Leibniz Supercomputing Centre
of the Bavarian Academy of Sciences and Humanities

V2C

Fig: Alessandro Podo, LRZ

V2C CENTRE FOR VIRTUAL REALITY AND VISUALISATION AT THE LRZ

SCIENTIFIC VISUALISATION AT THE V2C

The Centre for Virtual Reality and Visualisation (V2C) is working on visualisations with partners and customers from many different fields of research including earth sciences, archaeology, life sciences, architecture, arts and multimedia and engineering amongst others. The source and type of the data varies heavily and ranges from 3D-scans, models created via photogrammetry or handmade art to large data sets resulting from scientific simulations (usually run on the SuperMUC and SuperMUC-NG petascale systems at the LRZ).

LIFE SCIENCES

Being partner of the project “Mr. SymBioMath” that focuses on bioinformatics and biomedicine, the LRZ developed an application that uses the strengths of virtual reality to provide an innovative, three-dimensional way to compare multiple genomes (www.mrsymbiomath.eu).

Zoologists use the installations to analyse various scans of animals. For example, displaying 3-dimensional scan data of tiny animals on stereoscopic screen spanning several meters can reveal even the smallest details and help gain new scientific insight.

Medical applications can benefit greatly from virtual reality. One such application could be the analysis of blood flows through certain blood vessels or how the placement of a stent influences the flow.

Scientific visualisation can provide the key to understand the data produced by complex simulations.

Fig. (top): Coveney/UCL/LRZ
Fig. (bottom): CompEX Project

ARCHAEOLOGY

Several projects the V2C conducted with various partners deal with history of art and archaeology. Historical sites are not always easy to visit: some have been destroyed, gaining access can be hard due to access restrictions or they may just be very far away and hard to reach. Digital models provide an easy way to "visit" such sites in virtual reality and analyse them from any desired perspective. Projects conducted at the V2C also included digital reconstructions: This enables scientists to observe objects in their original as they were hundreds, sometimes even thousands of years ago.

HISTORY OF ART

One example for such a project is the virtual model of the chamber chapel in the Schleißheim New Palace in Germany. A high quality 3D-model including very detailed textures makes it easy to study, examine and analyse the room, which is not open to the public, from any perspective.

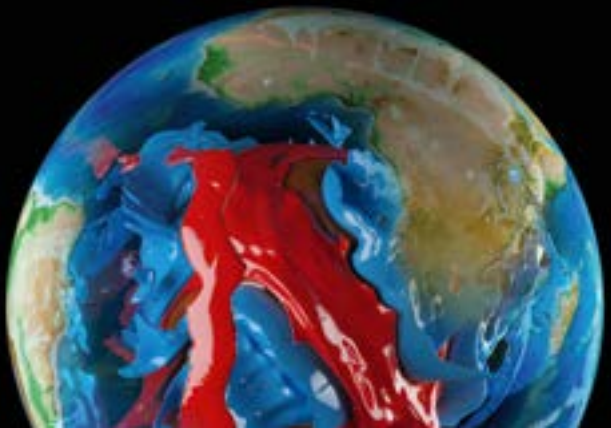
The installations at the V2C have also been used to digitally recreate historical sites and objects. Highly detailed models created using sources like 3D scanners, photogrammetry or sometimes even modeled by hand were used by scientists to experience destroyed sites, analyze objects or to study digital reconstructions. One example for such a cooperation is with the project "bavarikon", which provided highly detailed 3-dimensional models of historical artefacts. (www.bavarikon.de)

Fig. (top): Ute Engel, Karin Guminski and students from „history of art" and „arts & multimedia" (LMU)

EARTH SCIENCES

Several projects have been conducted in collaboration with the V2C in this field of research: The DRIHM project, funded by the EU (www.drihm.eu), researches ways to predict meteorological and climatic phenomena and their effect on the environment.

Seismological data dealing with the propagation of seismic waves has been visualised for the VERCE project, also funded by the EU (www.verce.eu).



Scientists study a simulation of the convection currents in earth's mantle over the course of 200 million years visualised using virtual reality.

Fig: Bunge, LMU

Glaciologists took advantage of VR to analyse the growing and shrinking of glaciers while another project dealt with photorealistic real-time rendering of large terrains.

In cooperation with geophysicists, the V2C has developed a visualisation of the simulation of the convection currents within the earth's mantle. The simulation that covers a time span of 200 million years was computed on the SuperMUC petascale system at the LRZ and produces up to several terabytes of source data that is prepared by the V2C and visualised in real-time.

Another recent cooperation was with the project ClimEx, which investigated the effects of climate change on meteorological and hydrological extreme events and implications for water management in Bavaria and Québec. (www.climex-project.org)

TEACHING

Besides scientific visualisations the V2C is also cooperating with the Ludwig-Maximilians-Universität München (LMU) as well as the Technical University of Munich (TUM) to teach students and provide access to virtual reality devices. Courses are held at the V2C and include: A virtual reality lecture and a course in arts and multimedia.

Fig. (top): Gumiaski, LMU
Fig. (bottom): LRZ

Lecture „Virtual Reality“

This course is aimed at bachelor and master students of the LMU and TUM to teach basics of virtual reality as well as practical knowledge on how to use these devices. To successfully complete the course each student has to implement an application using a VR device. Each year, the V2C organises the „open lab day“ where the students can present their project to representatives of the industry as well as their friends and family.

Course Arts and Multimedia

The V2C partly hosts the seminar “3D software in creative processes” from the LMU Department of Art. In the scope of the course, students model a virtual world and get the chance to visit their creation in the V2C. The seminar provides a basic skillset for 3D modeling especially for virtual reality and acts as a platform for the students to experimentally work out the visual language of VR artworks.

INSTALLATIONS

Built in 2012 the main purpose of the Centre for Virtual Reality and Visualisation (V2C) is to provide access to high-quality virtual reality installations to the customers of the LRZ. The stationary equipment of the V2C is comprised of two powerwalls and a 5-sided projection installation.

Powerwall

One of the powerwalls features a screen with a size of 6m x 3.15m (about 20ft x 6.5ft) using two projectors to project 3D images stereoscopically with four times the resolution of regular HD screens (4096 x 2160 pixels). Additionally, the powerwall is equipped with an optical positional tracking system to provide accurate tracking information.

In 2018 a second 3D-capable powerwall based on the latest LED technology was acquired for the V2C. This technology not only provides excellent colour reproduction, high brightness and contrast values allow to use the installation in a room brightly lit by daylight.

5-sided projection installation

Inspired by the concept of the CAVE (CAVE Automatic Virtual Environment) by Carolina Cruz-Neira this installation enables a user to step into a cube where the sides, floor and ceiling are displays that completely cover the user's field of view. The installation in the V2C has the shape of a 5-sided cube with a side length of 2.7m. Two active stereo HD projectors are used for each wall where one is projecting onto the upper half of the wall and the second one onto the lower half.

Fig.: LRZ

SERVICE

The V2C is a service center for our customers, providing access to virtual reality installations as well as devices. Besides the stationary high quality VR systems of the two powerwalls and the 5-sided projection installation, the V2C also provides a number of mainstream devices such as the HTC Vive, Oculus Rift or Samsung GearVR that customers can use for visualisations or borrow to present their results.

Besides providing access to hardware, V2C team members, who specialise in virtual reality, data preparation and data handling, develop custom visualisations tailored specifically to the needs of our customers based on the datasets they provide.

„Even after working on the simulation of the dynamics of Earth's mantle for over 25 years, there is always something new to discover.

The visualisation developed by the Centre for Virtual Reality and Visualisation of the LRZ allowed us to investigate our results from – literally – new perspectives which opens up the possibility to gain new insight into the dynamics of Earth's deep interior. Moreover, it also created a platform that brings together scientists of various fields allowing interdisciplinary exchange and drawing a more complete picture of the Earth.

We are highly impressed by the professional visualisation of our models and are thankful for the services and facilities provided by the LRZ."

Prof. Dr. Hans-Peter Bunge,
LMU Munich, Department of Earth- and Environmental sciences

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