

Interactive data visualization in Processing using the GLGraphics and Proscene libraries

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Motivation

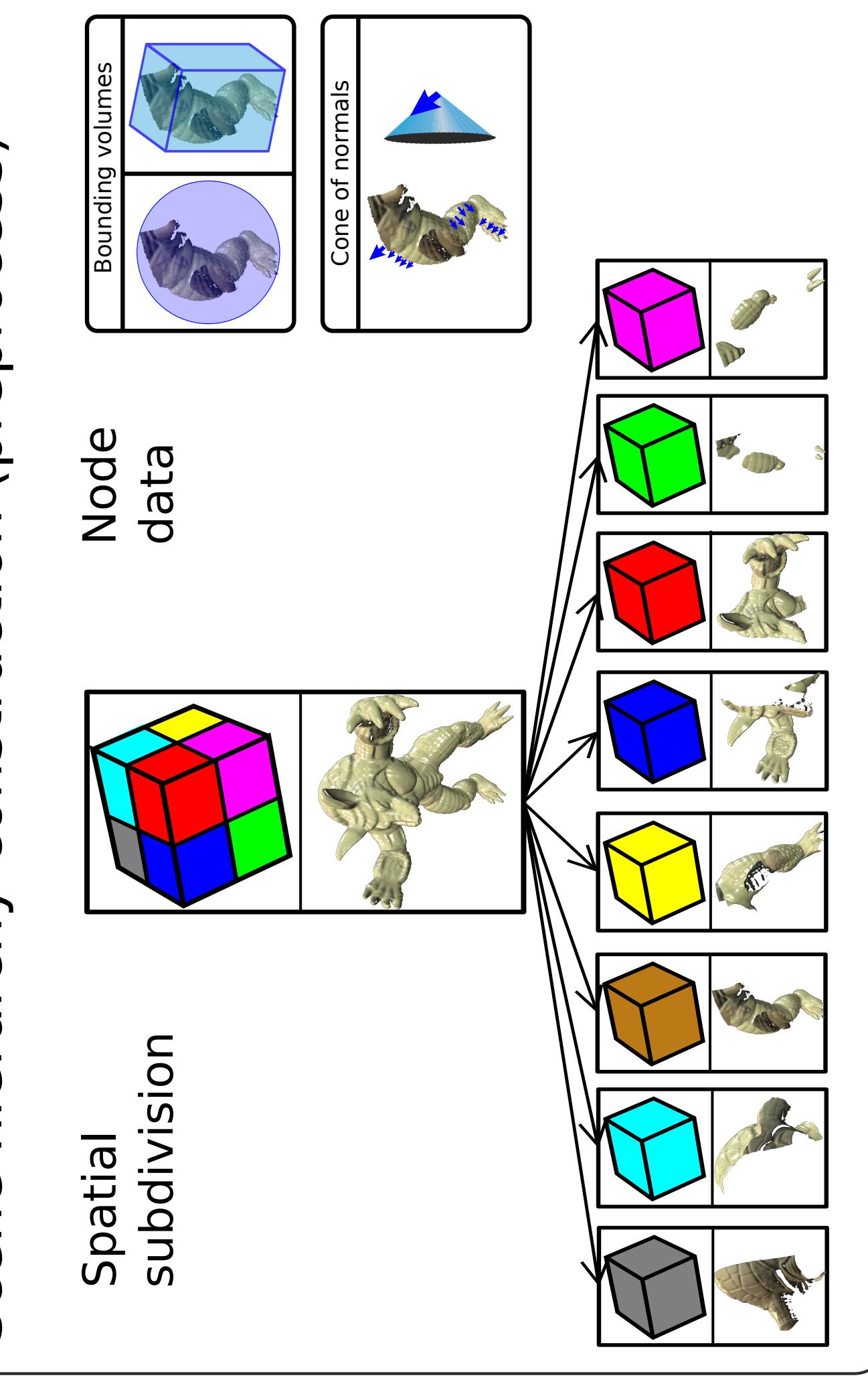
- The visualization of large data sets from sources like the social web [1], urban and mobile sensing [2], and high-throughput genomic sequencing [3], requires new techniques and tools that allow designers, visual artists and researchers to navigate and analyze this data.
- Growing interest within the scientific and artistic communities in creating data visualizations that have an intrinsic aesthetic value [4, 5].
- The Processing language and environment [6] is a widely used tool in computational design due to its simple API and extensible architecture.
- Processing has been used in numerous data visualization projects [7, 8], but it presents performance limitations for generating interactive visualizations from large data sets.

Goals

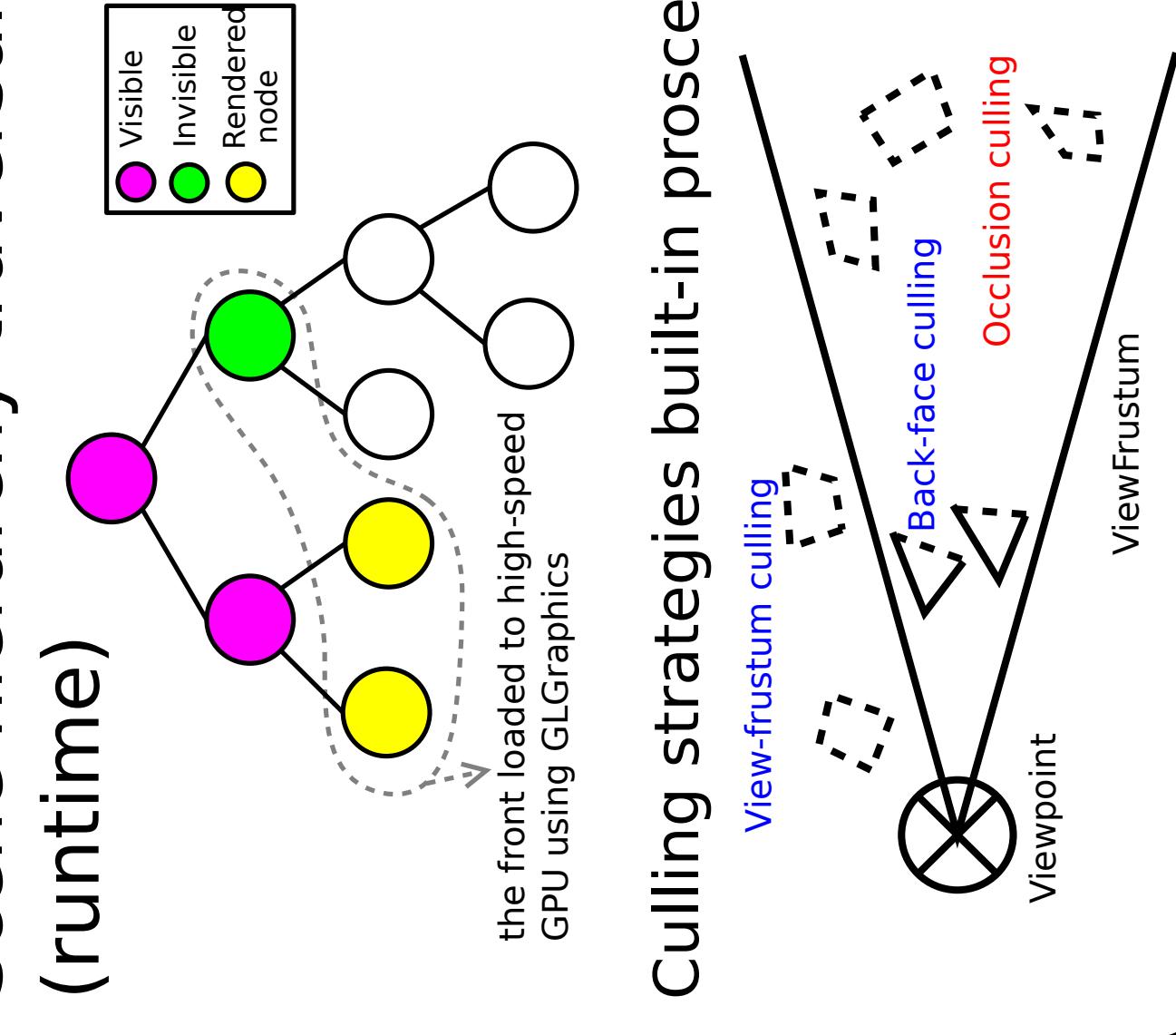
- Simplify the creation of interactive data visualizations in Processing, with a focus on the display of large quantities of 3D information in real-time.
- Provide advanced techniques for geometry culling, GPU rendering, and scene navigation through a class interface integrated with Processing's API.
- Make these techniques more accessible for visual designers, data artists and other creative coders.
- Complement more advanced visualization toolkits [9, 10, 11] in the sketching and prototyping stages.

Approach

Scene hierarchy construction (preprocess)



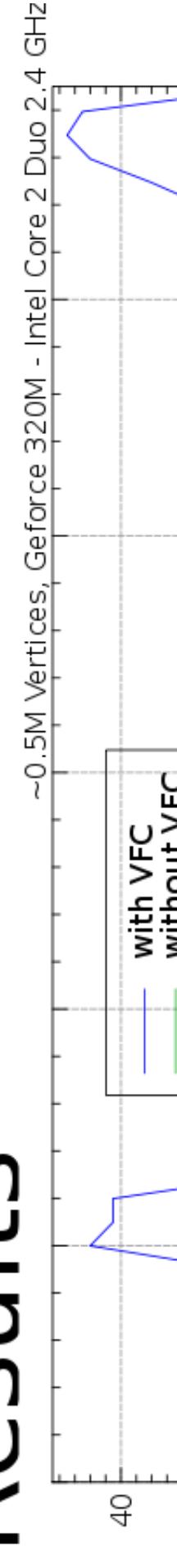
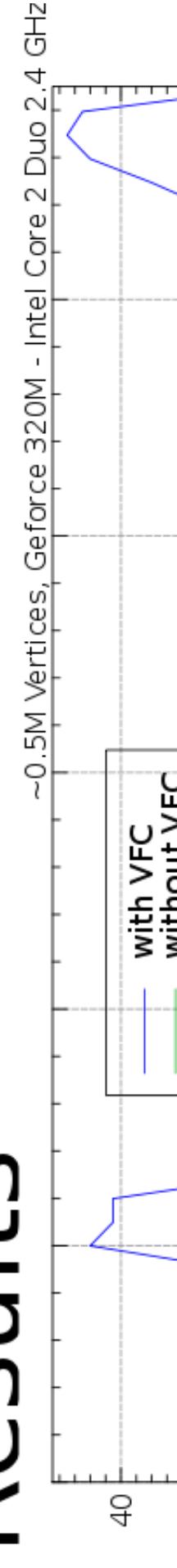
Scene hierarchy traversal (runtime)



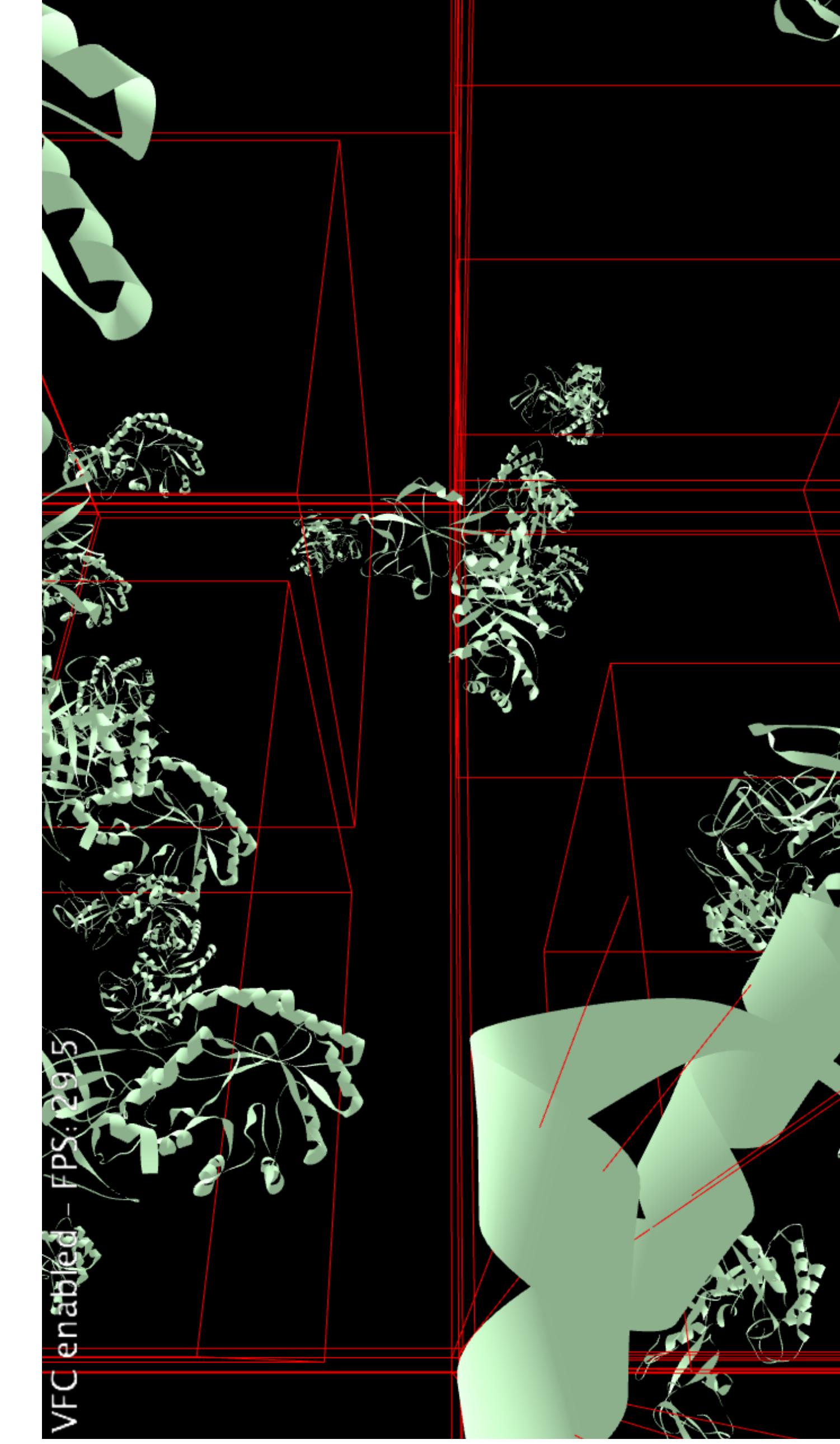
Limitations and future work

- Our proof-of-concept framework is functional and it is currently being used in several applications, as shown below. Future work directions are the following:
- To incorporate functionality for scene hierarchy construction into the libraries and to support other spatial subdivisions such as BSPs (currently only octrees are supported).
 - To add k-dops and other bounding volumes for the geometry, currently only bounding boxes and bounding spheres are supported.
 - To Level-Of-Detail (LOD) in a per-node basis, out-of-core techniques and occlusion culling to be able to visualize even more challenging data-sets.
 - Dynamic LOD on the GPU, using geometry shaders and transformation feedback techniques, and tessellation shaders on newer hardware.

Results



Large-scale molecular visualization



GLGraphics/Proscene framework

The visualization framework being developed in this project consists in two open-source libraries for Processing: GLGraphics for geometry rendering and Proscene for scene navigation. They can be installed and used separately, but in combination they allow users to create complex interactive 3D scenes.

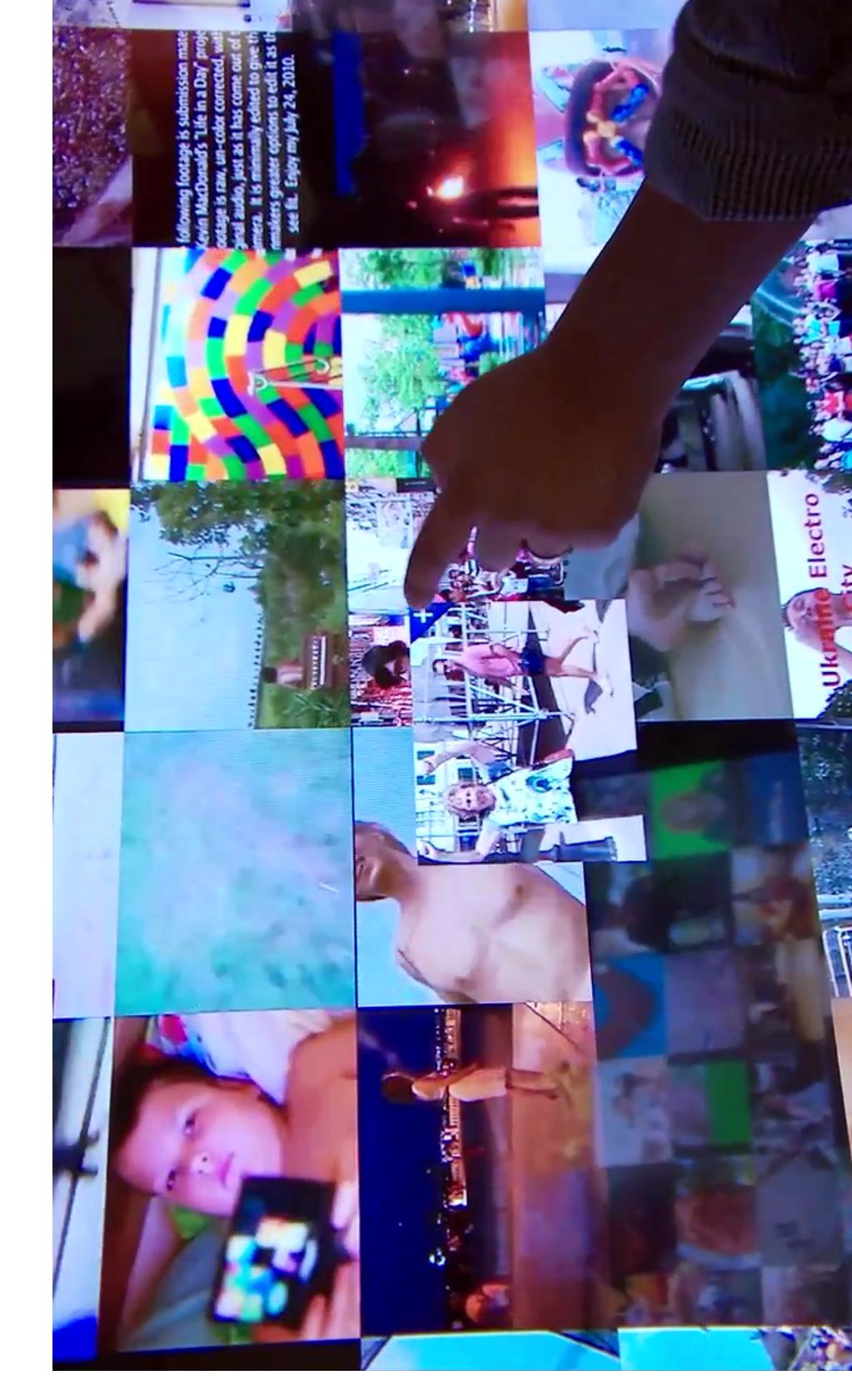
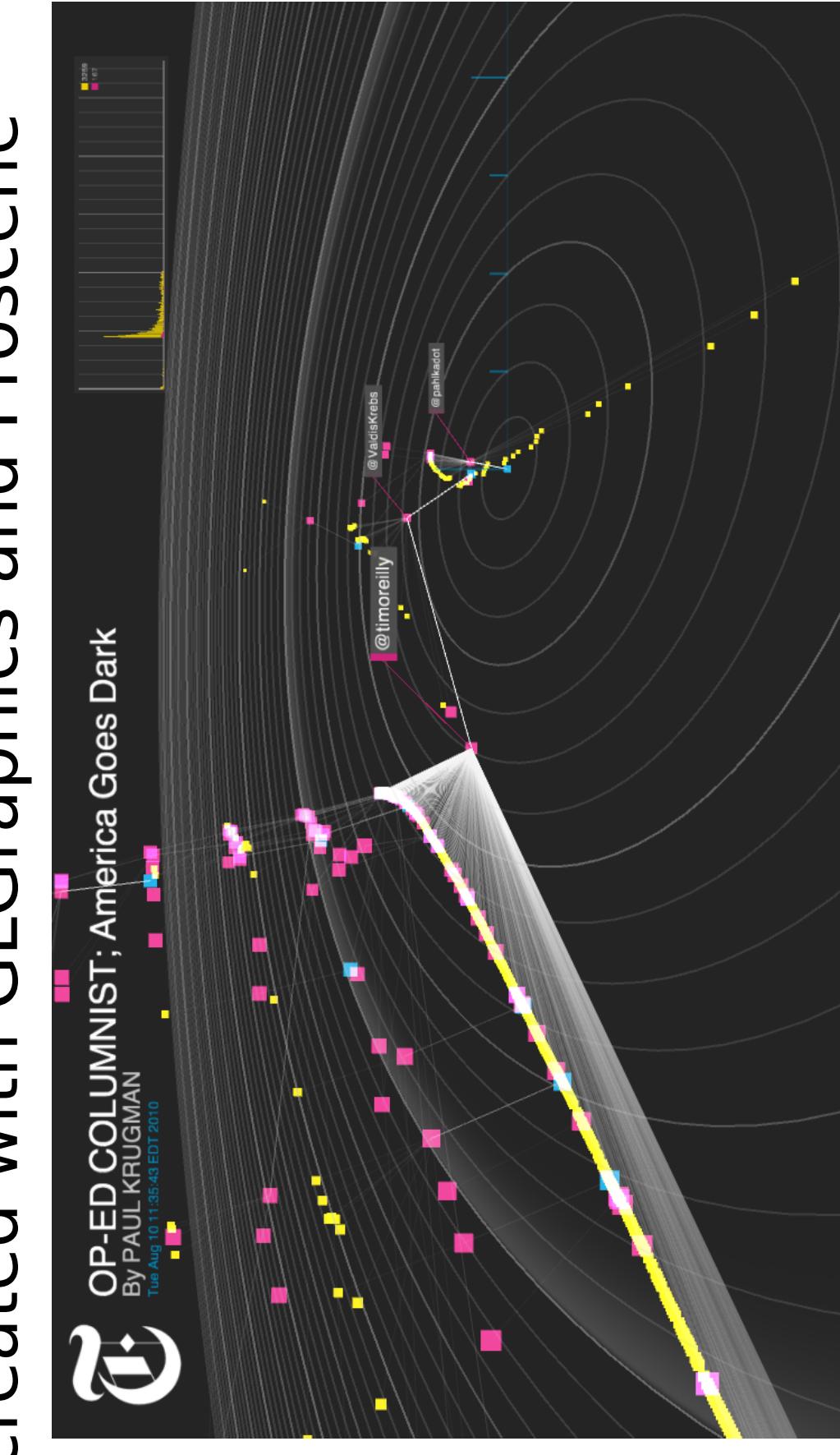
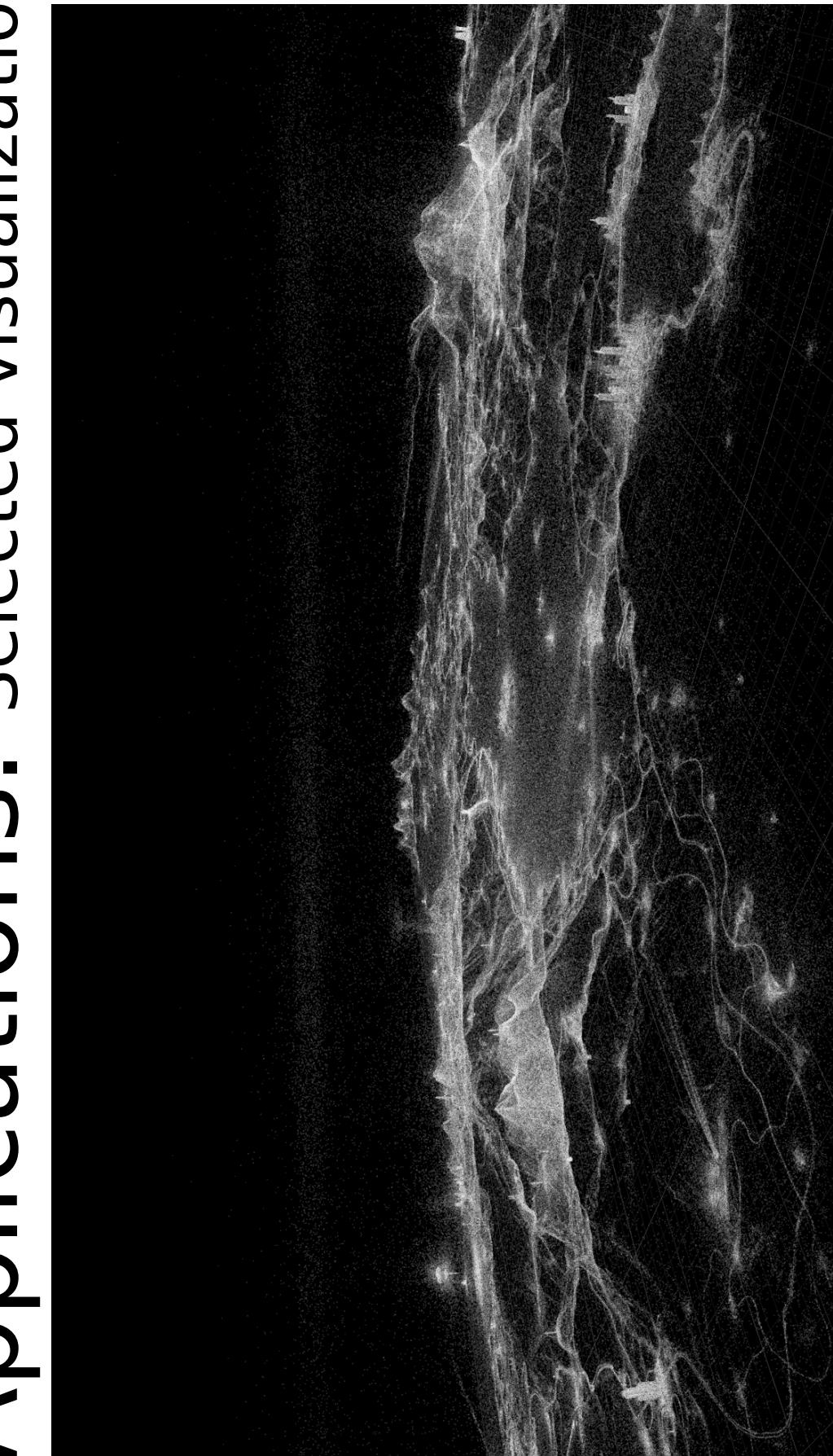
GLGraphics

- OpenGL-accelerated on- and off-screen rendering engines.
- Texture images and VBO-based 3D models.
- Image post-processing filters.
- Rendering effects.
- Support for GLSL, Cg shaders and CgFX format.

Proscene

- Arcball, walkthrough and third person camera modes.
- Built-in view frustum and back face culling routines.
- Hierarchical coordinate systems.
- Animation framework.
- Support of human interface devices.

Applications. Selected visualizations created with GLGraphics and Proscene



References

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- [4] http://infovisarts.com/
- [5] http://www.visualcomplexity.com/
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- [7] Flight Patterns by Action Kohin: http://www.actionkohin.com/work/fightpatterns/
- [8] In the Air by Victor Viana Cavalcis: http://www.intheair.es/
- [9] Visualization Toolkit: http://www.vtk.org/
- [10] Paraview: http://www.paraview.org/
- [11] Vistals: http://www.vistals.org/
- [12] Proscene website: http://code.google.com/proscene/
- [13] GLGraphics website: http://graphics.sourceforge.net/

A Life in a Day video touchscreen (Google Creative Labs): This application shows the use of GLGraphics for GPU-accelerated movie playback.
http://www.youtube.com/watch?v=g4y6cppFxygo