Improved Data Analysis with Virtual and Augmented Reality

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1. Abstract

The Leibniz Supercomputing Centre (LRZ) of the Bavarian Academy of Sciences and Humanities is not only IT service provider for the Munich Universities but competent and reliable research partner as well. Over the last decade, the LRZ has acquired great expertise in the field of visualisation while focusing primarily on the topics of Virtual Reality (VR) and - more recently - Augmented Reality (AR). Large-scale VR installations (such as CAVE-like systems [1] or ultra-high resolution stereoscopic displays) have been a staple in certain industries for decades. Their complexity and cost, though, have always been a limiting factor and prevented the widespread availability and use. However, thanks to advances in hardware and software development over the last few years, VR technologies have taken a leap forward in terms of accessibility, usability, quality, and affordability, especially with regards to head mounted displays (HMDs).

The LRZ provides visualisation services to the universities as well as to research communities, in the latter case, in the framework of joint research projects. In the area of biomedicine, good examples are the current research projects “DigiMed Bayern” (P4 medicine) and “1000GenomBayern” (rare diseases) as well as several collaborative efforts focussing on the VR visualisation of protein structures, blood flow, and medical volume data, like CT scans. One example is the EC-FP7 project Mr.SymBioMath [2], which developed methods of comparing genomes in VR (as shown in Figure 1).

In this talk, we will focus on the benefits VR can offer to scientific visualisation, especially to the area of biomedicine. Making use of VR and AR technologies, we can follow a new and simple way of data analysis and computer-based learning. Additionally, with current advances in computer graphics inching towards photorealism, we can now not only present abstract models but also almost life-like representations of various (organic) objects, creating a link from wax models used for medical studies of the past to the high-tech solutions of today.

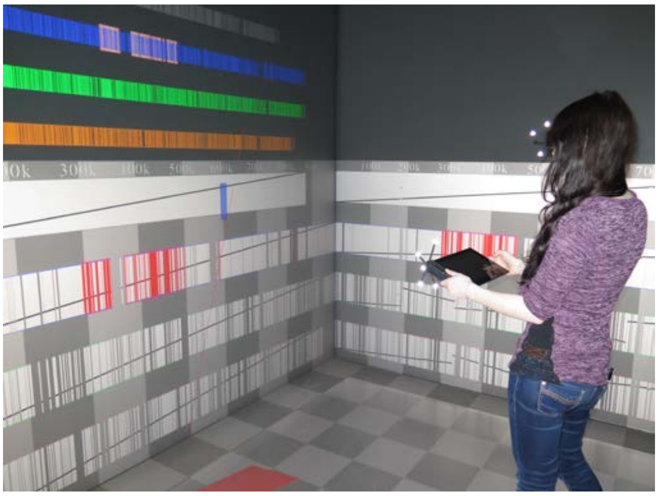

Figure 1 *Genome comparison in VR (Mr.SymBioMath)*

Using projects currently underway at the LRZ as examples, the talk will outline the advantages of using VR for scientific analysis, the potential of this technology and then discuss how it may be used to overcome limitations of 2-dimensional displays, such as the difficulty of understanding spatial relations or interacting with a visualised dataset. In addition, we will illustrate the benefit of full 6 degrees-of-freedom movement available on many current VR and AR devices and point out upcoming features introduced in this field such as hand-based interactions announced for the Microsoft HoloLens 2 [3]. On the other hand, we will also consider issues, limitations, and disadvantages of current VR and AR technologies.

Finally, we will reflect on possible additional applications of these technologies and discuss future developments within this area.

2. References

[1] Carolina Cruz-Neira, Daniel J. Sandin and Thomas A. DeFanti. "Surround-screen projection-based virtual reality: the design and implementation of the CAVE", Proceedings of the 20th annual conference on Computer graphics and interactive techniques. ACM, 1993

[2] Luisa Wurm, Rubén García, Christoph Anthes, Dieter Kranzlmüller and Wolfgang Höhl. "Benefits of Tablet Interfaces for Immersive Visualization in Information Visualization", WSCG 2016 poster paper proceedings, pp 1-4, WSCG 2016, 2016

[3] Microsoft HoloLens 2 Specification, https://www.microsoft.com/en-gb/hololens/hardware, visited 2019-05-27