

Please check the VizLab calendar at https://earthscience.rice.edu/research/facilities/visualization-rooms-calendar/, to avoid any time conflict.


Figure 8: Signing up.

## 2.2 Powering on the projection wall

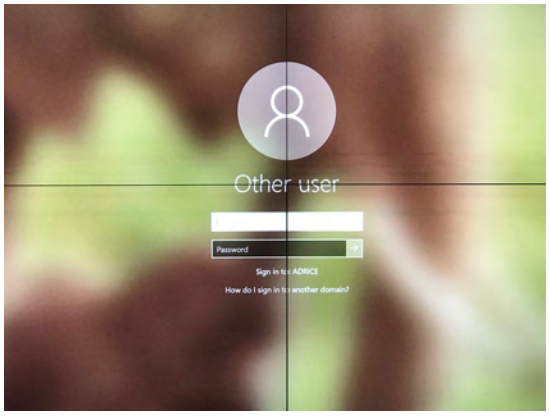
To power on the monitor wall, tap the control pad on the left side of the monitor wall. After the window comes out, click "Power on" button. The powering on of 16 monitors needs time. Please be patient. You can also turn on or mute the audio.


Figure 9: The control pad of the monitor wall.

## 2.3 Logging In your Rice NetID

Once the monitor wall is powered on, choose login other user, then log in Windows using your Rice NetID (Figure 9).

If you don't have a Rice NetID, you might want to contact our VizLab data scientist, Yueyang Jiang for a solution (his office is KWGL 305).




(a) The log-in screen.

(b) Inputting devices.

Figure 10: Login screens.

## 2.4 Data uploading

To connect your data to the lab workstation, you can upload data through online tools(e.g., BOX), email, or through the USB hub on the desk (Figure 11). Please make a new folder for your use. Once you finish the use of VizLab, you can simply delete your entire folder.

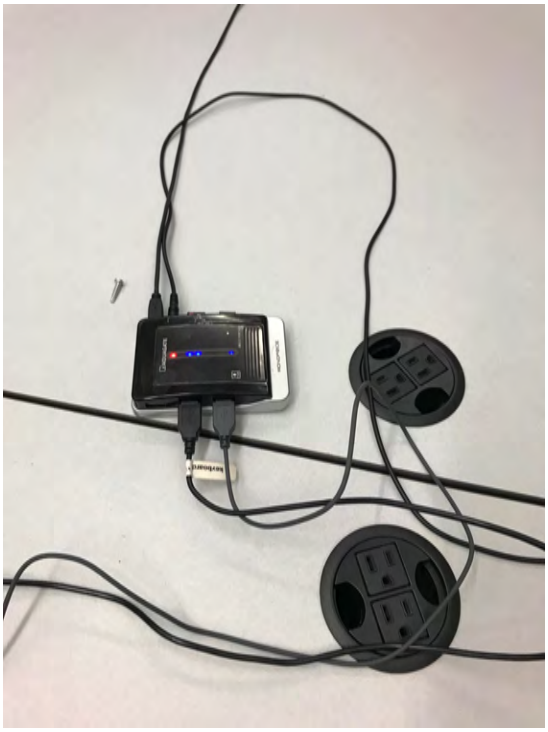


Figure 11: The USB hub used for data transfer.

## 2.5 Visualization Software

The workstation at VizLab provides two main software for 3D visualization, Paraview and Stereoscopic Player (Figure 13), and other programs including: ArcGIS, Blender, GeoTeric 2018, Google Earth Pro, Matlab, Move, PaleoScan, and Petrel. This manual provides guide for Paraview, Stereoscopic Player, and Google Earth Pro.

Figure 12: The logo of ParaView (left), and Stereoscopic Player (right).


Figure 13: The logo of Google Earth Pro.

# 3 Paraview

## 3.1 NetCDF data

Open the Paraview application from the desktop, and in the software window.

Click **File** on the file menu bar, then click **open file...**, select your data, then choose the netcdf reader from the **Open Data With** list. Here we choose **NetCDF Reader**. Hit the **Apply** button to actually do the import.

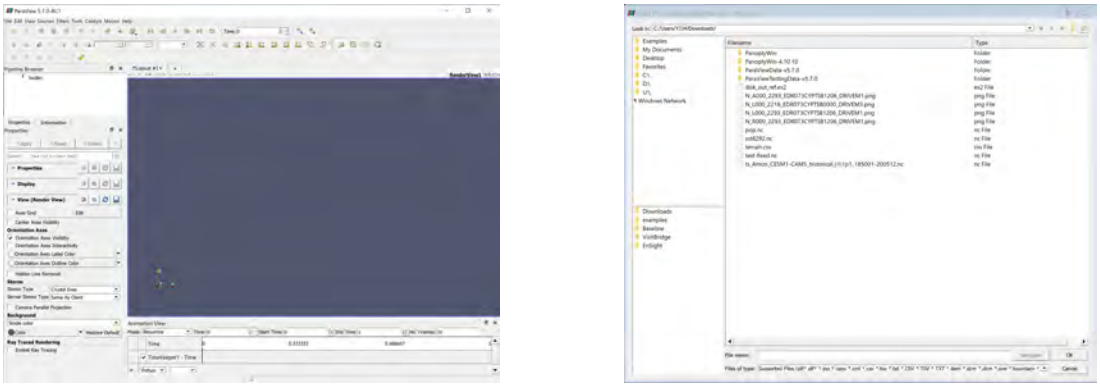


Figure 14: Importing data into Paraview.

Here we use a netcdf file as an example. Once the .nc file is read into Paraview, you can select the **Representation** method, such as **surface** here. Then select the coloring method (Figure 11).

Make sure the **stereoscopic** is checked and the selection is **crystal eye**, if you want a stereoscopic view. Select **Fill missing value with NaN** on the bottom, if the .nc file contains missing values.

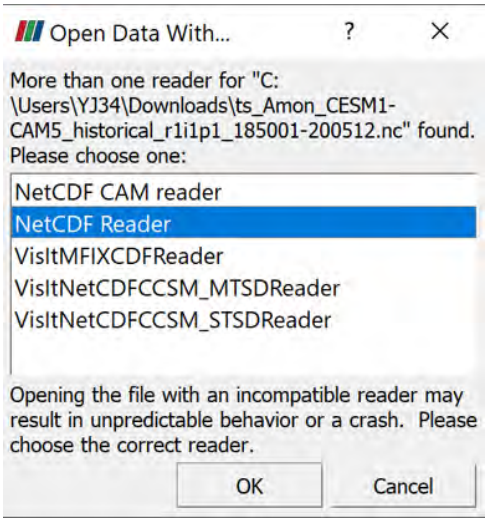



Figure 15: NetCDF Reader.

It will show a 3D planet with gradient color showing the surface temperature as in Figure 13. It the data has temporal domain, you can click **play** on the top tool bar to show animation of the time series.

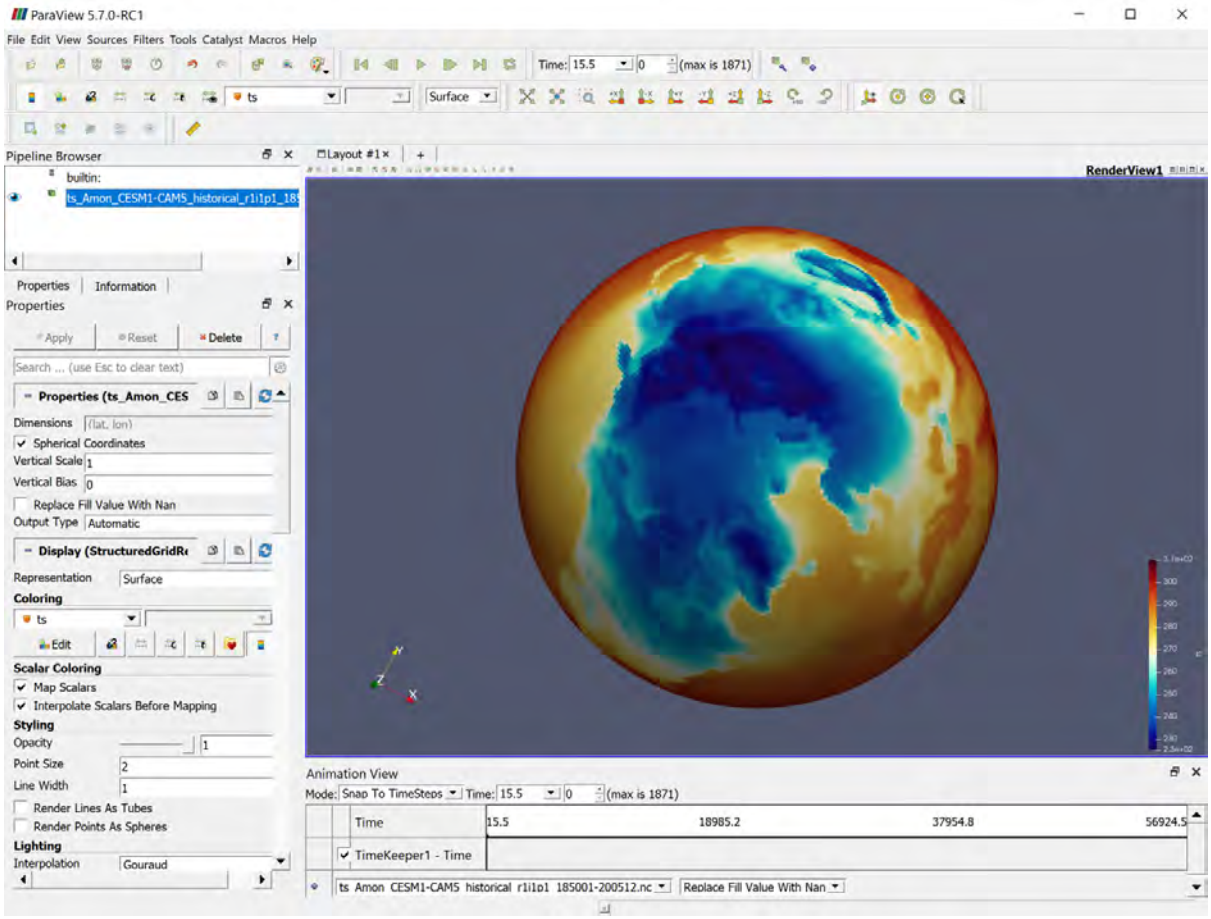



Figure 16: 3-D planet colorred by surface temperature.

## 3.2 Terrain data

Click **File** in the file menu bar, then click **Open**, choose your CSV file. Then click **Apply** to read the data. A table window will jump out to show the content of the CSV file. If table is not shown correctly, you need to double check the format of your CSV file.

Click **Filter** from the file menu bar, choose **Alphabetical**, then **TableToStructuredGrid**. Fill in the **Whole Extent** boxes with the first and last index in each dimension. Fill the "X Column", "Y Column", "Z Column" with you X,Y,Z coordinate. Click **Apply** to execute the filter.

Choose **Surface** in the **Representation** list. You will say a pure color terrain image as shown in Figure 16.

To correct the scale, **Transform Filter** to scale the X scaler to 1.14925.

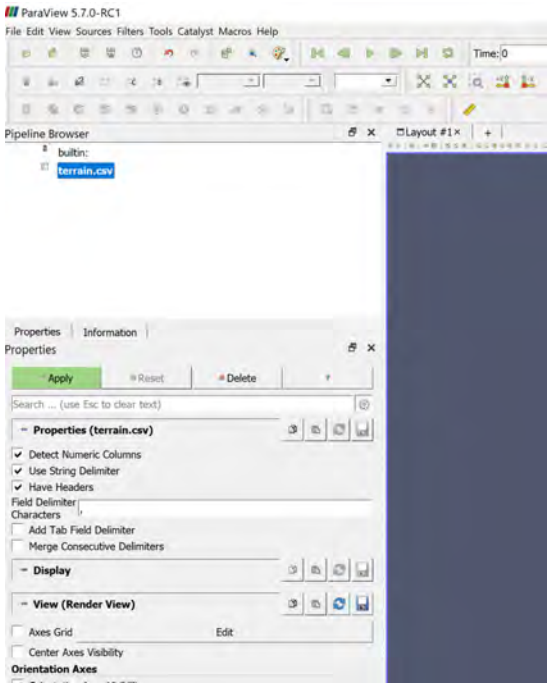



Figure 17: Importing terrain data.

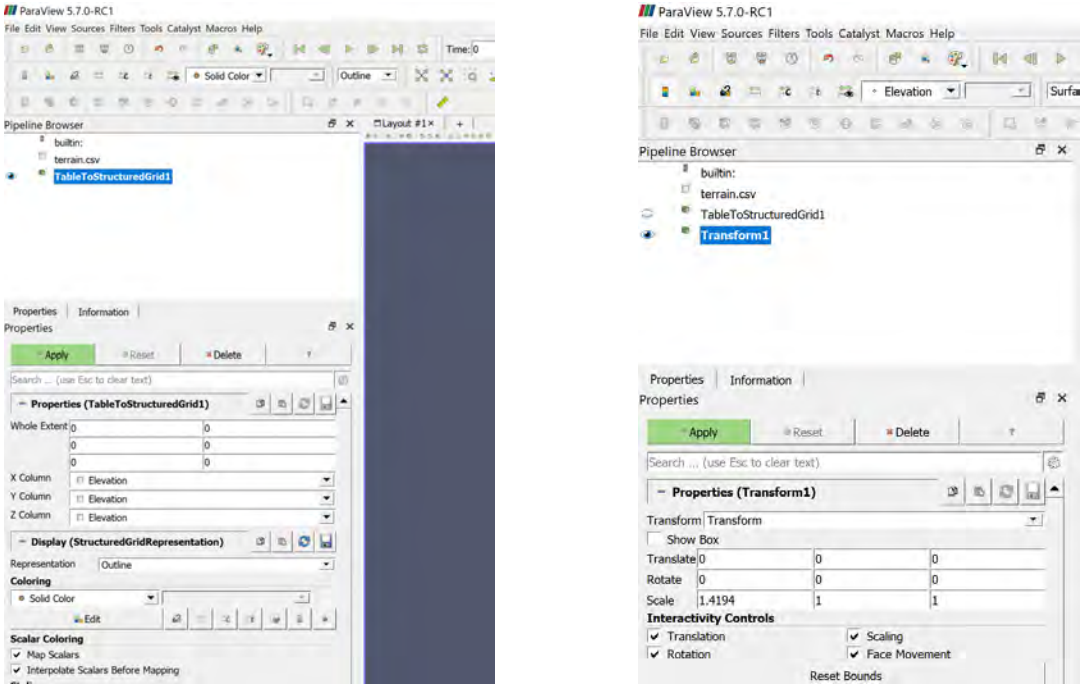



Figure 18: Filter: Table to Structural Gird (left) and Transform (right).

Choose your desired coloring for the terrain surface.

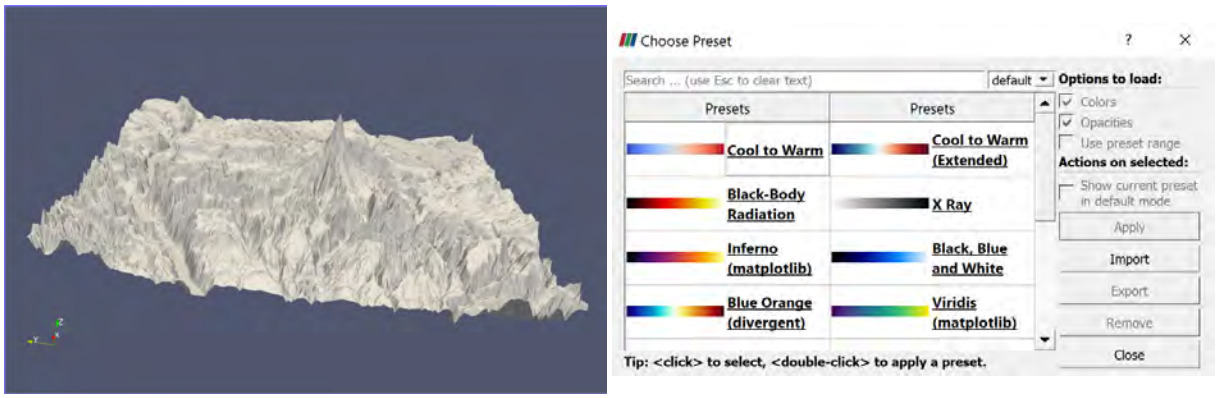



Figure 19: 3D terrain image with no plain color (left) and preset color scheme for choosing.

A 3D colored terrain image will be displayed as Figure 17.

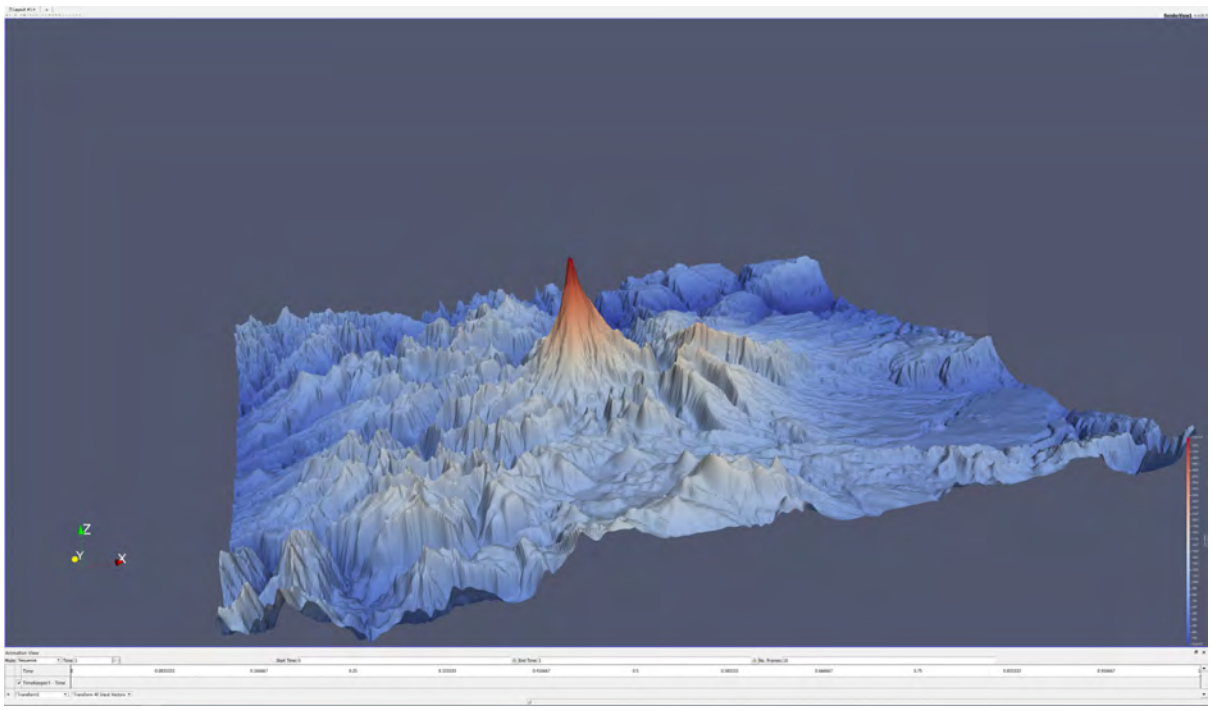


Figure 20: Scale-corrected 3D terrain image with gradient color scheme.

## 3.3 Point cloud

In the lab workstation, the Point Cloud Library (PCL) is compiled into the Paraview software. PCL is a well known and versatile open-source C++ library for working with point cloud data, with functionality for keypoint extraction, alignment, segmentation, etc. It is a standalone, large scale, open project for 2D/3D image and point cloud processing. It is released under the terms of the BSD license, and thus free for commercial and research use.

We have compiled an open source PCL plugin to bring a subset of this functionality into ParaView. The PCL plugin provides support for conversion of all PCL point types and the implementation of several PCL filters.


Figure 21: PCLPlugin logo.

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## 3.4 Advanced 3D data visualization

Coming soon.....

# 4 Stereoscopic Player

## 4.1 Importing data

Here, we used an example with both left and right observing images. Click **File** in the file menu bar, then click **Open Left and Right File...**.

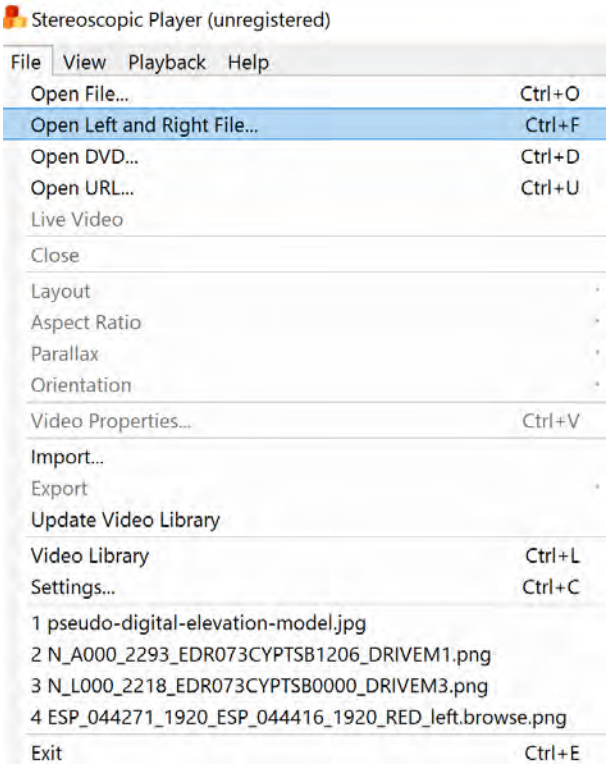



Figure 22: Importing data.

Choose your left side image, and right side image. Then click **OK**.

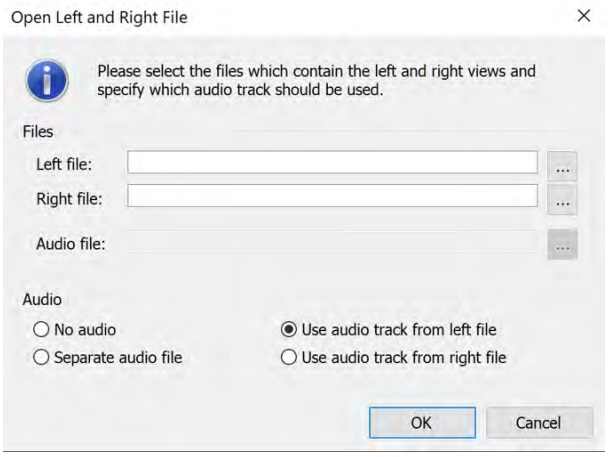



Figure 23: Choosing left and right images.

## 4.2 Visualizing data

Click **View** in the file menu bar, then click **Preferred Viewing Method** and choose **Stereoscopic**.

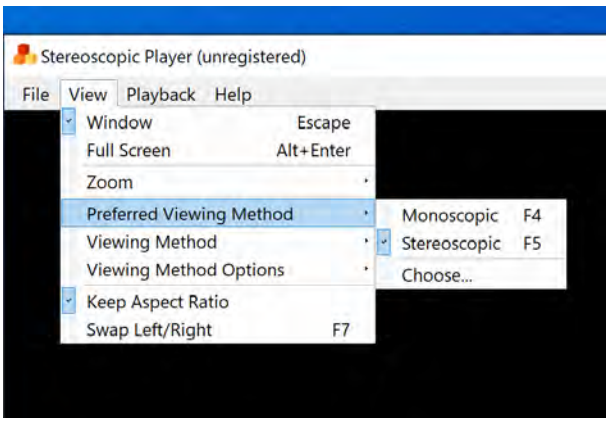



Figure 24: Preferred viewing method.

Click **View** in the file menu bar, then click **Viewing Method** and choose **Quad Buffered OpenGL**. Then a 3D stereoscopic image will be displayed.

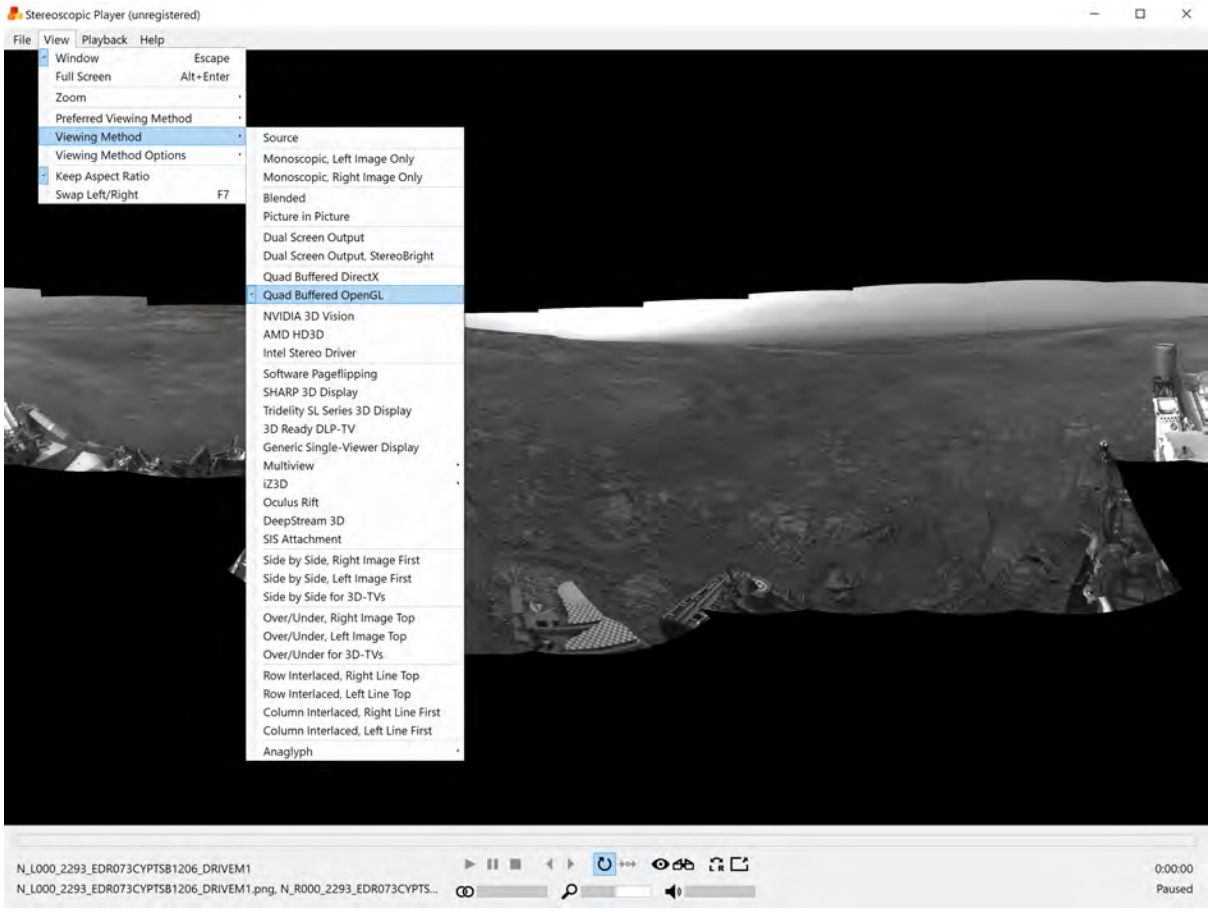



Figure 25: Viewing method.

# 5 Google Earth Pro

## 5.1 Importing data

A common data format used in Google Earth Pro is the .kml file. To date, major image processing software, such as ENVI, ArcMap can produce .kml file. The Geodata providers (e.g., NCAR) also provide maps in .kml format.

There are many software that can produce .kml files. For example,

Import your KML map data into Google Earth Using Google Chrome on your computer, open Google Earth. On the left, click My Places . Click Import KML file. Choose the location of the file you want to upload. Select and open the KML file. A preview of the list will open in Google Earth. To keep these places in your list, click Save.

Using Google Chrome on your computer, open Google Earth. On the left, click My Places . Click Import KML file. Choose the location of the file you want to upload. Select and open the KML file. A preview of the list will open in Google Earth. To keep these places in your list, click Save.

If you have a KML file from previous versions of Google Earth, you can view it in Google Earth for web browsers.

First, to view KML files, click Menu Menu and then Settings Settings and then Enable KML file import and then Save. Using the web browser on your computer, open Google Earth. On the left, click Projects Project. Click the New Project button. To add a file directly to your computer, select Import KML File. To add a file from your Google Drive or a shared file, select Import KML file from Drive. Select the KML file you'd like to view. The files will be automatically saved to your KML files within Projects.

Here, we used an example with both left and right observing images. Click **File** in the file menu bar, then click **Open Left and Right File...**.

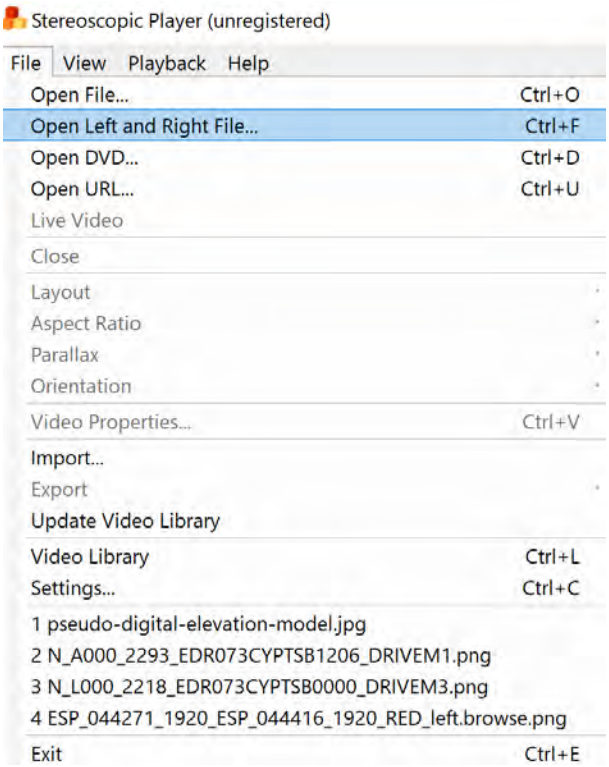



Figure 26: Importing data.

Choose your left side image, and right side image. Then click **OK**.

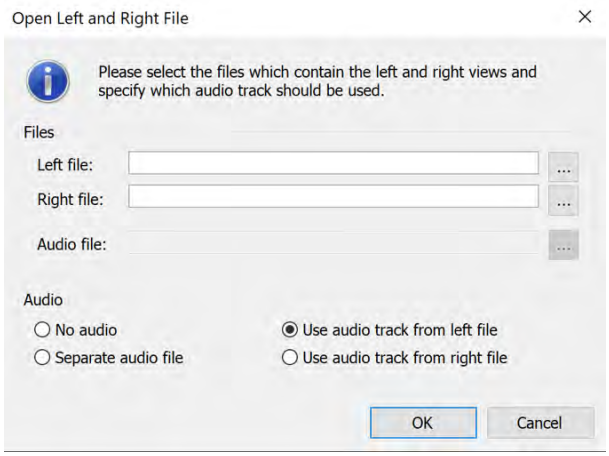



Figure 27: Choosing left and right images.

## 5.2 Visualizing data

Click **View** in the file menu bar, then click **Preferred Viewing Method** and choose **Stereoscopic**.

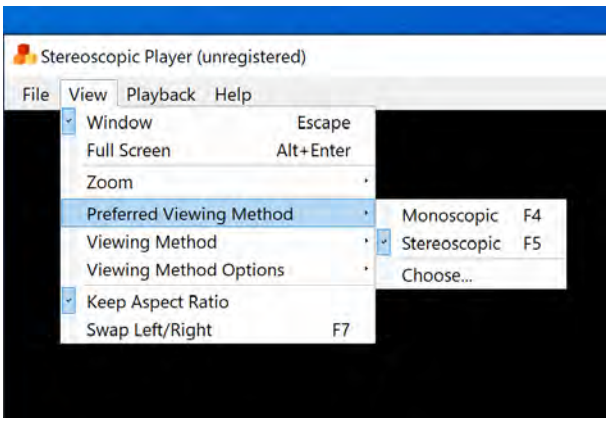



Figure 28: Preferred viewing method.

Click **View** in the file menu bar, then click **Viewing Method** and choose **Quad Buffered OpenGL**. Then a 3D stereoscopic image will be displayed.

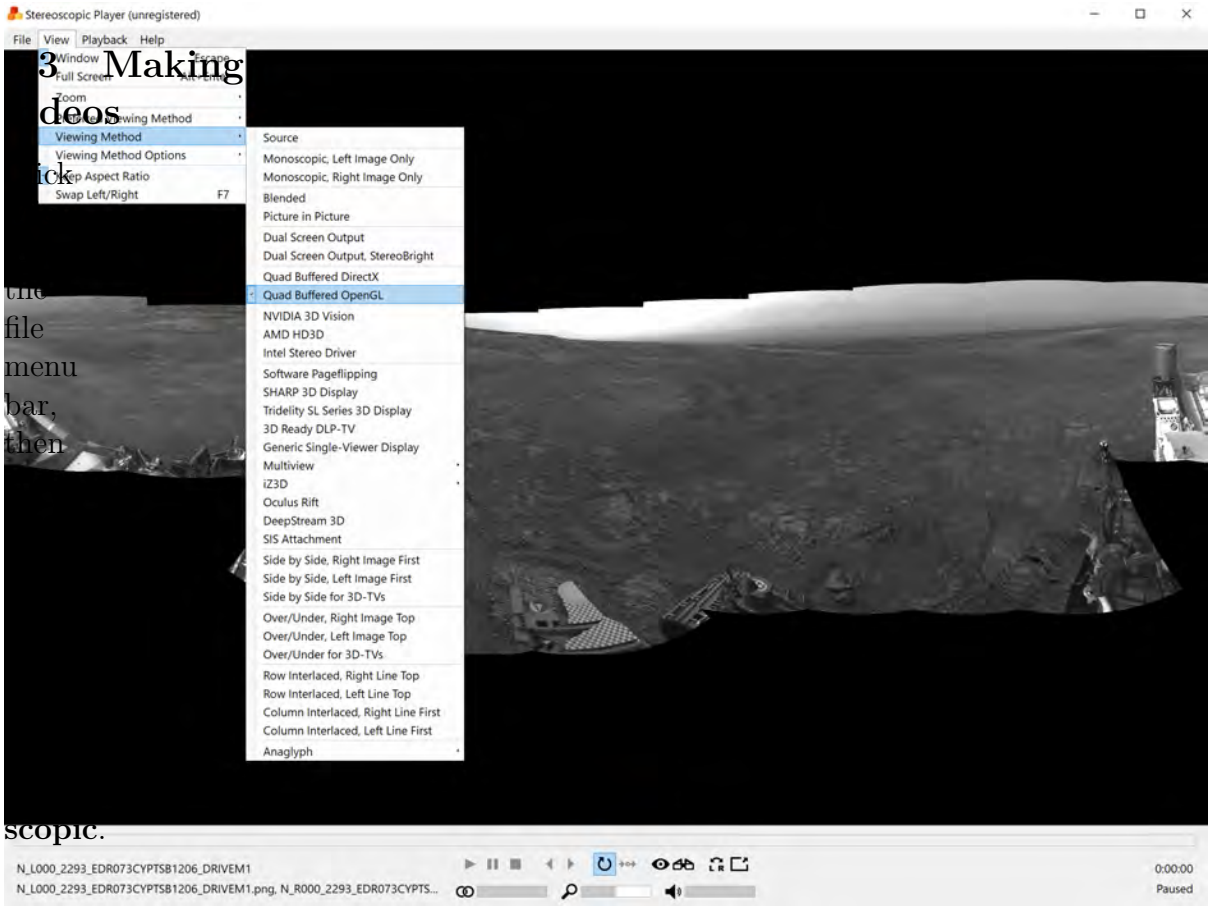



Figure 29: Viewing method.

Click **View** in the file menu bar, then click **Viewing Method** and choose **Quad Buffered OpenGL**. Then a 3D stereoscopic image will be displayed.

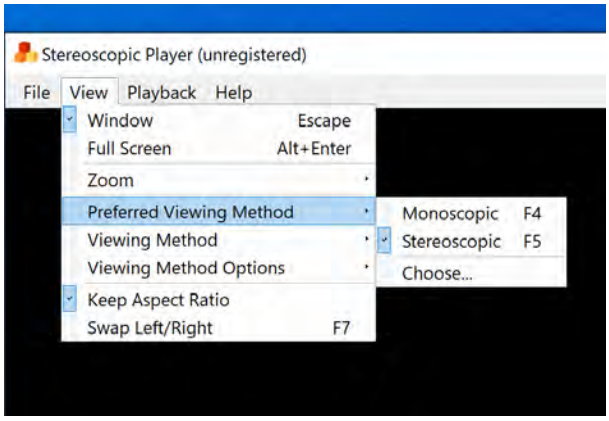



Figure 30: Preferred viewing method.

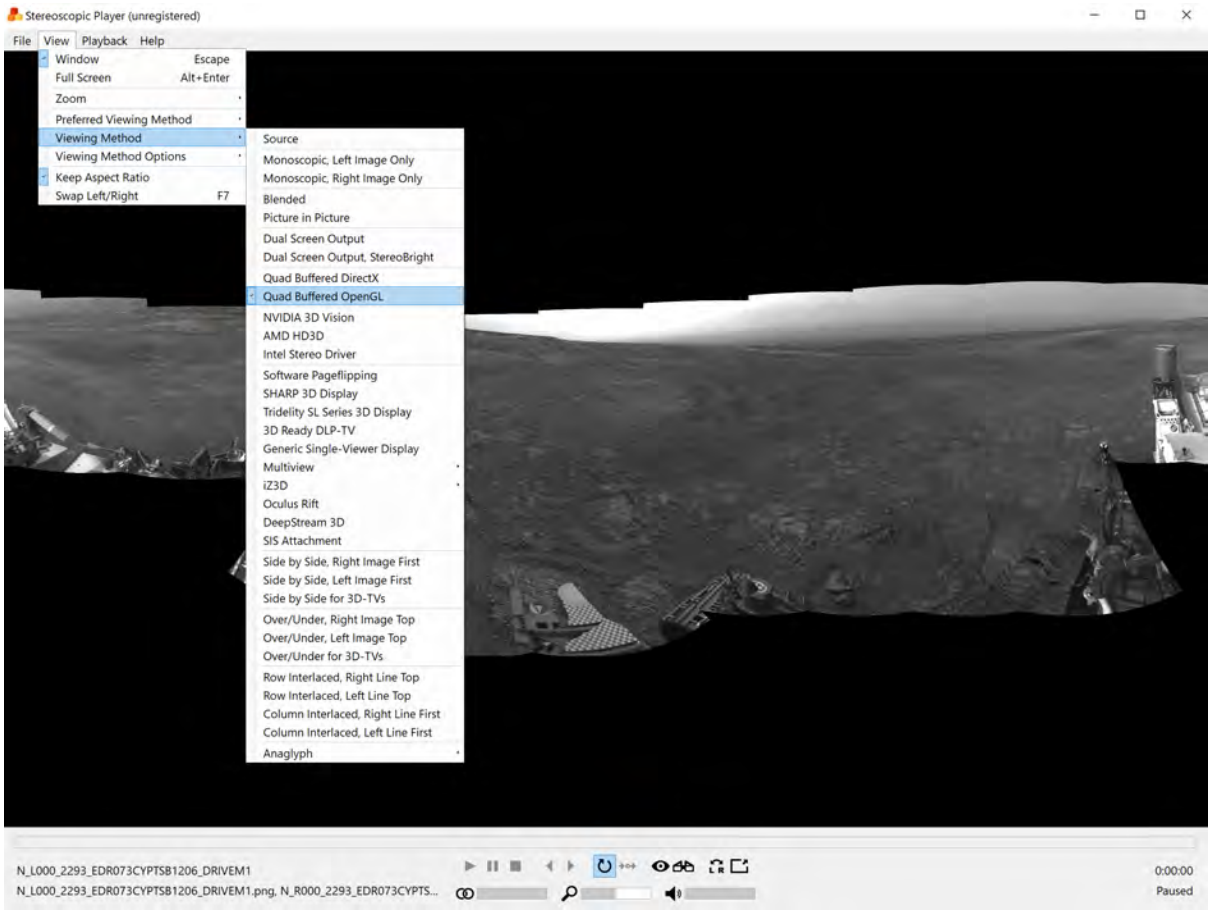



Figure 31: Viewing method.

# 6 Our Gears

## 6.1 3D glasses

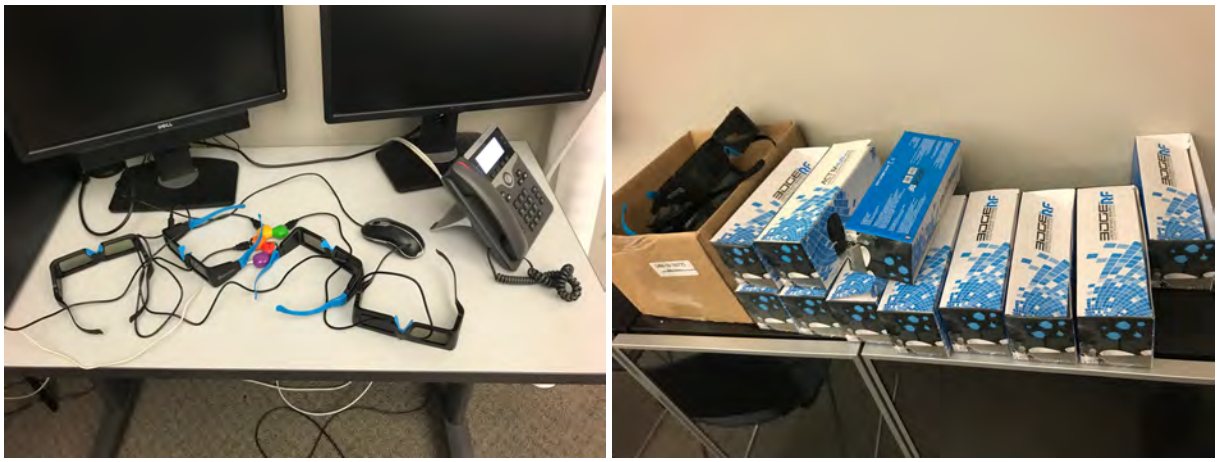


Figure 32: 3D glasses.

In Vizlab, you can use two types of 3D glasses: 1) Active 3D glasses with RF link and 2) IR RF 3D glasses for Virtual Reality. You can find the glasses in the two places showing in Figure 23. After using the 3D glasses, please recharge them by plugging in the mini-USB port where you got the gears.

## 6.2 Backup monitor

The Vizlab also provides a 56-inch monitor for backup use. In case the 4 x 4 monitor wall does not fulfill your need, you can use this backup monitor. A HDMI connector is used to connect you computer to the monitor. Please don't touch the monitor's screen. We have a remote for it.

## 6.3 White Board Camera System

The Vizlab also provides a Kaptivo White Board Camera System for live white board sharing and video conferencing via software (e.g., Skype, Zoom, WebEX).

Figure 34: Kaptivo White Board Camera System in the VizLab.


Figure 35: "Start" button to use the white board system.

In the next two papers, we attached the Guide for Kaptivo White Board Camera System, created by the IT office, Rice University.

# Kaptivo White Board Camera Quick Guide

## Digital White Board Collaboration

Online info: go to kb.rice.edu and search for “Meeting Rooms”

## Usage

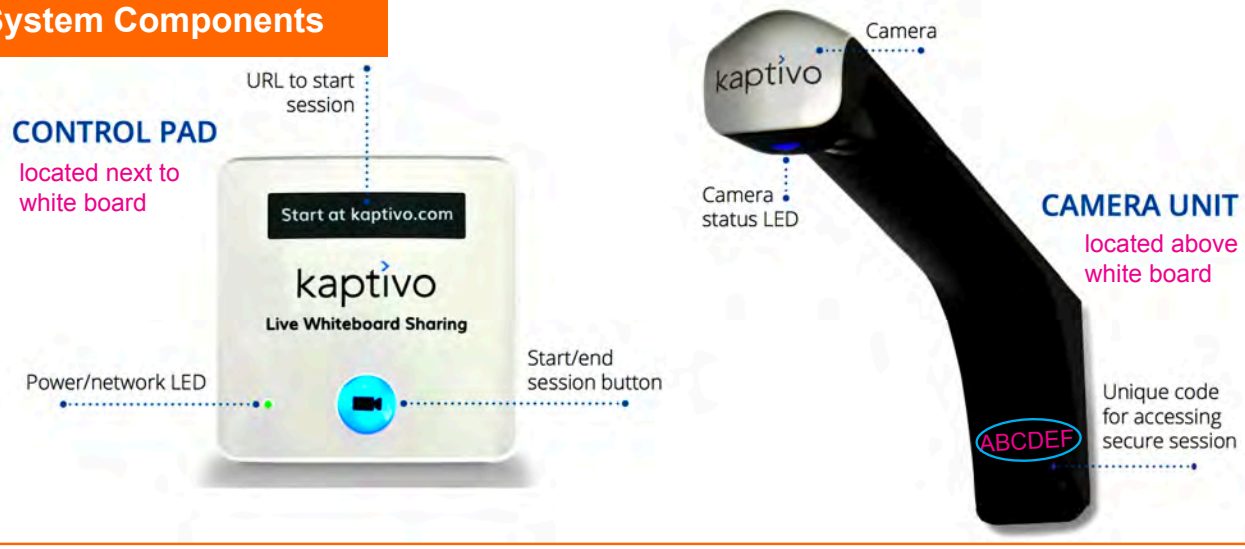
The Kaptivo system allows for live white board sharing and small group collaboration as well as capturing images of the slides. There are a few subtle differences, so consider if you only want materials to be visible during your presentation or if you want individuals to retain copies.

**White Board Sharing Only**
Used as a white board sharing tool, Kaptivo can record a series of images of the white board as it is updated in presentations or collaborative discussions. It could be used in a classroom setting where it can be difficult for students to see the white board. The Kaptivo system can display the white board on their laptops.

Participants can also download the white board contents (limited to 15 participants). Presenter invites watchers in the Participants buttons.

**Video Conferencing**
The Kaptivo system can be used in conjunction with video conferencing software (i.e. Zoom, Skype, WebEx). Individuals participating via the video conference are not be able to download the slides. Kaptivo doesn’t limit the number of participants. Presenter distributes the URL of the Kaptivo web page via the sharing options in the video conferencing software. Note: depending on how you invite them- you can have both individuals who can only see the white board live (given URL in video conference) and those who can download the contents (shared link to participants in Kaptivo).

## System Components




## Tips

A five second delay occurs from writing on the board to online display, which is when the system removes the presenter from the image.

The largest area the camera can scan is 6 feet wide by 4 feet tall but it can be configured to for smaller white boards. Larger white boards should have the capture area delineated.

The Kaptivo system creates new snapshots of the white board after major changes, such as erasing a major section of the board or changing the color marker used. An algorithm determines when to take a new snapshot so there is no way to force a new snapshot.

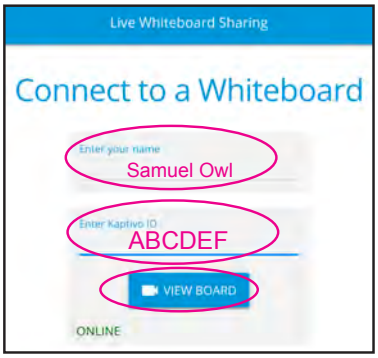
The download link is active for 1 hour after the session is terminated or until the next session begins. For best practice, download immediately after the session.

12-6-18

1. To start session, go to: http://kaptivo.com

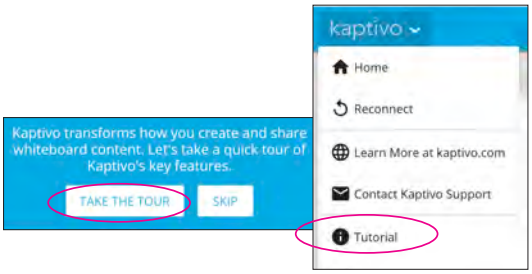
2. In the upper right corner of the web site, click


3. Enter your name and the Kaptivo ID code, which is located at the base of the camera unit and is unique to each room.

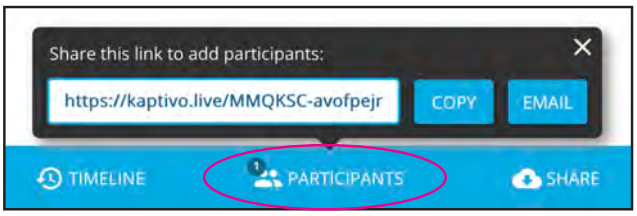



4. Click the view board button. On the control pad, next to the white board, press the start session button when it flashes blue.

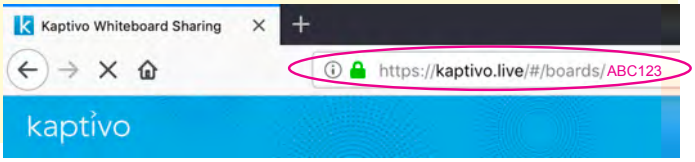

You are given the option to take a tour or you can view a tutorial off the main Kaptivo menu.



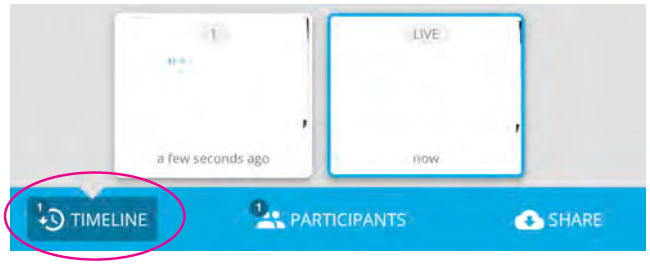

5. To invite up to 15 people to view the white board, select the Participants button. (These individuals will be able to download copies of slides.)




Note: To invite people via the video conferencing tool of your choice, share the URL located at the top of the web screen. (These individuals can only view slides.)

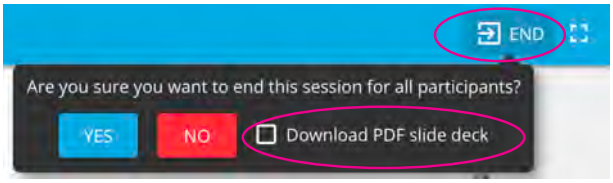



6. The Timeline button lets you jump back in time to previous slides. Just click on the thumbnails to move around.




7. You can use the Share button to distribute a single slide or snapshot in .png format with others or the entire slide deck in .pdf format.


8. When you are done with the session, click the End button in the upper right corner.




You will be prompted about two actions. Do you want to end the session? Click Yes or No. And then if you want to download the final slide deck in .pdf format, click the option box.

## 6.4 Glass boards

Vizlab provides two black surface glass boards for your use.

Figure 36: Two glass boards with black surface.

# 7 Supplemental materials

## 7.1 References

***Paraview*** - https://www.paraview.org/paraview-guide/

***Stereoscopic Player*** - https://www.3dtv.at/Products/Player/Index_en.aspx

***Matlab*** - https://www.mathworks.com/help/pdf_doc/matlab/index.html

***ArcGIS*** - https://desktop.arcgis.com/en/arcmap/latest/get-started/introduction/arcgis-tutorials.htm

***Google Earth*** - http://earth.google.com/intl/ar/userguide/v4/index.htm

***Move*** - https://www.mve.com/resources

***Geoteric*** - https://www.geoteric.com/tutorials

***PaleoScan*** - http://www.eliis.fr/products/paleoscan%E2%84%A2-software

***Petrel*** - https://www.software.slb.com/products/product-library-v2?itemid={6BD29832-1E8A-4F26-AE73-A869E2AF7779}&tab={9FD130BC-C048-43A4-9665-6E879EA62FF7}

## 7.2 Getting help

This user guide tries to cover most of the common use of the VizLab. If you look for some uncommon use or meet some technical issues, please check with our data scentist, Yueyang Jiang, whose office is KWGL 305. A more emergent option is to ask Rice IT help desk at the number of 713-348-HELP (4357) or by email helpdesk@rice.edu. The Vizlab has a land phone for campus calls, as shown in Figure 28.

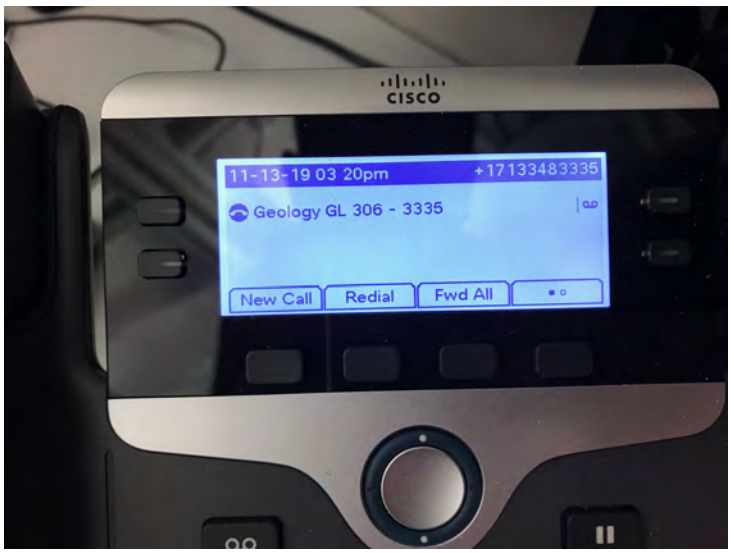



Figure 37: Land phone in the Vizlab.

## 7.3 Problems' Solution

If you meet any problem, like the following ones in using the monitor wall, please contact Yueyang Jiang in office 306.

Problem 1 **Flickering**

Figure 38: Flickering in monitor display.

Problem 2 **Asynchrony**

Figure 39: Asynchrony in refreshing rate.