Task 2.1 Command and Control Visualization: Implementation of DGL version of DIVERSE API for development of TALOSS
Dr. Ronald D. Kriz

2.1.7: *SBD demonstration of moving towed array,* ***March 04***
2.1.7: *Final report,* ***April 04***
2.1.7: *Documentation of Enhanced TALOSS software,* ***April 04***
2.1.7: *Documentation to netted/distributed software upgrade to DTK,* ***April 04***

2.0 Background:
Our objective is to provide a distributed collaborative network of graphical and device independent tools in a shared virtual environment, which can be used by Command and Control (C&C) personnel to gain a strategic advantage. Specifically we focus on the mission critical C&C interpretation of acoustic undersea data from towed arrays for the Naval Undersea Weapons Center (NUWC) using the CONRAY simulation models. These simulation models can be extended to "real-time" data acquisition systems. Under the direction of personnel from NUWC and the Naval Research Laboratory (NRL) we have identified a working prototype which we have successfully incorporated into our Device Independent Virtual Environment Re-configurable-Scalable-Extensible (DIVERSE) tool that works in stereo in the (C)AVE Automated Virtual Environment (CAVE), Immersive Work Bench (IWB), Immersive Desk (I-Desk), desktop workstation simulator, and Head Mounted Display (HMD) systems at the Virginia Tech Center for Virtual Environments and Visualization (CVEV). This effort has evolved and become part of the 3D Visualization Project called TALOSS, which was originally called SubVE.

Accomplishments:

Task 2.1a TALOSS: The Taloss project has ceased the active development phase here at Virginia Tech and has entered the support and deployment phase due to the lifetime of the NAVCITTI grant. We are now fully supporting NUWC with installation and usage of the TALOSS system on a day to day basis. The personnel at NUWC are currently using TALOSS powered by desktop Linux systems along with their existing SGI hardware.

The Simulation Based Design (SBD) of a moving towed array was demonstrated on the DIVERSE powered Immersive Wall at NUWC. One frame from the animated movie with a description of results is shown in Figure 1. Also attached to this report is a one page summary of the NUWC/ Virginia Tech SBD Partnering Initiative.

Task 2.1b DIVERSE API: The past quarter has been extremely productive for the DIVERSE API. Two new additions to the DIVERSE API are now completed and ready to release to the public. These are DPFGL and DADS-1.0. Along with DTK these two additional resources have been documented and released on the diverse.sourceforge.net Web site.

DPFGL is the Diverse interface to openglPerFormer for openGL. This component of DIVERSE allows support for raw OpenGL. This will enable task 2.1a to leverage more of the DIVERSE API's power if the project is developed on a different grant. Also, this will allow the usage of many popular VR content toolkits that are currently available. For the navy this will mean that they will have many choices as to how it wants to display content in a virtual environment.

DADS is the DIVERSE Adaptable Display System that provides software support of commodity hardware to replace monolithic SGI hardware. The DADS system provides greater performance than our current SGI computer while only costing a fraction of the price. The advantage to the navy is that they

will be able to leverage DIVERSE to provide a foundation for next generation VR application development. The DADS system can be used in conjunction with existing technology or can function in a standalone configuration. The system works with current infrastructure so no new hardware is needed

5.0 Importance of the task to the Navy:

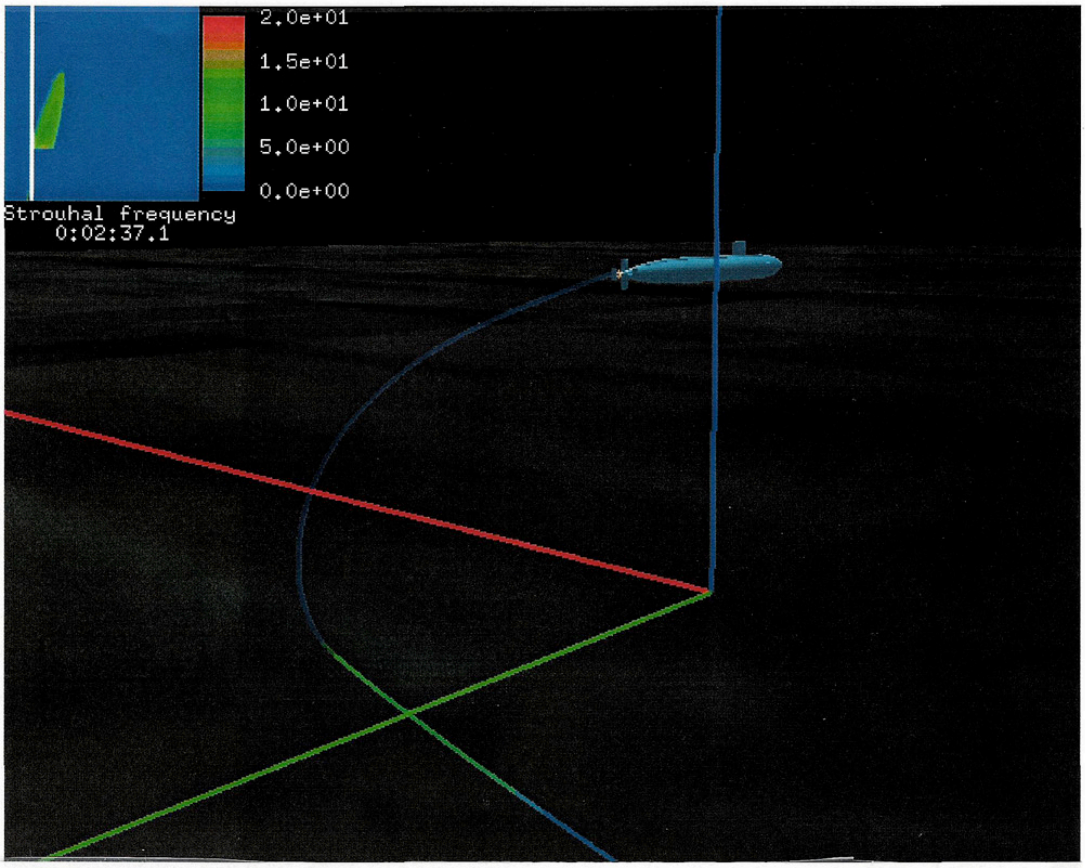
The new DPFGL DIVERSE software API for OpenGL and DADS display system are documented for reproduction and downloaded for the diverse.sourceforge.net Web site. Furture upgrades will be available and supported for future Navy projects.

Activities during the quarter: publications, conferences, demonstrations, visitors:

N/A

Issues if any:

None



* A simulation was performed off-line of a Los Angeles (688) class sub streaming out a 3700 ft line consisting of a 1000 ft tow cable attached to a 2700 ft towed sonar array. There are three DIVERSE applications which communicate via shared memory to render the scene: 1) a controller which sets the simulation time of interest, 2) a database server which interpolates to obtain the data sets corresponding to a given time, and 3) a renderer which displays what has been retrieved by the database server.

* The renderer displays the sub and towed array and utilizes the standard DIVERSE navigation services. The tow cable is rendered as a transparent line; the sonar array as a solid line. Both sections are colored according to the selected data set which the user may cycle through dynamically by a mouse button push. In the upper right hand corner is an inset God's-eye view. In the upper left is a representation of the displayed data set for the entire array and time of the run, color-coded according to the adjacent legend, with the current time indicated by a vertical line. In the lower right is the VCR-style time controller window superimposed over the renderer window: it is not currently an integral part of the renderer.

* In this movie, the sub starts executing a 90 degree turn to starboard when the sub center of gravity coincides with the coordinate origin. Mouse clicks are shown that start, pause, and re-start simulation time. The various data sets are cycled through, indicated by the inset in the upper left and the re-coloring of the towed array. The horizontal valuator of the VCR controller is selected and dragged left and right to quickly select a time of interest.

* The data set of special interest is the Strouhal frequency, a nondimensionalized vortex shedding frequency. A high Strouhal frequency is indicative of a high level of self noise. In the movie, an array element colored anything but blue is shedding vortices: any useful signal reaching it is overwhelmed by the resultant noise level.

* The ability to accurately process data sensed by a towed array is dependent on knowing the position, orientation, and self-noise of each of its elements. The capability to visualize the simulation of a submarine maneuvering with a towed array deployed will improve this processing ability.

Figure 1. One frame screen capture of SBD of a moving towed array with a description

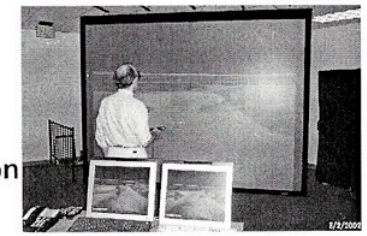
NAVSEA NEWPORT Undersea Warfare Center Division

NUWC / Virginia Tech Partnering

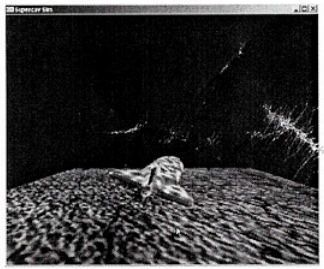
Simulation Based Design (SBD) Initiatives

DEPARTMENT OF THE NAVY ONR Science & Technology

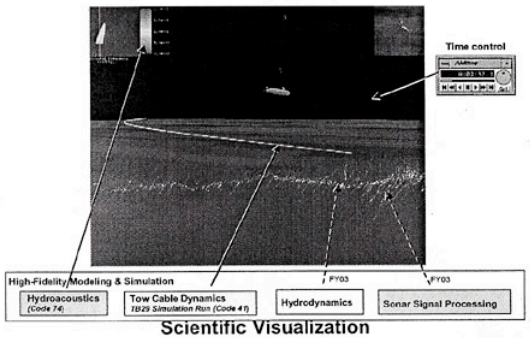
- **NUWC actively developing high-end visualization applications using Virginia Tech Diverse software API**
  - **Selection of DIVERSE driven by both developmental and economic considerations**
    - » **Access to both source code and VT team streamlines creation of Navy-specific features**
    - » **Open distribution drives widespread adoption and significantly reduces cost**
  - **NUWC Reality Center and multiple immersive display systems on DIVERSE**
- **DIVERSE supports both ONR and internal NUWC initiatives**
  - **Undersea Weapon Design & Optimization program – ONR 333**
    - » **ONR 6.2 Simulation Based Design (SBD) initiative**
    - » **Leveraging DIVERSE to support distributed engineering collaboration**
  - **NUWC Common Product Development Process (CPDP)**
    - » **Corporate initiative to improve product development processes**
    - » **Includes strategic initiatives focused on high-end visualization**



High-End Visualization Laboratory



Virtual Design & Testing



Scientific Visualization

NUWC Cost Saving

42K – 57K

(3 development displays for 2 years)

Current GSA cost for commercial equivalents

Software	Purchase	Recurring
CAVELib	13K/display	1K/display
Vega	16K/display	3K/display