Scientific Visualisation and Mac OS-X

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Scientific visualisation primarily involves presenting datasets in such a way as to provide additional insight into the underlying science. Aspects of data can be mapped onto any of the human senses but the main sense is usually our visual system and includes the powerful depth perception we experience through stereopsis.

Software that supports visualization has some unique requirements as well as a number of highly desirable characteristics. The Centre for Astrophysics and Supercomputing at Swinburne University of Technology is successfully utilising Apple hardware and the Mac OS-X operating system to meet its visualization requirements.

An important aspect of scientific computing in general is the sharing of source code written by collaborators and other researchers. There is the expectation that this source code can be compiled on the particular computer system owned by the research institution irrespective of where it was written. There are specific tools and conventions that support this activity on a UNIX platform, this is significantly more difficult between MicroSoft Windows platforms and the Apple Macintosh before OS-X. This is even more difficult for applications that use media rich information such as audio and rely on graphical user interfaces. This is alleviated on most UNIX platforms by a large collection of cross platform libraries and because of a windowing environment known as X-Windows which is uniformly supported on UNIX based systems including Mac OS-X.

Visualisation applications generally deal with large volumes of multidimensional data. Real time performance (at least 25 frames per second) is critical to being able to effectively interact with these datasets. This generally requires hardware assisted 3D graphics in the form of OpenGL compliant graphics cards. The standard support across the whole Macintosh range for OpenGL graphics including uniform driver support further ensures that such applications have a better chance of performing adequately across the various vendor hardware options.

Most high performance computing resources, whether based upon clusters or not, are running the UNIX operating system. There are significant advantages for researchers to also be using UNIX as their desktop operating system. The Centre manages a large cluster of Linux based machines and staff within the Centre have a mixture of either Linux or Mac OS-X desktop computers. All of the visualization tools the Centre has developed locally can be compiled for both platforms, a significant efficiency given the time consuming nature of software development.

Many visualisation problems can benefit from stereoscopic projection, that is, the independent presentation of images from a left and right eye perspective to the corresponding human eye. This gives a strong sense of depth that assists in the understanding of 3 dimensional relationships in a way that cannot be obtained with a

single perspective view. The Centre has a long history in using stereoscopic techniques and the vast majority of the visualization software developed locally can operate in that mode on any Macintosh equipped with a dual display graphics card. These applications can be employed to explore data in stereo3D in our stereoscopic enabled lecture theatre driven by a high end G5 tower. The same applications run on the midrange machines staff may have on their desktop and on laptops when researchers are presenting their work externally.

The suitability of the Apple Macintosh running the OS-X operating system as a platform on which to conduct scientific research is seeing it become the platform of choice in many science disciplines, this includes its use for visualisation. This is in addition to the other advantages such as providing a single solution for commercial applications as well as research based software. With regard to visualization applications there are still some challenges for Apple, in particular, support for more powerful graphics cards. The current highest end support is for the Radeon cards which are in the middle of the performance range. There are additionally some unexpected differences between the X11 and OpenGL implementations on Mac OS-X compared to other UNIX platforms. It is expected the suitability of the Mac OS-X platform for visualization and scientific research will improve as Apple continues to pursue the high performance market in the future.

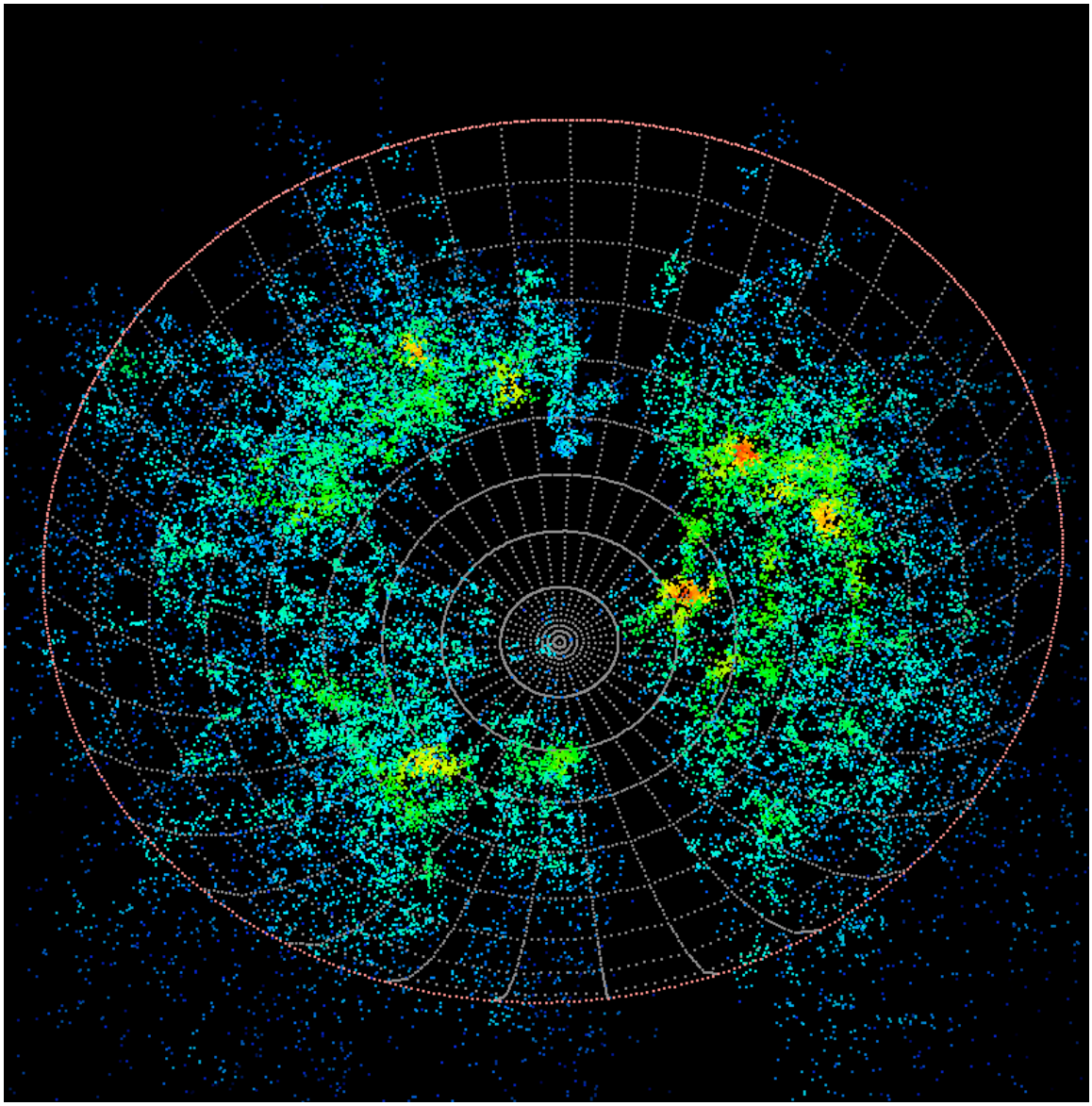

Figure 1: A general purpose stereoscopic 3D enabled geometry viewer. Visualisation of galaxy positions in the 6dF survey. [Anglo-Australian Observatory]

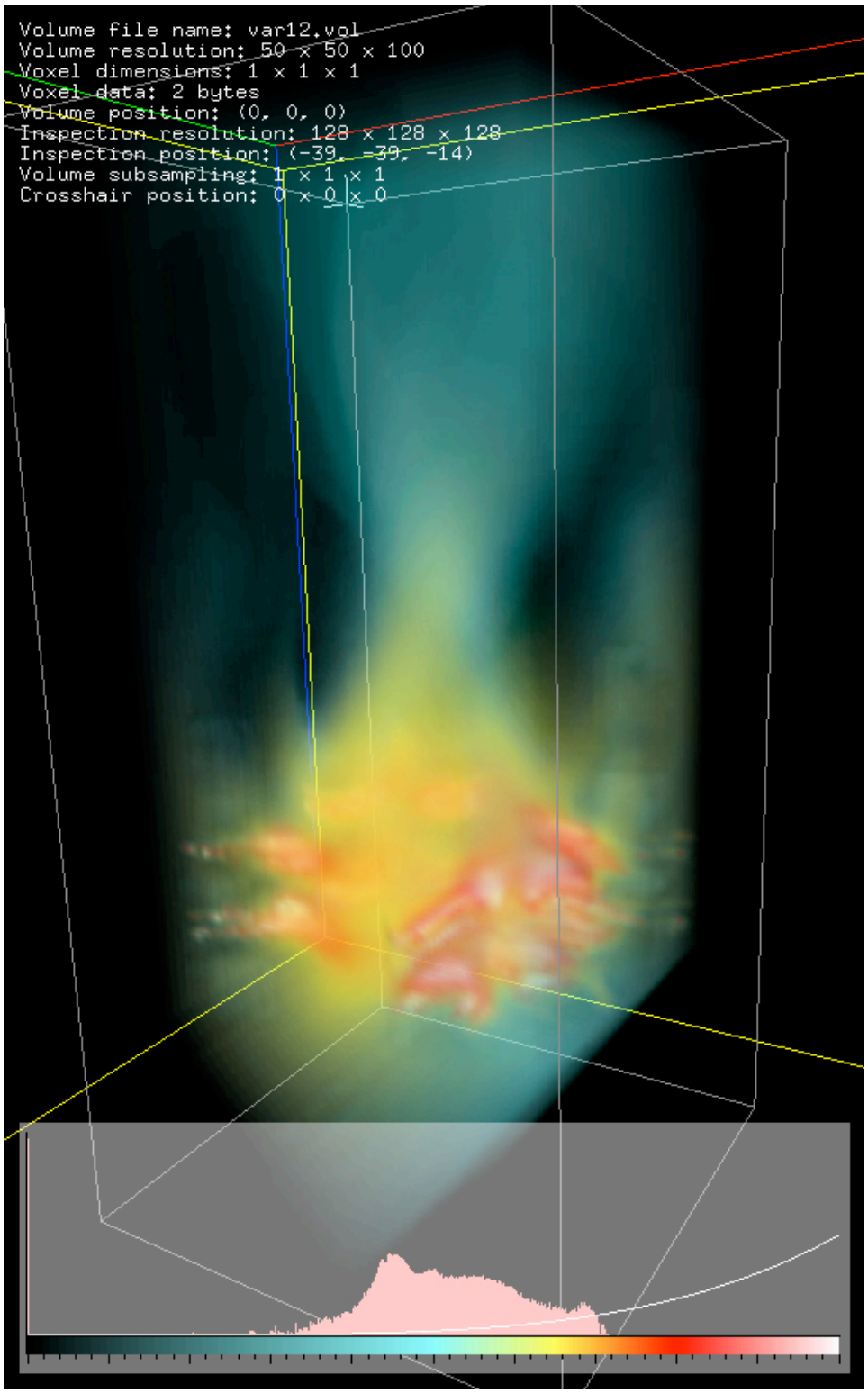

Figure 2: Hardware assisted interactive volume rendering. Visualisation of nitrous oxide in a coal burning powerstation furnace. [Dr Jamal Naser, Swinburne University]

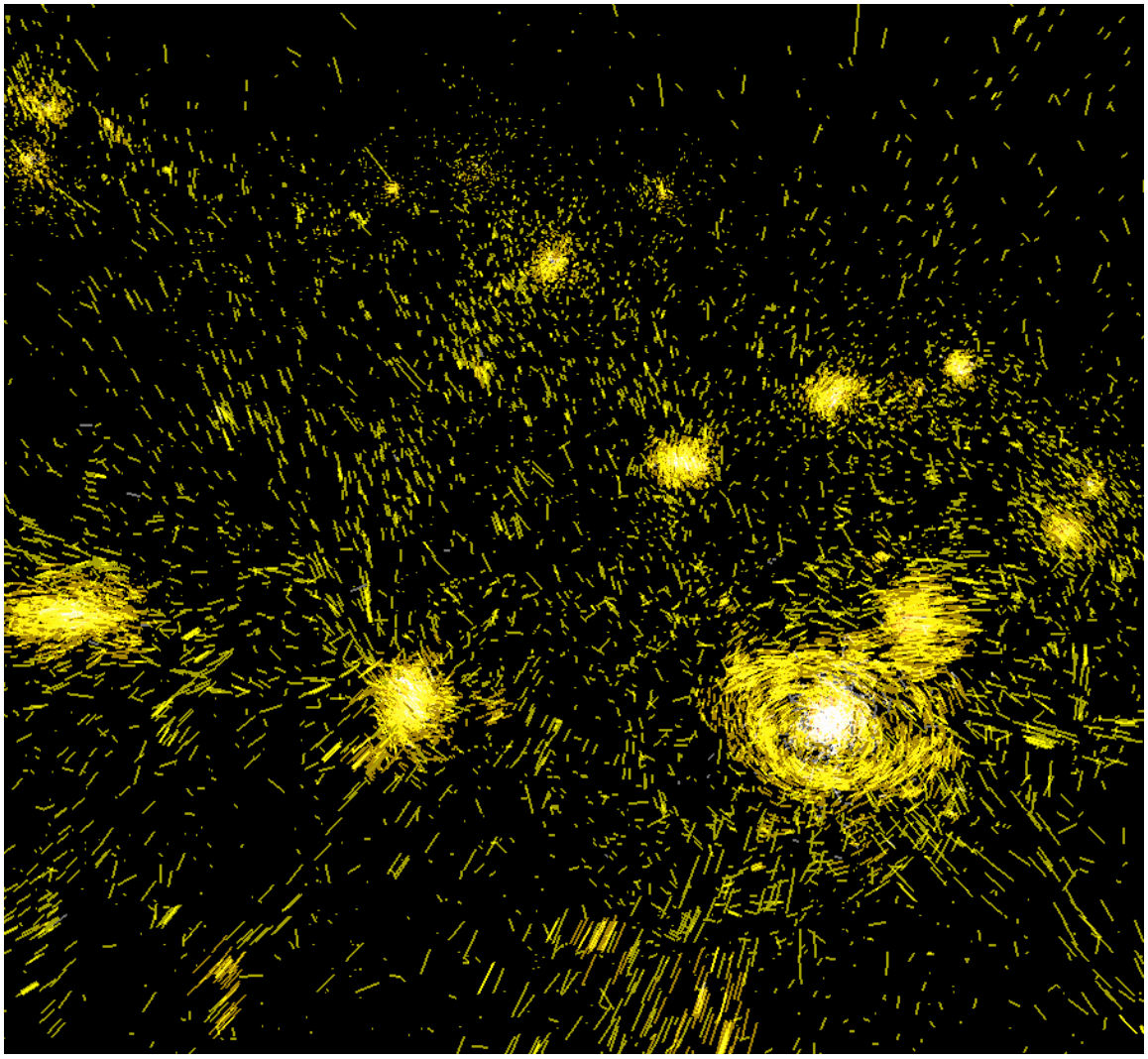

Figure 3: Real time visualization of dynamic systems with large volumes of geometry. Mass trajectories in a galaxy formation simulation. [Dr Chris Brook, Swinburne University]