Abstract

The field of data visualization has exhibited a rapid growth in recent years due to the increased availability of data sets from various sources such as the social web [1], automated data mining and sensing [2], genomic and proteomic sequencing projects [3], etc. This data abundance has led to the creation of novel representation techniques and algorithms, most notably in the area of network visualization [4], as well as the implementation of several software applications and toolkits [5, 6] for parsing, analyzing and displaying information originating from large data sources. There is a also a significant interest within the scientific and visual design communities in creating data visualizations that have an intrinsic aesthetic value. This intersection between infovis and art is usually describe by the new term of "infoaesthetics" [7, 8].

Within this growing field, the Processing language and environment [9], created at the MIT in 2001 by Casey Reas and Ben Fry, is a widely used tool thanks to its simple API and extensible library architecture. Processing has been used in numerous data visualization projects [10, 11], but it presents some performance limitations for generating interactive visualizations from massive data sets. The libraries described in this work, Proscene and GLGraphics, aim at solving these limitations.

GLGraphics extends the 3D drawing functionality of Processing by adding a number of classes that encapsulate OpenGL textures, GPU-accelerated image filters and shader effects, and VBO-based 3D models for high performance rendering. Proscene adds support of camera modes, camera profiles, key frames, frames (coordinate systems) and object picking.

High performance rendering of large 3D models in GLGraphics is coupled with several culling algorithms implemented in Proscene. In this way, massive geometries can be displayed interactively in real-time. An algorithm for adaptive camera movements allows for easy navigation of data sets where geometric primitives are scattered over large volumes or present a wide range of spatial scales. Both Proscene [12] and GLGraphics [13] are freely available for download and their source code are released under the GPL2 license.

Some applications of the visualization framework that results of the integration between Proscene and GLGraphics are already available (see accompanying Figure). As part of our research, we are currently implementing an integrated system for visualization of biological data at the cellular level (protein interaction networks, transduction and regulatory pathways, etc.), where several features of this framework will allow for seamless navigation of complex scenes containing thousands of molecular entities.

In order to improve the performance and range of applicability of the framework, we plan to implement some of the culling algorithms on the GPU, port the framework to Processing.js so it can be run directly from web browsers, and add support for 3D input devices such as the SpaceNavigator from 3Dconnection.

References

[1] Structure and tie strengths in mobile communication networks. Onnela JP, Saramaki, J, Hyvonen J, Szabo G, Lazer D, Kaski K, Kertesz K, Barabasi AL. Proceedings of the National Academy of Sciences. Vol 104, pp 7332-6 (2007).

[2] A Survey of Mobile Phone Sensing. Lane ND, Miluzzo E, Lu H, Peebles D, Choudhury T, Campbell AT. IEEE Communications Magazine Vol. Vol 48 (2010).

[3] The IntAct molecular interaction database in 2010. Aranda B, et al. Nucl. Acids Res. Vol 38 (suppl 1), pp D525-D531 (2010).

[4] Force-Directed Edge Bundling for Graph Visualization Holten D, van Wijk JJ. Eurographics/ IEEE-VGTC Symposium on Visualization 2009, Vol 28 (2009).

[5] Many Eyes: http://www-958.ibm.com/software/data/cognos/manyeyes/

[6] Visualization Toolkit: http://www.vtk.org/

[7] http://infosthetics.com/

[8] http://www.visualcomplexity.com/

[9] Processing website: http://processing.org/

[10] Flight Patterns by Aaron Koblin: http://www.aaronkoblin.com/work/flightpatterns/

[11] In the Air by Victor Viña, Nerea Calvillo: http://www.intheair.es/

[12] Proscene website: http://code.google.com/p/proscene/

[13] GLGraphics website: http://glgraphics.sourceforge.net/