

ABSTRACT

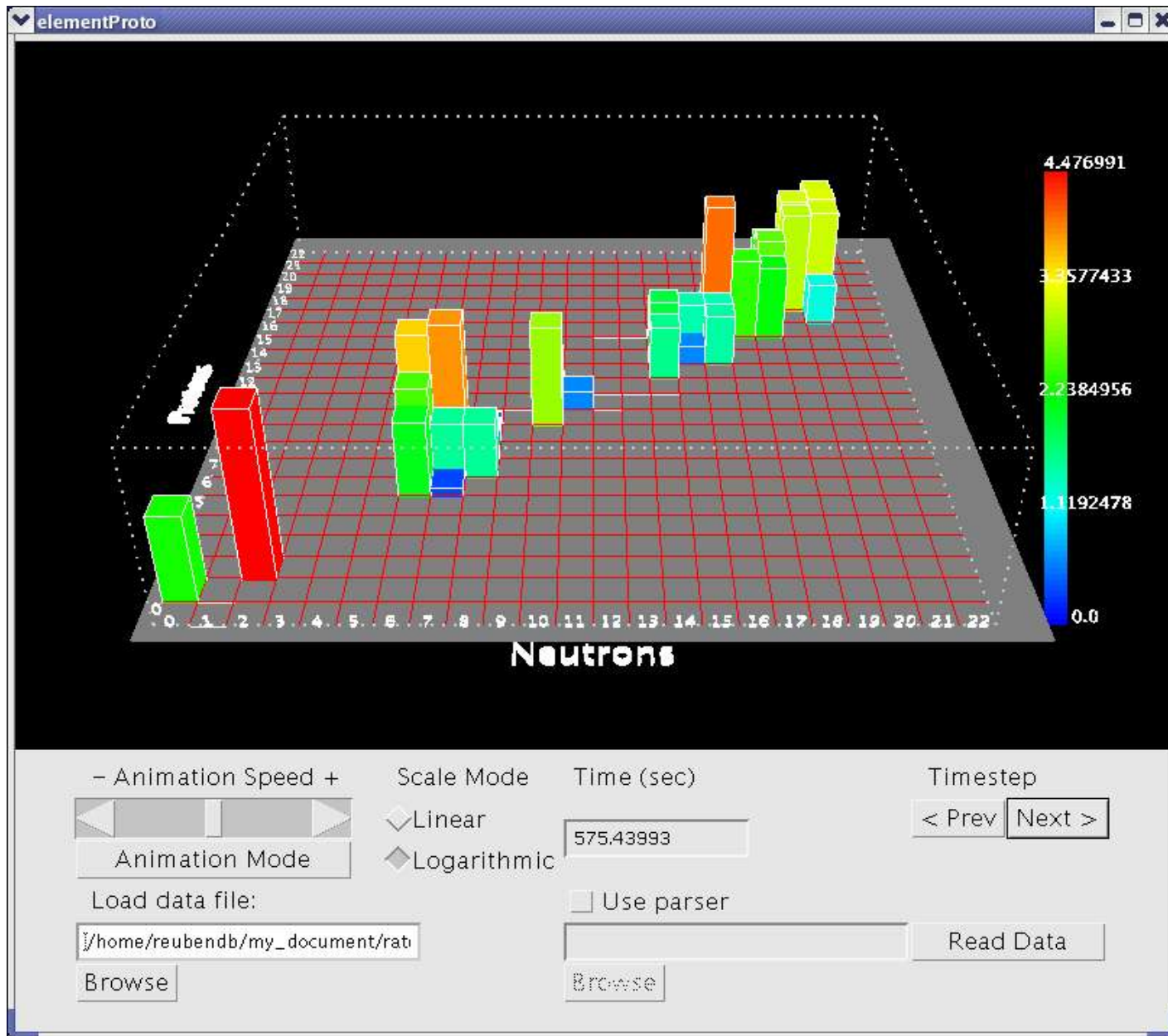
We are developing portable multidimensional visualization tools that permit the results of large-scale element production calculations to be displayed interactively on desktop level computers (Windows, Linux, Unix, and Macintosh). These tools can be adapted to accept data in a variety of formats and to analysis of output from various codes. We shall present specific examples from network calculations for nova and X-ray burst simulations.

Technology

For building the visualization software, Java technology was chosen because of its portability across different platforms. It is also chosen because a technology called Java3D exists as a supplement to Java programming language which provides a set of object-oriented application programming interfaces (API) to easily create, render, and control a three-dimensional visualization. Compared with existing API for three-dimensional graphics such as OpenGL, Java3D is probably easier to learn because of its high-level language, although admittedly it may be inferior in term of speed or performance and features.

Results: Element Production Visualization Tool

The result of this effort is a fully working prototype of an element production visualization tool. Basic features for this software have been implemented, although a lot more features can be added, and the existing ones can be improved upon. The software displays a three dimensional representation of elements abundance at an instance of time. Two dimensions are used for representing proton and neutron numbers of the elements. A glyph, or a histogram, is rendered on this plane representing the element, where the position depends on the proton and neutron number of this element. The height, which is rendered on the third dimension, and the color of the histogram represent the abundance of this element at that instance of time. Many elements with different combinations of proton and neutron numbers can be rendered simultaneously on this plane. A screenshot of this visualization software is included below.



As time progresses, the abundance of these elements changes. Hence, the height and color of these histograms also change to represent the change of the abundances. Computational results from simulations of these element productions give discrete time steps and the abundances of elements at that time step. This provides all the necessary information for a key-frame based animation. The visualization software can then interpolate based on this key-frames, or discrete time-steps, to provide an animation of a smoothly changing abundances of the elements over time. For the purpose of the animation, the time for the interpolation is computed in logarithmic scale. However, the linear time scale is displayed on the user interface. Therefore, data that covers large time interval does not take excessively long time for the animation to complete. Vice versa, data that covers very small time interval can still be observed in the animation.

It may also be desirable to view the data in discrete mode rather than in animation. User interface is therefore provided to accommodate this. In “Timestep mode” user can click through the time-steps from the datafile and see the visualization of the element abundances on the screen.

The basic features that are common in 3-dimensional graphics such as zooming, translating, and rotating objects on the screen are also implemented. Other features include the user interface to read datafile and the ability to display the abundances in logarithmic and linear scale. The speed of the animation can also be adjusted using a sliding-bar user interface.

A hands-on demonstration of the software running on laptop is also available.

Discussion and Future Improvements

Currently the software only supports a specified format of input file. However, it is very easy to adapt it so that more formats can be used directly with the software. A programming interface such as JNI is useful so that the software can accept common scientific data format that has Fortran or C interface natively. Another way is to write a small program or script to convert custom format to the specified one. Although it is planned to support more datafile format in the future, users can also do this themselves and help the development of the software by reading the documentation of the software in the software project website.

Java3D can be memory and resource hungry. A better optimization of the software is required to handle big datafile. Currently the software has some memory problem after loading and displaying animation of a large datafile (due to large time intervals or many elements in the file), which then caused java virtual machine to issue *out of memory* error. Restarting the software always help, but this is obviously not the optimum solution. A better tuning

of the java virtual machine may help cure the problem.

Another planned feature is the ability for the user to click on the histogram and get all the information about the element represented by the histogram. However, this may be computationally costly.

Another useful feature would be to limit the display to only several chosen elements, and ignore the rest that the user not interested in although they are in the datafile. This way the user can observe the evolution of the abundance of the chosen elements more closely.

In conclusion, this software provides a portable multidimensional visualization tools that permit the results of element production calculations to be displayed interactively on desktop level computers. The aim is also to provide much more economic visualization tool for element production calculations, not to replace a more general high-end visualization tool that are available commercially.

Software Availability

The software can be obtained by contacting the author, or by going to the URL of the software project page:

<http://csep10.phys.utk.edu/visualization/>