Virtual Observatory Virtual Reality

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Abstract

The virtual observatory (VO) and its standards have become a success story in providing uniform access to a huge amount of data sets. Those data sets contain correlations, distributions, and relations that have to be unveiled. Visualization has always been a key tool to understand complex structures. Typically high-dimensional information is projected to a two dimensional plane to create a diagnostic plot. Besides expensive stereoscopic visualization cubes, only stereoscopic displays provided an affordable tool to peek into a three dimensional data space.

We present a low-cost immersive visualization environment that makes use of a smart-phone, a game controllers and Google cardboard. This simple equipment allows you to explore your data more natively by flying through your data space. The presented software consists of a central server application running on a computer and a client implementation performing the rendering on multiple smart-phones, enabling users to inspect the data jointly. As the server application uses the VO simple application messaging protocol (SAMP), it is seamlessly integrated with other VO tools, like topcat or aladin. Access the data in the usual way and employ Virtual Observatory Virtual Reality (VOVR) to explore it.

4 Reasons to use VOVR

immersive

Being in the data and flying through the data is more than just having a 3D screen. The perception of depth together with the head-tracking provides an immersive access to your data. It appears to be more natural to turn your head or look down, to orient yourself in space, instead of navigating with a keyboard in front of a computer. In contrast to just inspecting a projection, spatial relations and the notion of distance can be perceived better when literally moving through your data.

affordable

The costs of VOVR are really low. There is no need to invest huge amounts of money in dedicated solutions. Visualization cubes or hyper-walls typically demand their own cluster to provide sufficient compute power to generate the required data stream. VOVR provides another solution with lower performance, but in an affordable way. You just put your mobile phone in a stereoscopic viewer like the one invented by Sir Charles Wheatstone in 1833, or the re-invented one by Google. By attaching an off-the-shelf gaming controller, like an X-box controller, you can start navigating through space. A Google cardboard viewer together with a game controller can be bought for approx $20. Excluding the mobile device that most people already have, this is the cheapest solution to immerse yourself.

easy

With the orientation sensors and accelerometers of the mobile devices the majority of user interactions is done in a very natural way. By simply moving your head, you can change the field of view. The navigation with the gaming controller is so easy, that digital natives can use it, instantaneously. Companies invested millions in making the usage of such input devices as easy as possible; something we now can profit from. Newbies, including small children, typically just need a few minutes to get use to navigating though data space. If you don't believe this, try it!

free

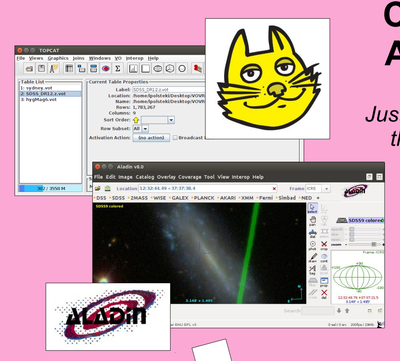
VOVR is completely free. Both, the server and the clients can be downloaded for free. The server is written in Java and therefore runs on multiple platforms. Pre-compiled clients are provided for Android, Windows, Linux, and Mac OS. In addition to the compiled software, the sources are available, too. The software is published under the GPL v. 3 and can be used free of costs.

Installation

- *go to our web-page (qr-tag)*
- *download the server jar-file*
- *make sure a WIFI network is available*
- *start the server (java -jar vovr.jar)*
- *download and install the client*
- *make sure the config file is your client folder (e.g. /Android/data/org.hits.vovr/files/vovr.cfg)*
- *enjoy your data in 3D*

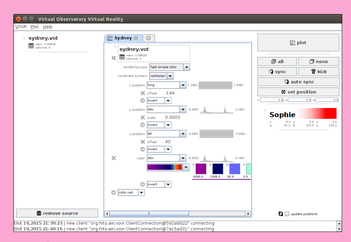
Client-Server Architecture

Just import data through the simple application messaging protocol (SAMP) from, e.g. topcat or aladin. If your data is in the VO you can access it directly. Otherwise import it from file.



SAMP

Specify your plot by selecting the data source and values to be presented and send the preprocessed data to the connected clients.



WIFI/ network

mobile phone client

standalone PC client

view your sources:
a list of all imported sources, with basic statistics.

manage your plots:
rename, remove and create new plots.

do your plots:
- send plot data to the clients
- abort sending of plot information

define plot type:
select from three different types of plotting:
- sprite texture
- multi texture
- fast simple points

manage the clients:
a list of all connected clients allows to:
- check where the clients are
- select dedicated clients
- activate synchronization of positions
- change position
- disconnect clients

define value modification:
- apply log scale
- [0,1] normalization
- scale with factor
- adding offset
- inverting values

define texture:
select a texture from a large set of available shapes or add an own texture from file

define color:
select a predefined color map or define your own color gradient. Assign an individual color to as many values as you like.

define coordinate system:
choose between cartesian and spherical coordinates

multi texture:
this plot type allows to specify an individual texture file for each individual entry by selecting a column.

drag sources:
to add to plot or to replace

column pre-inspection:
see a simple histogram and minimum/maximum values when selecting a column.
- simplifies modification
- gives good overview
- improves selection of discriminative columns

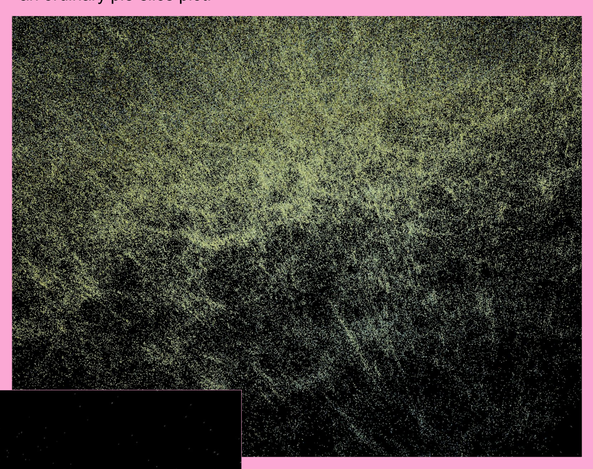
specify position:
at least 3 values have to be selected to specify a 3D position:
- table columns
- fixed values

specify extra properties:
Depending on the selected plot type additional properties can be added and removed:
- color
- color-red
- color-green
- color-blue
- color-alpha
- texture
- size

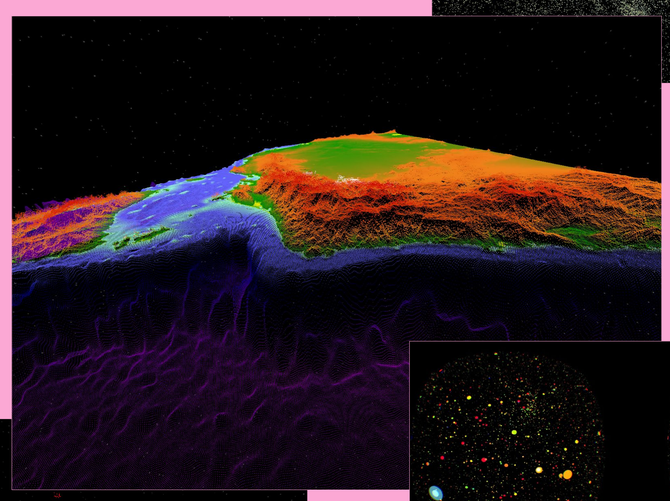
auto update:
enables automatic updating of client positions.

message bar:
tells you what is going on.

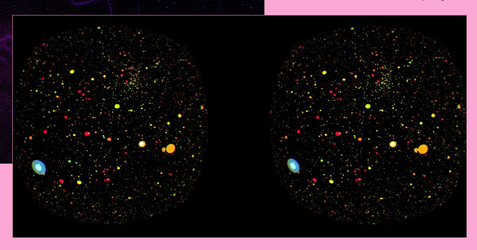
simple points:
use millions of simple points to understand the density distribution of your data. All SDSS galaxies with spectroscopic redshift allow you to fly through the cosmic web. 3D is completely different than an ordinary pie-slice plot.



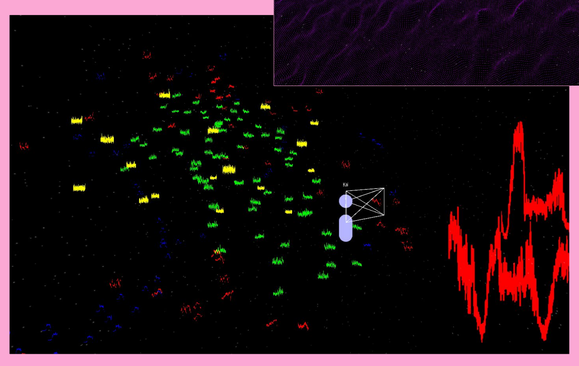
simple points:
visualize surfaces with additional color coded information. Here you see southern Australia on a grid with 1km resolution.



sprite texture:
use a smooth point to show objects that mimic a sphere. Below you see 100k stars in the surrounding of our sun. Size and color reflect physical properties. Note the binocular display.



multi-texture:
use individual textures for each object to visualize complex data, like time series data from X-ray binaries. When using VOVR with multiple clients, you can see each other and discuss what you see.



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