Master's Thesis Preproposal: Visualizing the Inner Structure of N-Body Data using Splatting and Skeletonization

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June 16, 2006

Introduction

N-body simulations produce a large amount of data that must be visualized in order to extract interesting features. This data consists of thousands of particles, each with a number of properties such as velocity, mass, and acceleration, that are persisted across hundreds of time steps. Rendering these points using traditional means quickly leads to a image that is "saturated" because the number of particles is greater than the number of pixels available. Volume rendering, and particularly splatting, seeks to remedy this and allows one to see inside the volume and discern the inner structure. The definition of inner structure itself can vary and is usually determined using one of the observable properties of the particles.

Previous Work

In [3], n-body data was visualized using two-dimensional images with color being used to illustrate the density of the galaxy. In [4], splatting was used to visualize n-body data, taking a hierarchical approach to allow interactive manipulation and high-quality final rendering. The usage of volume splatting allows the inner structure to be seen. The Spiegel visualization framework [2] has been developed to provide a framework for visualizing arbitrary types of data. There is currently functionality to visualize n-body data in Spiegel in a manner similar to that of [3]. In [1], thinning was used to extract a skeleton from a volume dataset. The skeleton can be defined as the "locus of all points where the scalar value is locally maximum."

Planned Work and Goals

A number of existing techniques will be combined and used to extract the inner structure of an n-body dataset. The volume will be skeletonized and this will provide the basis for speeding up the time-intensive operation of volume splatting. Areas of the volume that are along the skeleton will be rendered in higher detail in a manner similar to [4]. Inner structure will be determined by classifying particles using properties such as their density, velocity, and temperature.

References

[1] N. Gagvani and D. Silver. Parameter controlled skeletonization of three dimensional objects, 1997.

[2] The grape cluster project. http://www.cs.rit.edu/∼grapecluster/.

[3] Stefan Harfst, Christian Theis, and Gerhard Hensler. Modelling galaxies with a 3d multi-phase ism, 2005.

[4] Matthias Hopf and Thomas Ertl. Hierarchical splatting of scattered data. In *VIS '03: Proceedings of the 14th IEEE Visualization 2003 (VIS'03)*, page 57, Washington, DC, USA, 2003. IEEE Computer Society.