P1.2 OCEANOGRAPHIC RESEARCH AT PMEL USING PC AND UNIX BASED 3-D STEREO VISUALIZATION

Christopher W. Moore*[1], Nancy Soreide[2]

Affiliations:

[1]Joint Institute for the Study of Ocean and Atmosphere, University of Washington, Seattle, WA
[2] NOAA/Pacific Marine Environmental Laboratory, Seattle, WA

ABSTRACT

Research work at NOAA's Pacific Marine Environmental Labs will be presented showcasing the latest desktop analysis and visualization tools in use today. Techniques will be shown for piping interactive, stereo 3-D graphics from a UNIX-based visualization server to a desktop PC, utilizing the latest PC hardware acceleration. This new, inexpensive method for utilizing local video card graphics over a local area network has revolutionized high-end stereo visualization of oceanographic and atmospheric data.

This poster-session demo will not only show the latest PMEL research in Fisheries Oceanography using a massively parallel supercomputer, and in-situ data from NOAA's tropical Pacific TAO-Triton array in full stereo 3-D, but tips and tricks will be shown for using inexpensive hardware and free software at the desktop as another tool for analysis, for creating web-based animations, or for creating high-end stereo animations at presentations.

1. GLX: X-TERM STEREO GRAPHICS ON A PC

Viewing large oceanographic and atmospheric data sets in stereo 3-D usually requires a high-end graphics machine. The SGI line of computers has been used at PMEL and other oceanographic institutes, though for very large data sets (upwards of 10^6 data points) the computers used are fairly expensive. An SGI Onyx2 was purchased to serve this purpose at PMEL, though until now the user had to sit in front of the console to view 3-D data sets in stereo.

In the push to let scientists at PMEL work at their desks and still take advantage of the SGI graphics, we have found a product that allows a remote user to view 3-D stereo graphics produced on the SGI at their desk on a PC taking advantage of the PC's local hardware acceleration. With the gaming industry driving advances in PC video card technology, relatively inexpensive video cards are available for the PC that support 3-D stereo acceleration. The link between the graphics served by the SGI machine, and the user is the PC-based X-window server software Exceed 3-D. This popular X-window software recently enabled GLX extensions, allowing OpenGL commands to be passed in an X-window directly to the video card on a PC. Using two- and three-year-old PC's, scientists at PMEL can do large-scale stereo graphics on the SGI, and pipe the results over the local area network through the X-window simulator Exceed. Instead of walking to the computer lab and waiting in line to use the SGI Onyx2, users can simply view the interactive graphics at their desktop. We have successfully used the NCAR/stereo version of Vis5D in this way, as well as custom software using the Visualization Toolkit (VTK) API. In this way, we have allowed many more users to take advantage of the SGI using relatively inexpensive PCs.

There are limits on the PC end: we have done some preliminary testing and found that PCs with pre-Pentium II technology bog down fairly quickly, and, to take advantage of rendering the GLX commands from Exceed in stereo, the video card must support stereo rendering, and 3-D goggles must be acquired. Stereo video cards can be expensive, but orders of magnitude less expensive than an additional Onyx2. We found the following video cards support stereo 3-D in OpenGL (by no means an exhaustive list):

Diamond Fire GL Pro 1000
Elsa Gloria XL
Hewlett Packard fx6
3Dlabs Wildcat 5110

* *Corresponding author address:* Christopher W. Moore, JISAO/NOAA-PMEL, 7600 Sand Point Way NE, Seattle, WA 98115; e-mail: aeolus@ocean.washington.edu.

The video cards listed all support standard page-flipping stereo technology, and are capable of driving standard LCD shutter goggles (such as Crystal Eyes, or NuVision). A simple web search will produce vendors of these cards and goggles.

This hardware configuration will be shown during the poster session, with an SGI graphics server running Vis5D piping output to a PC with local hardware acceleration showing stereo output of the following PMEL research results:

2. PMEL RESEARCH VISUALIZATIONS

2.1 *TAO/Triton buoy array data*

Output from NOAA's TAO/Triton buoy array in the tropical Pacific shows temperature, salinity, currents, wind speeds and thermocline depth in near real-time. This visualization shows the relationship between failing trade winds and the El Niño Southern Oscillation. Users can animate the onset and occurrence of an El Niño or La Niña event and see the relationships between the various measured physical properties.

2.2 *Fisheries-Oceanography*

The Fisheries- Oceanography Coordinated Investigations (FOCI) program will show model output of a new model based on the Regional Ocean Modeling System (ROMS) and of a 3-D, nested, biological predator/prey model (Herman and Stabeno, 1996). The model of the Bering Sea and Gulf of Alaska is a study of the relationship between meso-scale physical properties and fish populations, and is run on the new 512-node, massively parallel computer 'Jet', maintained by NOAA's Forecast Systems Laboratory in Boulder Colorado.

2.3 *Tsunami modeling*

Comparisons of tsunami runup and inundation models from NOAA's Modeling and Forecasting Group (Titov and Synolakis, 1997) and the University of Alaska's Geophysical Institute (Hansen, et al, 2001) will be shown using custom software applications based on the CAVE libraries. Modeled regions include Kodiak Island, Alaska, and Okushiri Island, Japan.

2.4 *In-situ hydrographic data*

Data from the 1998 FOCI "Inner Front" mooring array in the Bering Sea will be shown, diplaying temperature, salinity, and currents near the Pribilov Islands over a six month period in 1998.

3. CONCLUSIONS

The 3-D nature of atmospheric and oceanic data lend themselves to viewing in full 3-D, and the techniques using a graphics server and desktop PC graphics acceleration give the scientist a powerful tool in the quest to better understand the world around us. Stereo 3-D rendering of oceanic and atmospheric data is the culmination of a natural evolution in scientific visualization from simple 2-D cartesian plots and early 3-D perspective drawings. Fully stereographic, interactive 3-D rendering takes advantage of the mind's ability to grasp complex environments to its full extent.

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