A World-class ECDIS Laboratory

In September 2001, the University of Southern Mississippi, in conjunction with the US Navy, established an Electronic Chart Display and Information Systems (ECDIS) Laboratory to conduct Research, Development, Test and Evaluation (RDT&E) on the capabilities and limitations of electronic charting systems, data, display and updating services required for US Navy and allied operations.

To assist the Navy's goal of fleet-wide implementation of an ECDIS-N capability by 2004, the ECDIS Lab is used to conduct quality control and testing of electronic chart products produced by the Naval Oceanographic Office (NAVOCEANO) and other government agencies. Additionally, the lab is helping the Navy to gain a greater appreciation for and understanding of the use of electronic charts when operating in the shallow littoral areas of the world. The ECDIS Lab also serves as an information clearinghouse and demonstration centre on available electronic chart data, systems, services and technological advances.

In 1986, the University of Southern Mississippi (USM) established its Marine Science academic and graduate research programme at the John C. Stennis Space Center, Mississippi. With the assistance of NAVOCEANO, USM has developed an intensive one-year Master of Science degree in Hydrographic Science. The purpose of this new degree programme is to provide graduate education in hydrographic surveying, an area of increasing importance to naval operations. To date, 36 candidates have successfully completed their degrees. Material covered in the programme provided part of the basis for having the NAVOCEANOUSM Joint International Hydrographic Applied Science Program recognised in April 2000 by the Fédération Internationale des Géomètres/International Hydrographic Organisation (FIG/IHO) International Advisory Board at the Category A level.

Further Efforts

USM furthered its efforts in hydrography by establishing a Hydrographic Science Research Center (HSRC) in 2001. This new research centre is part of the combined efforts of the Navy and USM to establish a National Center of Excellence in Hydrography (NCOEH) at the Stennis Space Center. The purpose of the NCOEH is to focus more effort in an area that is a core competency of the Navy. USM participates in this effort through its Hydrographic Science Master's Program and the HSRC.

NAVOCEANO, with seven of the world's most modern survey ships, a solid core of experienced field hydrographers, a significant investment in surveying equipment, and the nation's most extensive holdings of bathymetric and hydrographic data, plays an integral role in the continuing development of the NCOEH. In 2001, the HSRC initiated several research projects that included the establishment of the ECDIS Lab located at USM's Stennis Space Center campus. Doug Brunt of the Canadian Hydrographic Service spent six months in Mississippi helping USM establish the ECDIS Lab.

Jointly supported by NAVOCEANO and USM, the lab was established to become a one-of-a-kind electronic charting laboratory by procuring, installing and maintaining Electronic Charting Systems (ECS) and ECDIS software, associated electronic chart-related equipment, systems and data. Through the initial acquisition phase, the ECDIS Lab became a Navigation Demonstration Center and clearinghouse for electronic charting and navigation information.

The ECDIS Laboratory consists of eight computers connected to a dedicated local area network (LAN). Two of these computers serve as shipboard sensor simulators providing necessary real-time sensor data to run various electronic charting applications. One computer serves as the electronic charting production and analysis platform. Another serves as the electronic chart data library warehouse, easily accessible by all platforms via the LAN. The remaining computers house the electronic charting applications that include ECS, ECDIS, and US Navy ECDIS-N candidates that have passed the 'direct read' portion of the initial certification process required by the US Department of Defense (DoD). Due to space limitations, some of the computers run several electronic charting engines, albeit not simultaneously. Since all computers are networked, every electronic charting application has access to all electronic chart data.

Sensor Simulators

The two sensor simulators provide the necessary information for navigational displays such as latitude, longitude, speed log and depth. The latitude and longitude positions can be sent as either GPS or DGPS. All sensor information is sent using the NMEA 0183 standard protocol. Both simulators also have the capability of generating an Automatic Radar Plotting Aid (ARPA) target for real-time display. The two sensor simulators can be linked together via the LAN to provide the same positional information to all machines to portray the same navigational display to the different ECS, ECDIS, and ECDIS-N candidate systems.

The production and analysis computer plays host to several different electronic charting production software packages and analysis tools. The two production suites consist of CARIS and SevenCs ENC tools. The backbone of the CARIS suite is its Geospatial Information System (GIS) module that supports the CARIS HOM and CARIS DOM modules for Electronic Navigational Chart (ENC) and Digital Nautical Chart (DNC) respectively. CARIS HOM and DOM are also supported with additional modules to create Additional Military Layers (AMLs). The SevenCs suite consists of ENC Analyser, ENC Optimiser and ENC Designer. Other electronic chart analysis toolkits include dKart Inspector for post-production analysis of ENCs, and VPF Validator for post-production analysis of DNC. Visual quality control analysis tools include several viewers such as SeeMyDEnc, Easy ENC and the Full Utility Navigation Demonstration (FUND).

The electronic chart data warehouse provides up-to-date charts to all systems depending on licensing agreements. The chart library consists of the DNC folio (the only complete worldwide vector format database), the entire ARCS folio of the world, and S-57 datasets from countries such as Canada, the USA, Mexico, Peru, Japan and Australia, among others. Many of the S-57 datasets are test datasets downloaded from hydrographic office and agency websites or provided by ENC service providers such as Primar. Other data housed in the digital library are Maptech's BSB (raster format) charts of the USA and the US Army Corp of Engineers' latest release of Inland ENC of several major rivers of the USA.

The laboratory has one of the largest collections of ECS, ECDIS and ECDIS-N Direct Read electronic charting applications housed within a single setting in the world (see Table 1).

Paperless Bridge

Using sensor simulators (e.g. GPS) with these systems, the ECDIS Lab is able to create a near real-time operational test of data, displays and systems. Not only does this demonstrate interoperability between electronic charting applications, it also ensures interoperability of the chart data. In some cases, one electronic chart system may be more forgiving in electronic chart dataset errors and easily displays the data while another system may not be able to display the data because of the same errors.

As the US Navy migrates to a 'paperless bridge', many additional capabilities of ECDIS will be realised, such as the integration of Automatic Identification System (AIS) and NATO AMLs. This will require decision-making advice, testing and evaluating new electronic chart products, interoperability analysis and display issues. The ECDIS Lab is working toward gaining a simulated AIS feature to support the electronic charting systems installed at the lab. In the future, display aspects of these applications will become more important as ECS and ECDIS become overloaded with additional information to display. These will include Automatic Radar Plotting Aid (ARPA), AIS and overlays, whether they are Marine Information Objects (MIO), NATO AMLs or USN Tactical Electronic Chart Overlays (TECO). At some point, there has to be a determination of information and display overload which creates a situation in which the mariner 'loses the bubble' or navigational picture.

As more electronic charting systems become involved in the ECDIS-N certification process, the ECDIS Lab will include those systems as part of its inventory. Although the US Navy has a stated goal of having an ECDIS-N on every ship by the end of the financial year 2004, based on a recent assessment by the Navigator of the Navy, this may not be realistically achieved until 2010. During this transitional period, many ships will continue to use ECS and ECDIS that were procured to improve overall 'situational awareness'. Other allied navies will also increase their dependence on electronic charting applications, and may not use systems that are capable of meeting US Navy ECDIS-N requirements. This may tax interoperability capabilities between different allied navies, as well as within the US Navy. The ECDIS Lab can help identify and propose solutions to these interoperability issues, particularly when employing additional tactical information in these systems.

Looking to the future, the lab's resources are uniquely suited to conduct research related to the development of new systems, software, database applications and prototype products. Further, the ECDIS Lab will continue to play a key role in testing and evaluating the capability and limitations of electronic charting systems, data and products to meet the mission requirements of the US Navy, other government agencies and commercial applications.