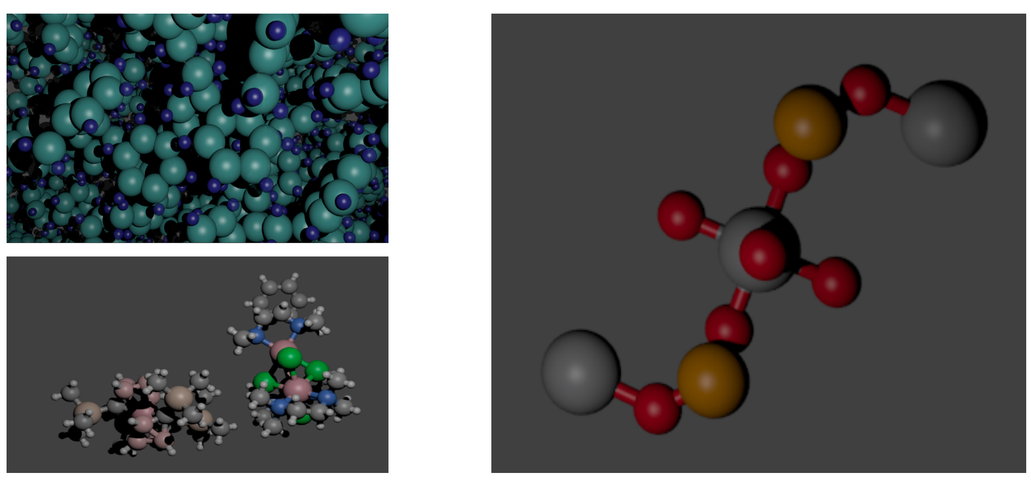
Immersive Visualization using the Oculus Rift: Applications in Material Science

Margaret Drouhard[1]; Chad A. Steed[1]; Steven Hahn[2] ; Thomas Proffen[2]
[1]Computational Sciences and Engineering Division, [2]Neutron Data Analysis and Visualization Division,
Oak Ridge National Laboratory, Oak Ridge, Tennessee

Introduction

Our prototype visualization environment enables virtual navigation of crystal structure and neutron scattering data. Our work includes gaze interaction to "bookmark" points of interest in the data. We anticipate that these tools will assist researchers in rapid data exploration and help them acquire near real-time feedback for ongoing experiments. We also expect that the immersive visualizations accessible through the Oculus Rift will facilitate collaborative investigation of complex data sets and allow for the convenient sharing of knowledge.

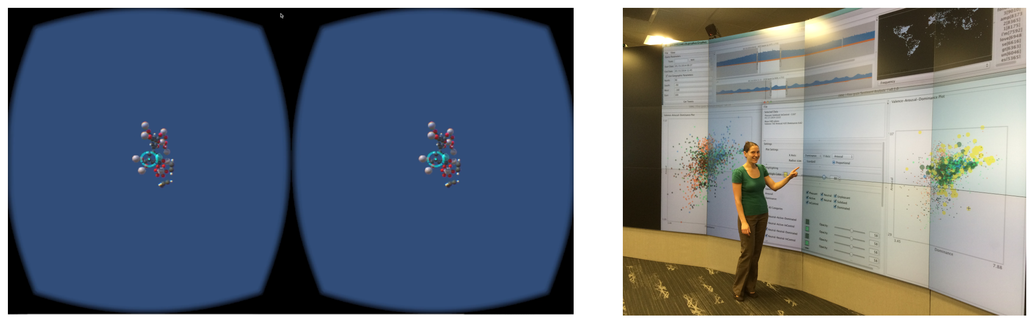


Crystal structure data created during the modeling and optimization phase of the project.

Background

Researchers in material science have access to powerful three dimensional (3D) visualization tools, allowing them to interactively explore data and generate illuminating figures. However, these tools tend to have steep learning curves for standard usage, and navigation of data may be onerous even for advanced users. Moreover, most of the views are limited to two dimensional (2D) projections.

The Oculus Rift integrates immersive 3D rendering with predictive head tracking to provide intuitive comprehension and interaction with the data. Our work focuses on providing intuitive interactions that allow users to efficiently navigate and understand large, multi-dimensional data sets in a 3D environment. We are also working on integrating our visualization with other 3D virtual reality displays, including the Everest display wall.

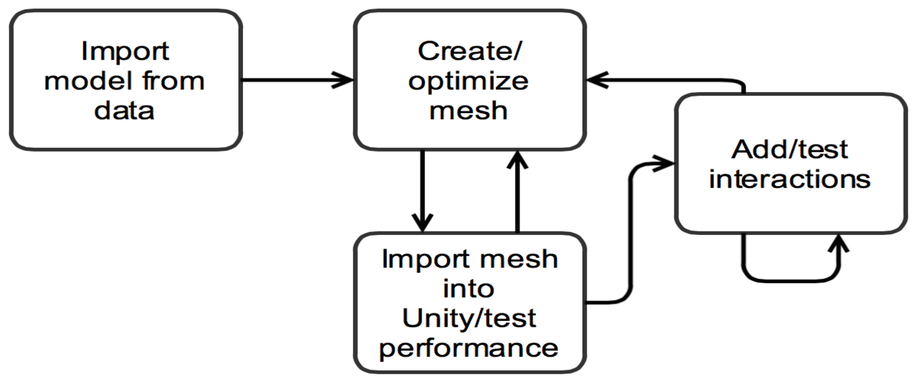


Oculus Rift display and Everest display wall. Both displays incorporate stereoscopic views and head tracking.

Mesh created from volumetric neutron scattering data of turbine blade. Rendering by Michael Matheson (used with permission).

Results

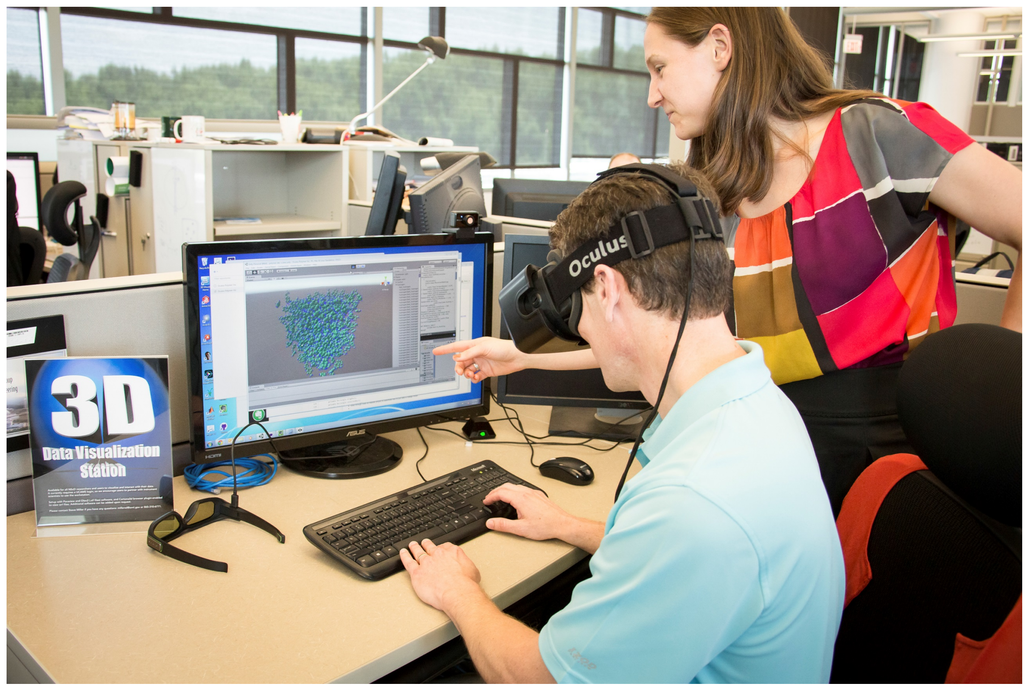
- Modeling/Mesh creation & optimization
- Navigation/locomotion
- 3D Bookmarking:
  - Location Saving with trigger
- Data object marking:
  - Gaze and trigger
  - Extended gaze
- Collaboration for integration with existing tools



Workflow for prototype immersive visualization environment

Additional Objectives and Goals

- Multiple levels of context (details-on-demand)
- Incorporation of hand-tracking
- Exploration of human-centered strategies for data navigation and pattern recognition
- Integration into other analysis and visualization software
- Integration with software engineering and workflow tools
- Additional features for remote immersive collaboration
- Extension to alternative virtual reality displays, including the Everest display wall



Demonstration of Oculus Rift visualization of crystal structure data.

Conclusion

Our prototype immersive visualization environment has enabled intuitive exploration of complex data sets.

We are collaborating with developers of specialized visualization software and software engineers to incorporate necessary usability and analysis features for wide-scale adoption by researchers.

Based on feedback we have received from demonstrations of the tool, we believe that immersive visualization can facilitate more efficient exploration of big data and encourage scientific discovery.

Contact

Margaret Drouhard
<mdrouhad@acm.org>

Steven Hahn
<hahnse@ornl.gov>

Chad A. Steed
<csteed@acm.org>

Thomas Proffen
<tproffen@ornl.gov>

Related Work

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