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Keynote

Cloud-mounted Virtual Reality Experiments During COVID Times

David Glowacki

Abstract

In 1977, artificial and augmented reality (AR) pioneer Myron Krueger began his paper "Responsive Environments" with the observation that "human-machine interaction is usually limited to a seated (person) poking at a machine with (their) fingers or perhaps waving (their) hands over a data tablet." Krueger went on to speculate that real-time, multisensory interaction between humans and machines might enable exciting and efficient new approaches for exploring realities that are otherwise impossible to access. In this talk, I will provide an overview of how cloud computing and virtual reality are enabling new approaches to scientific research, and how such approaches have helped researchers to make progress during despite COVID-related social distancing restrictions. For example, I will illustrate how new tools at the frontiers of human computer interaction (HCI) and high performance computing (HPC) enable groups of researchers distributed across the world to simultaneously cohabit real-time simulation environments and interactively build, inspect, visualize, and manipulate the dynamics of complex biomolecular structures with atomic-level precision, [1,2,3] in order to investigate drug-molecules proposed to target COVID-19. [4] I will also show how such tools are being used to develop experiences which offer therapeutic and mental health benefits that are statistically indistinguishable from moderate to high doses of psilocybin, a serotonergic psychedelic drug that is being used to treat anxiety, depression, and addiction in clinical contexts. [5]

[1] M. O'Connor et al., An open-source multi-person virtual reality framework for interactive molecular dynamics: from quantum chemistry to drug binding, J Chem Phys 150(22), 224703, 2019. DOI: 10.1063/1.5092590

[2] M. O'Connor et al., Sampling molecular conformations and dynamics in a multiuser virtual reality framework, Science Advances 4(6), eaat2731, 2018. DOI: 10.1126/sciadv.aat2731

[3] https://vimeo.com/420036282

[4] H. M. Deeks, R. K. Walters, J. Barnoud, D. R. Glowacki, A. J. Mulholland, Interactive molecular dynamics in virtual reality (iMD-VR) is an effective tool for flexible substrate and inhibitor docking to the SARS-CoV-2, J Chem Info Mod 60(12), 5803-5814, 2020. DOI: 10.1021/acs.jcim.0c01030

[5] D. R. Glowacki et al., Dissolving yourself in connection to others: shared experiences of ego attenuation and connectedness during group VR experiences can be comparable to psychedelics. arXiv: 2105.07796

Biographical Note

David Glowacki is originally from Milwaukee. He is a cross-disciplinary researcher, with interests spanning computer science, nanoscience, aesthetics, cultural theory, & spirituality. He works in VR applied to interactive scientific simulation and visualisation. He founded a research group called the 'Intangible Re-

alities Laboratory' (IRL) who carry out open source research and software development at the immersive frontiers of scientific, aesthetic, computational, and technological practice.

He graduated from UPenn in 2003, where he had the opportunity to study a range of subjects, including chemistry, mathematics, philosophy, comparative literature, and religions. In 2004 he obtained an MA in cultural theory as a Fulbright finalist at the University of Manchester (UK). In 2008, he completed a PhD in molecular physics at Leeds University (UK). He is the recipient of several research awards, including a Royal Society Research Fellowship, Philip Leverhulme award, ERC grant, and more. The immersive computational artworks he has worked on over the years have been experienced by more than 200,000 people on three continents.

He spends time in Santiago de Compostela in Northern Spain (where he haves a lab at the CiTIUS Intelligent Technologies Research Centre) and Quinta D'Alijo Retreat Centre in the mountains of Northern Portugal, where he works with a multi-disciplinary cast of collaborators to explore applications for multi-person VR beyond the confines of the traditional scientific laboratory.

Capstone

Visual Computing for Exploring Nanoscale Brain Tissue in Connectomics

Johanna Beyer

Abstract

Recent high-resolution electron microscopy imaging allows scientists to reconstruct neuronal cells and individual synapses in an unprecedented level of detail. Capturing those minute structures is crucial for connectomics, where neuroscientists aim to reconstruct the full wiring diagram of the brain to glean insights into brain physiology and function. However, mammalian brains are staggeringly complex, with tens of millions of interconnected neurons and billions of synapses, making an interactive analysis of the data challenging. This talk will focus on visual computing approaches for capturing, processing, exploring, and analyzing these large and complex datasets and look at future challenges for the visual analysis of the connectome.

Biographical Note

Johanna Beyer is a research associate and lecturer at the Visual Computing Lab at Harvard University. Before joining Harvard, she was a postdoctoral fellow at the Geometric Modeling and Scientific Visualization Center at KAUST. She received her Ph.D. in computer science at the University of Technology Vienna, Austria, in 2009. Her research focuses on GPU-based volume rendering techniques for large-scale neuroscience and medical data, with emphasis on the visualization of large and multimodal volumes. She is also interested in the combination of abstract information visualization with scientific visualization for novel domain-specific applications.