Interactive Visualization of Cosmological Simulations

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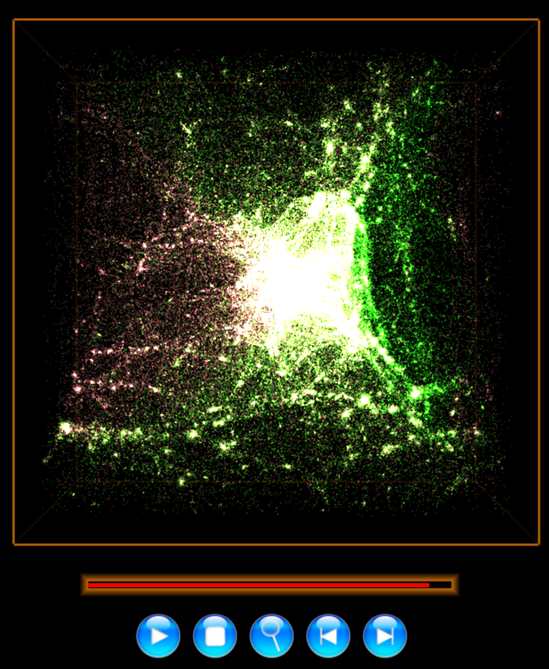
Contribution

We combine visualization techniques (SciVis & InfoVis) with innovative interaction capabilities (touch-sensetive & large displays) for very large, time-dependend astronomical datasets. Interaction methods (in 3D space and per frame) are provided to support scientifiic analysis. We explore a combined display of a spatial plot and specialized visualizations, such as parallel coordinate- or scatter-plots and provide methods to interact with those plots.

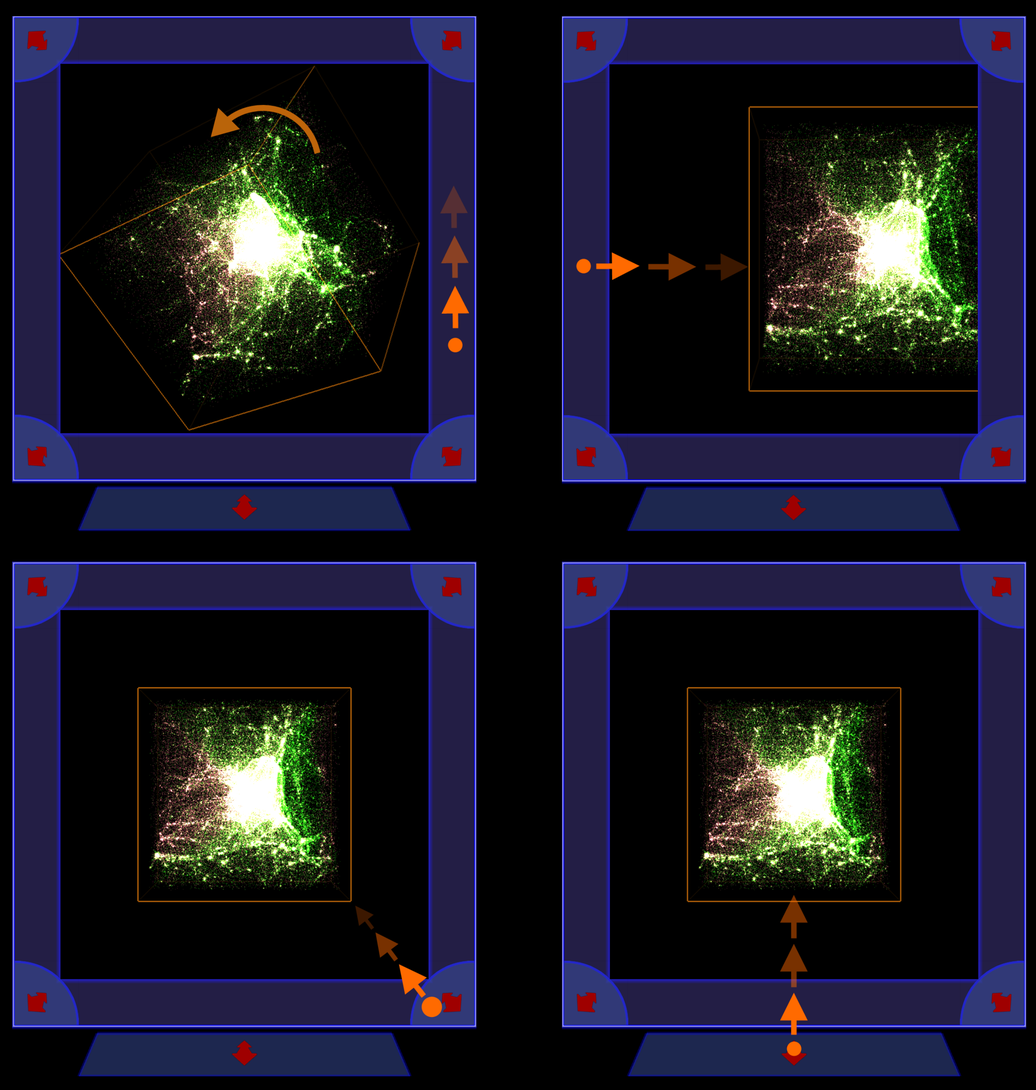
Data (Cosmological Simulations)



Cosmological simulations are used as our dataset [1]. By analyzing astrophysical processes and exploring such large volumes of particles, scientists are trying to understand the fine-scale structure predicted around the Milky Way. Such precise analysis requires us to provide scientists with rapid and accurate manipulation methods at various levels of precision.

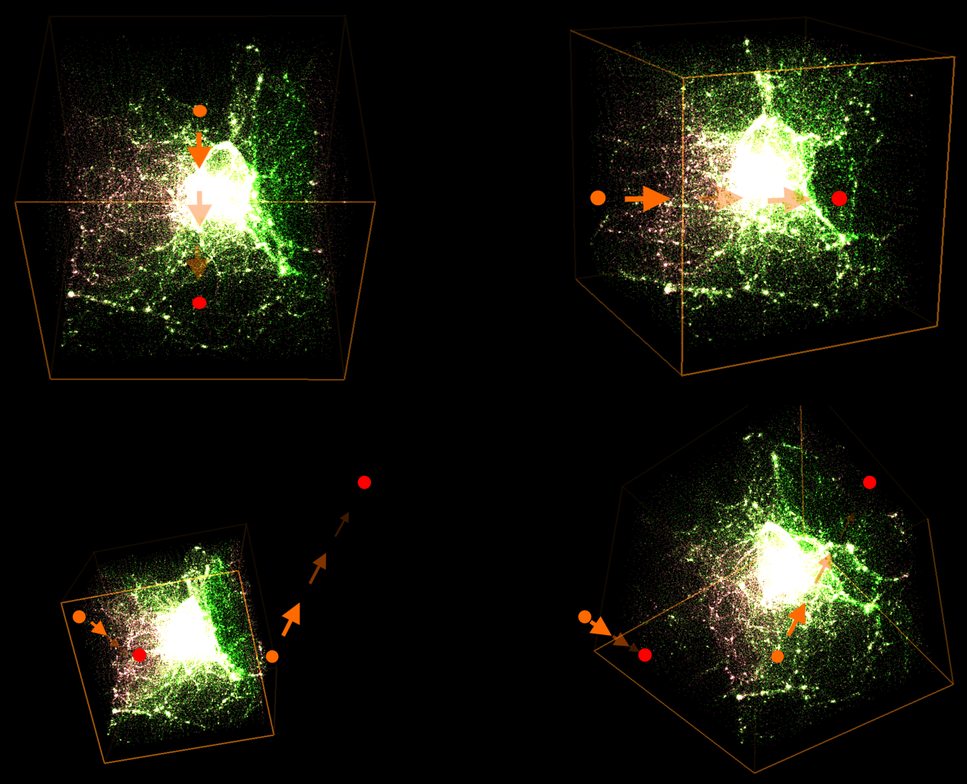
Frame Interaction

Inspired by Nijboer et al.'s [3] interface, we use viewport's border to provide additional means of independent control for the location, orientation, and scale of the displayed space. These are used with a single touch and the invoked action depends on the initial direction of the finger's motion. In addition, we employ the area below the viewport frame to translate along z axis.



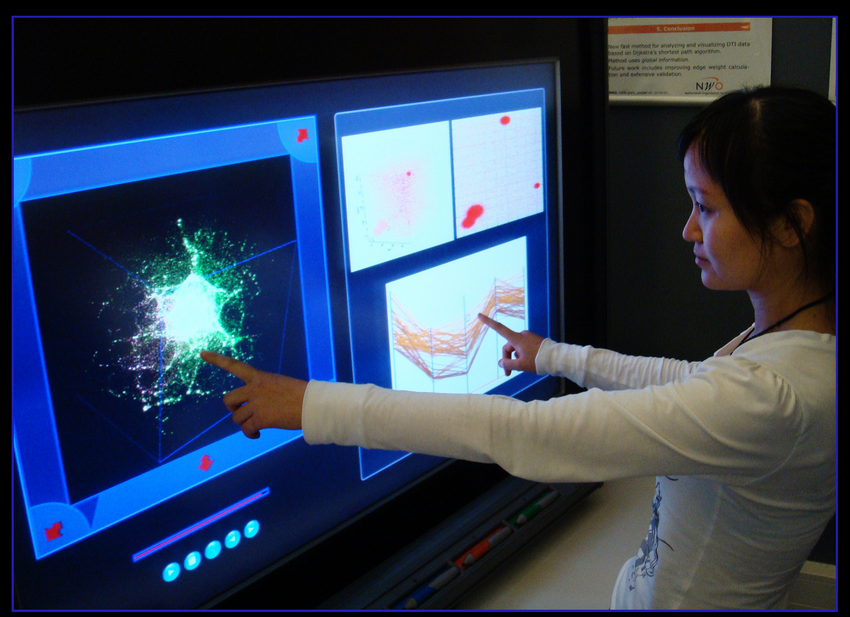
Single- and Dual-Touch Control of 3D Space

We use the trackball interaction to control the rotation around two axes (x and y) by mapping it to single touch interaction. For controlling the remaining degrees of freedom we are inspired by dual-touch interaction with 2D elements [2]. With two fingers used simultaneously on the same object, we can control an additional 4DOF, i.e, dragging two inputs from the orange points to the red points could perform integral interaction, such as rotation, scaling as well as translation.



Use of Large Displays

Large size displays provide group spaces where users can share information and perform both individual and collaborative interactions. The knowledge gained throughout this step will later contribute to the challenge of integrating an interactive system for SciVis & InfoVis on large displays [4], including how to allow people to interact with both SciVis & InfoVis elements using direct touch.



References

[1] Volker Springel, JieWang, et.al. The Aquarius Project: The Subhalos of Galactic Halos. Monthly Notices of the Royal Astronomical Society, 391(4):1685–1711, 2008.
[2] M. S. Hancck, F. D. Vernier, D. Wigdor, S. Carpendale, and C. Shen. Rotation and Translation Mechanisms for Tabletop Interaction. In Proc. TableTop, pages 79–86. IEEE Computer Society, 2006.
[3] M. Nijboer, M. Gerl, and T. Isenberg. Interaction Concepts for Digital Concept Sketching. In Posters of NPAR, New Orleans, USA, 2009. Extended abstract.
[4] Gerald N. Sahling Robert Kosara and Helwig Hauser. Linking scientific and information visualization with interactive 3d scatterplots. In Proc. WSCG, Visualization and Computer Vision, 2004.

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