

Exoplanets data visualization in multidimensional plots using virtual reality in DACE

F. Alesina,¹ F. Cabot,¹ N. Buchschacher,¹ and J. Burnier¹

¹*Observatoire astronomique de l'Université de Genève, 51 ch. des Maillettes, 1290 Versoix, Switzerland*

Abstract.

The Data and Analysis Center for Exoplanets (DACE) is a web platform based at the University of Geneva (CH) dedicated to exoplanets data visualization, exchange and analysis.

This platform is based on web technologies using common programming languages like HTML and JavaScript. During the past 3 years, the plotting tools has been improved in order to display large datasets on the platform, dealing with browsers performances constraints.

The next challenge is to display the exoplanets data in multidimensional plots. The web virtual reality technology has been added on DACE, and allows the user to display the data in virtual reality devices like cardboards and headsets.

The virtual reality is used for displaying 3D plots of synthetic planetary populations, discovered exoplanets from different archives, and 3D planetary systems with a star and its orbiting planets.

The used technologies are webVR, external GPUs called eGPUs in order to increase laptop performances, HTC vive pro headset and google cardboards.

1. Introduction

The DACE platform provides advanced visualizations of multidimensional datasets working on the most popular web browsers. With the explosion of virtual reality applications, we decided to explore this technology in order to provides new data visualizations. This project was initiated by a master student in computer sciences, at the University of Geneva and is now fully integrated in DACE on 3 modules.

There are two kind of visualizations possible in virtual reality. The realistic ones, popular and used by people that are interested by the beautiful views provided by professional headsets, and the scientific ones, used by professionals in order to achieve a task more easily than with a screen.

All the following outputs are generated according to the parameters filled in the DACE website and the data available in the DACE database.

2. Planetary system visualization

It is possible to run a dynamical evolution simulation using the GENGA integrator on a Keplerian system found with radial velocities or light curves tools. A 3D animation can

be generated with the integrator and displayed on a web page or on a Virtual Reality device, like Google cardboards or HTC Vive headset.

Since 2015, a webGl animation is showing the short time evolution of the planetary system, with planet trajectories.

This animation was updated in 2018 in order to add a virtual reality output combined to webGl. The result is a web page with a headset button on the bottom right corner. If a virtual reality headset is plugged on the computer, then the animation is exported to the device and a view is displayed on the computer.

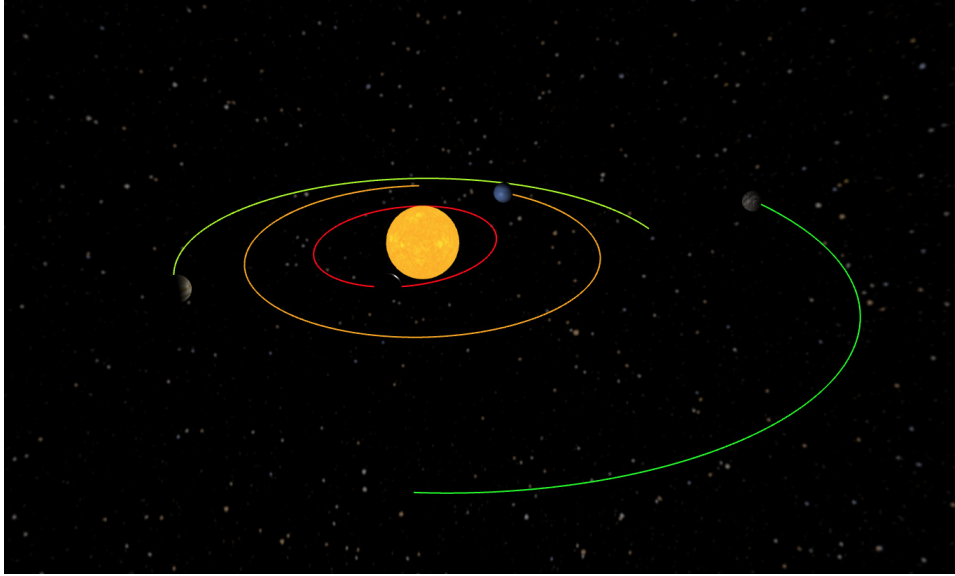


Figure 1. Screenshot of the GENGA webGl animation

The technologies used are webGl, aFrame framework and HTC Vive Pro headset. The controllers of the HTC Vive Pro are used for changing the planetary system orientation.

3. Exoplanets table

After a successful technology test with the planetary visualization, the next step was to find how scientist could use virtual reality to do science. The Exoplanets Table module in DACE provides a table and plot view of this multidimensional data. It was chosen in order to test the implementation of a 3D-Virtual Reality library.

After few month of implementation and using the same technologies as the planetary system visualization, the 3D-Virtual Reality plot library was integrated in DACE. It provides a three dimensional view of the plot, and a lot of user interactions with the headset controllers like data selection, zooms and translations. Other display settings can be changed by the user like points sizes, axes displays, labels, guides etc.

4. Synthetic planetary populations

The Virtual Reality application was extended to the Synthetic Planetary Populations module. Synthetic populations generated by the University of Bern team are available on DACE. We use these models to understand how planetary systems are created and to compare real observations and simulations.

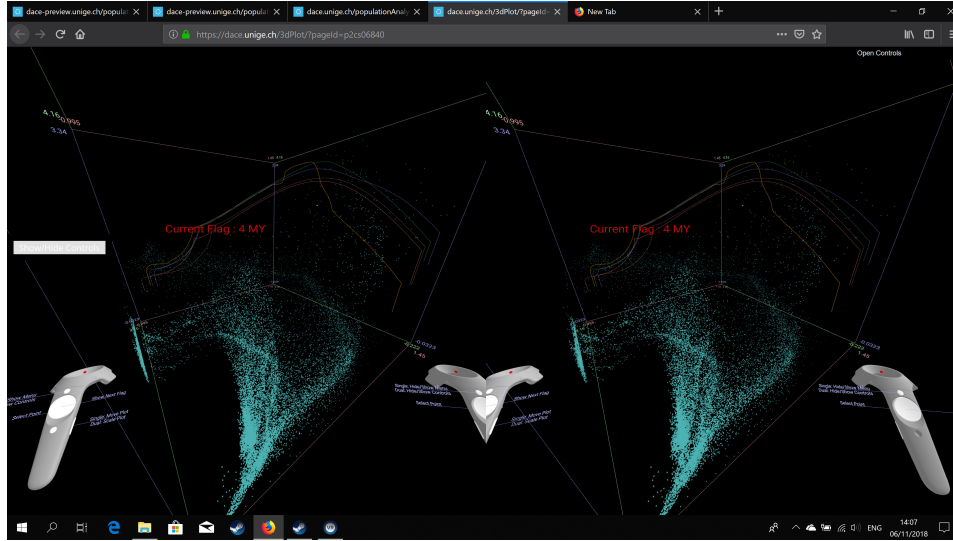


Figure 2. Screenshot of the synthetic planetary populations webGL visualization in virtual reality

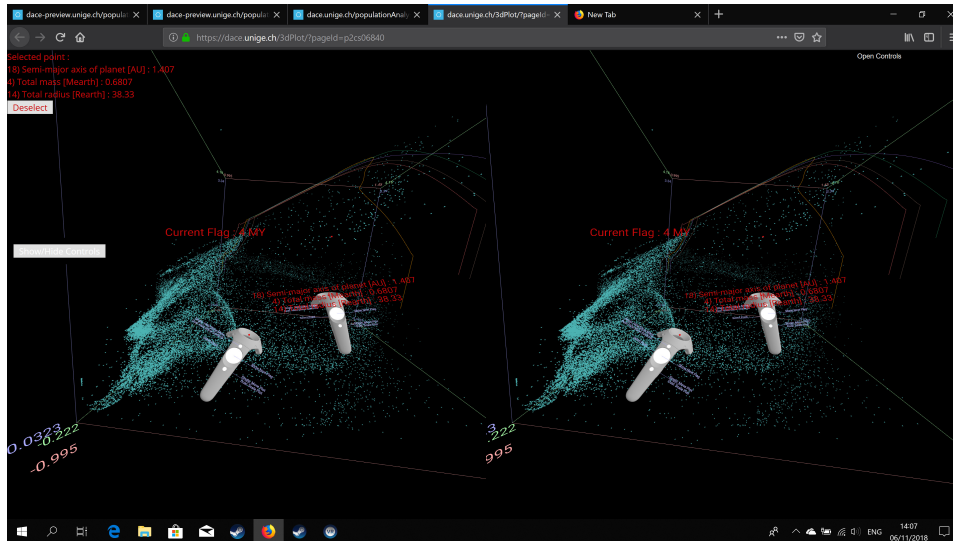


Figure 3. Screenshot of the synthetic planetary populations webGL visualization in virtual reality

With thousands of points, this plot is much bigger than the exoplanets table one. The synthetic populations are a set of snapshots taken at different ages. Each age is displayed one by one, using the buttons of the HTC Vive Pro controllers.

It is also possible to display a track of a planet simulation by using the time as the fourth dimension.

5. Acknowledgements

This work has been carried out within the framework of the National Centre for Competence in Research PlanetS supported by the Swiss National Science Foundation. The authors acknowledge financial support from the SNSF. This publication makes use of DACE, a Data Analysis Center for Exoplanets, a platform of the Swiss National Centre of Competence in Research (NCCR) PlanetS, based at the University of Geneva (CH).