Marine Physical Laboratory

Scientific and Technical Support for Submarine Development Group One

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The Marine Physical Laboratory (MPL) of the Scripps Institution of Oceanography and the Woods Hole Oceanographic Institution, Deep Submergence Laboratory (DSL) have provided the second phase of a long term program to provide technical, engineering, and scientific support to Submarine Development Group One (SDG 1) to enhance performance of their missions, including support of ocean research and to investigate the sea floor using both manned and unmanned vehicles. The support has taken two forms. First, participation in ongoing programs of SDG 1 by MPL personnel in order to better understand the operations to provide assistance in making them more cost effective and to build long term continuity to complement the skills of the Naval Personnel who rotate through assignments at SDG 1. Second, to carry out engineering and user related activities to enhance the capabilities of SDG 1 seafloor search, recovery, and research support systems.

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Abstract

The Marine Physical Laboratory (MPL) of the Scripps Institution of Oceanography and the Woods Hole Oceanographic Institution, Deep Submergence Laboratory (DSL) have provided the second phase of a long term program to provide technical, engineering, and scientific support to Submarine Development Group One (SDG 1) to enhance performance of their missions, including support of ocean research and to investigate the sea floor using both manned and unmanned vehicles. The support has taken two forms. First participation in ongoing programs of SDG 1 by MPL personnel in order to better understand the operations to provide assistance in making them more cost effective and to build long term continuity to complement the skills of the Naval Personnel who rotate through assignments at SDG 1. Second, to carry out engineering and user related activities to enhance the capabilities of SDG 1 seafloor search, recovery, and research support systems.

Research Summary

Shipboard Computer Group Support to SDG

During the past year, members of the Shipboard Computer Group at SIO have supported Sea Beam data acquisition and processing operations aboard Laney Chouest in two modes: continued support and consulting on an as needed basis, and hardware as well as software reconfiguration in emergency situations.

The continuing support has involved:

1. Ship-to-shore E-mail support using the Shipboard Computer Group's shore-based computer as the shore connection and internet dispatching site. Specific consulting to enable the transfer of large files via E-mail from the ship.
2. Software consulting activities including teaching DevRon5 personnel to use the software installed on the Sun workstation aboard ship for a specific task, training new personnel and providing training when software is upgraded.
3. Hardware and Software upgrade. New disk drives were installed on the Sun workstation aboard ship, augmenting the available disk by 3 gigabytes. The operating system was upgraded from Solaris 2.3 to Solaris 2.5.1 with the CDE (common desktop environment).
4. Database searches for locating available data in preparation for at sea operations. Providing plots of multibeam bathymetry data available in the database for areas where the ship is tasked to conduct a search.

Emergency support has involved:

1. Hardware support. Personnel from the Shipboard Computer Group joined the ship in Coos Bay, OR, and installed new RS-232 cards in the computer after complete electrical failure of the system for reasons that have not been determined. Computers were checked out and restarted to allow the operation to continue.

Precision Bathymetric Survey with LANEY CHOUEST

Summary

All available 16-beam multibeam Seabeam (SB) data files collected between 1992 and September 1996 on the DSVSS Laney Chouest have been extracted from magnetic tape and organized into an online database. Indexes of these data have been created to permit searching for SB files by geographic location. There are 214 files, each covering a few minutes to one day of ship time in the northeast Pacific between 18 and 52 degrees north latitude and 108 and 158 west longitude.

Background

Prior to 1994, data from the *LANEY CHOUEST* Seabeam system were collected and processed with a package developed and maintained by the University of Rhode Island on DEC Microvax computers using the VMS operation system. Data collected by this system were backed up on DEC TK50 format tapes.

In 1994, the Shipboard Computer Group of the Scripps Institution of Oceanography took over responsibility for the Seabeam computers and replaced them with SUN Spark-5 workstations running the Unix operating system. Files produced by this system have been logged to 8 mm Exabyte tape using the Unix tar tape archive command.

Present Status

The LANEY CHOUEST Seabeam database, containing 214 SB files from both the "old" URI/Vax era and the "new" SCG/Sun era (through September 1996) have been placed on the SIO/GDC machine names "gdcmpl". The size of the database totals 331 megabytes.

Files which matched cruise or project name identifications (39) were placed in subdirectories. These were assigned by DSU personnel on the LANEY CHOUEST. Each of the subdirectories contained one or more files and each file covers ship-time ranging from a few minutes to up to 24 hours. All files, both Vax and Sun eras, are in the same "SIO Swath format" for 16 beam data. This format can also be read as format 16 in the MBSYSTEM multibeam processing package.

The Vax-era data were extracted from DEC TK50 format tapes by Todd Porteous, SIO/SCG. These files are named in the form of "cb91_209.D01.cb", where 91 is the year and 209 is the Julian day. If more than one file ends on the same Julian day, the files are tagged D01, D02, etc.

The Sun-era data were extracted from Unix tar format tapes that had been made from disk files on machine lcsunb on 95Aug13, 95Oct16, 95Dec22 and 96Jun19 by Jim Charters, Ron Moe or Stuart Smith. Additional recent files, for cruises between July and 10 September 1996 were extracted from system dump tapes done on machine 'lcsunb' by Charters on 10 September 1996. These Sun-era files are named in the form of "SBmrg.95Mar03". If more than one file ends on the same data, the files are tagged 03, 03.1, 03.2, etc.

Both Vax and Sun tapes had a large number of duplicate files resulting from files from previous cruises not being backed up on tape and deleted from disk in a consistent manner. Seabeam files which had not been merged with navigation and for which no navigation could be found were deleted from the database, as were a number of very short files that covered only a minute or two of ship time. Navigation was located for several Seabeam files with no navigation and, after merging, these files have been retained.

Index files generated by program swath_check for the above seabeam files are located in the subdirectory SBINDEX. Program DOabersch.laney, located in the main LCHOUEST directory, will search these index files to locate files by latitude and longitude boundaries.

In addition to checking for short time length files, the index files were checked for reasonable latitude and longitude boundaries, but no other checks on navigation quality have been made. No checking or ping editing has been done on the depth values in the Seabeam files themselves.

Pagesize trackplot Postscript files for each of the 39 cruises or projects have been created in each subdirectory. Copies of these plots are included with copies of this report.

Future Tasks

- Integrate LANEY and SIO Databases - Considerations will be given if the LANEY SB data should be integrated with the SIO SB database for indexing and retrieval purposes. Integration will probably be recommended unless there are security or data proprietary considerations. Integration would permit searching for both SIO and LANEY CHOUEST SB data from a single command, as well as amplifying the database update process so that the same database updates could be done for the LANEY CHOUEST and the two SIO multibeam run by Scripps, R/V Revell and Melville.
- The main non-proprietary SIO SB database is available on magnetic tape and the SIO SB index be maintained online on the LANEY CHOUEST. The LANEY data should be backed up on separate magnetic tape and could be stored online, as well if 330+ magabytes of disk space are available.

- Improvements in Data Backup
- Updating of Future Database
- MBSYSTEM Processing Packaging

Modification Study to Improve the Wide Area Search Capabilities of Deep Silos

MPL is in the process of constructing a modified Deep Silos system for SDG1. The primary mission of the Deep Silos system was to determine the location of sunken Navy assets on the bottom of the ocean. The nature of the objects is that they are mostly of both ferrous and non-ferrous metals ranging in size from about one meter (aircraft pieces) to 100m (ships). Since the objects to be found are usually on the sea floor because of some kind of accident there is no control over the water depth at which they come to rest. Any vehicle whose mission it is to perform such underwater search operations should be capable of operating to a depth that covers most of the area of the earth's oceans.

The abyssal plain covers about 80% of the earth's sea floor and ranges between 11500-18000 ft (3500- 5500m). The shallower areas are taken up by the continental slope and shelf in about even proportions (8.5% and 7.5% respectively). Therefore to cover about 90% of the earth's ocean sea floor area the search vehicle should be capable of operating at depths of up to 6000 m. For efficient area coverage the vehicle should employ a sidescan sonar with a swath width of 1000-1500 m. To aid in target identification the vehicle should have a sensitive (1 Gamma or less) magnetometer. (to help distinguish between a rock outcrop and a ship)

These are the main search components. For effective search and location, however, several other components should be added. A navigation system to know where the vehicle is three dimensionally in a standard coordinate system (Lat., Lon, depth). An obstacle avoidance capability so that underwater collisions of the vehicle with the submarine topography can be avoided (which can save the operators from timely and costly repairs and possibly even the loss of the search vehicle). An emergency locator transponder to locate the vehicle in the event that it is severed from it,s tow cable. Of course these sensors are only as useful as their displays on the surface are effective and the skill of the operators in interpreting the information. The above recommended components of an effective towed wide area search vehicle are summarized in the following list:

1. 6000m depth capability

2. Side scan sonar w. 1000-1500m swath width

3. Magnetometer w. 1 Gamma sensitivity

4. Navigation: Transponder interrogation and pressure gauge

5. Obstacle avoidance sonar

6. Emergency locator transponder

Not all of these items need to be implemented at once to improve the wide area search capabilities of the Deep Silos system. Rather we want to explore the possibilities of an incremental approach to accommodate both manpower resources as well as financial constraints. Such an incremental approach would benefit by just adding, say, a precision pressure gauge to the system so that accurate depths could be obtained thus improving the positional knowledge of the vehicle. Or adding a magnetometer. One thing that is clear from the present system is that adding almost anything will require some kind of frame on which to hang it.

Visual Imaging Analysis

At the request of the Commander of the Deep Submergence Development Group One, Dr. Jules Jaffe, an Associate Scientist in the Marine Physical Laboratory, performed a study of the optical imaging system that is currently on the Advanced Tethered Vehicle (ATV). The purpose of the study was to examine the existing optical imaging system that is on the ATV and to make recommendations to improve the performance of the system. The basic technique which was used to examine the performance of the existing system was to input the locations and the performance parameters of the cameras, lights, and any other important factors into a computer modeling system called UNCLES (UNderwater Camera Light Experimental System). This system is basically a Computer Aided Design (CAD) device which will produce a simulated image, based on the input parameters, and assuming certain environmental conditions. By examination of the output image, in concert with the performance of the system's cameras, a prediction can be made which allows an assessment of the capability of the imaging system to record images about objects in its field of view.

Specific tasks included:

1. An assessment of the HMI lights, presently on the vehicle, with a recommendation for a near term purchase.
2. An ATV Lighting brief by Dr. Jaffe to Commodore Durham on 17 Mar 1995.
3. A full study of the existing camera/lighting/vehicle system with a characterization of the system performance under various scenarios with recommendations for repositioning of the cameras and lights and potential new additions to increase system performance.

A detailed report [1], given to the group contains the details of the computer output and also the conclusions of the study. The results of the task (1) led to the recommendation of purchase of a set of HMI lights by Birns, Inc. (Oxnard CA). The result of the briefing by Dr. Jaffe to the Commodore was to recommend the purchase of an underwater transmissometer from Wet Labs (Philomath, OR). The results of task (3) indicate that the present configuration of the lights and cameras which are on the vehicle are basically sound and, within the limited range of choices that are open to the placement of these devices, the present imaging system is producing almost optimal results. The performance bounds will be described in this document. In addition, the computer modeling system was used to examine the images that would be collected with several hardware upgrades. Foremost among these was the acquisition of a new camera. The task at hand was to examine the performance of the system in a search mode. In this case, it is noted that the range capability of the imaging system can be vastly improved with the purchase of a large dynamic range Electronic Still Frame Camera. The increased performance of the system that is obtainable with this type of camera was described in the report.

Publications

1. Jaffe, J. S. Advanced tethered vehicle lighting survey. MPL Technical Report to CDR J. Green, SUBDEVGRP One. 124 pp. (March 1995).

2. Zimmerman, R. Modification study to improve the wide area search capabilities of deep silos. MPL Technical Report to CDR J. Green, SUBDEVGRP ONE, 4 pp. (July 1996).

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