

ACTD LASER LINE SCAN SYSTEM

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LONG TERM GOALS

The Electro-Optic Identification (EOID) Sensors project developed and tested the EOID Sensor, a high resolution underwater electro-optics imaging sensor designed for rapid visual identification of mines and mine-like contacts (MLCs). The EOID Sensor, in a stand-alone configuration, was successfully demonstrated to the fleet at the Combined Joint Task Force Exercise 1996 (CJTTFEX96). The goal of the current project is to prepare the EOID Sensor for participation in the Joint Countermine Advanced Concept Technology Demonstration[1] (JCM ACTD).

OBJECTIVES

The Electro-Optic Identification (EOID) Sensor will be demonstrated in the JCM ACTD as part of the Advanced Sensors System[2]. The EOID Sensor will demonstrate rapid visual identification of MLCs detected and classified by sonar systems. The objective of this project is to prepare the EOID Sensor for participation in this ACTD.

The EOID sensor, which was completed in early FY96, was designed to produce $\frac{1}{4}$ in pixels throughout a 70 degree field of view while operating at 4 knots. The underwater component of the EOID Sensor consists of a 28 inch long by 16.5 inch diameter pressure vessel, which is contained within a 32 inch long by 21 inch diameter wet hull. It contains a 500 mW laser and operates on < 300 Watts power. The sensor was designed to be deployable from a fiber-optically tethered UUV or from towed 21" diameter underwater platforms.

For the JCM ACTD, the EOID sensor will be deployed in an active depressor towed by a Dolphin semi-submersible ROV. It will be in the Very Shallow Water (VSW) sensor package, along with a dual frequency (high and low) Synthetic Aperture Sonar (SAS) and a Seabat ahead looking sonar (ALS). The dual frequency SAS will provide detection, classification, and localization of MLCs with a very low false alarm rate. MLCs, detected and classified by the SAS, will then be identified using the EOID Sensor. The ALS will be used to reacquire the MLCs.

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In this deployment scenario, the Dolphin and the advanced sensors will be controlled from a MILVAN on a ship. For command and control there will be a slow two-way radio link between the MILVAN to the Dolphin. There will also be a microwave link from the Dolphin to the MILVAN for sensor data transmission. These links are much slower than the fiber-optic link the EOIDS Sensor was designed for. Significant sensor changes are required to adapt the sensor to deal with these lower data rates.

APPROACH

The EOIDS Sensor in its original configuration is fiber-optically connected with a topside real-time processor. The real-time processor handles the real-time control of the sensor, as well as performing real-time image processing and recording of the image data. For the ACTD, this high-speed fiber-optic data link must be replaced with the much lower data rate microwave and radio links. The active depressor towed by the Dolphin will contain a Gigaflop Embedded Multiprocessor (GEM) which will do the beam forming of the sonar data and will handle data communications with a computer system in the MILVAN. For the ACTD a single board computer dedicated to the EOIDS Sensor will be inserted into GEM. This single board computer will provide real time control of the EOIDS Sensor. Since the bandwidth of the microwave data link is smaller than the data rate of the EOIDS Sensor, decimated data from the EOIDS Sensor will be transmitted to the MILVAN in real time to be displayed and recorded. Full resolution EOIDS Sensor image data will be maintained in a circular buffer on the single board computer in GEM. Upon command, full resolution data from any segment of the circular buffer will be transmitted to the MILVAN at a rate the data link can support. The effect of these changes is that the functionality of the real-time processor will be split between a surface component and a remote component.

In order to implement these changes it was necessary to design and fabricate new telemetry boards for the sensor. Substantial software changes were also required. The real time software was ported to the VxWorks real time operating system, to be compatible with GEM.

WORK COMPLETED

The changes outlined above were initiated in FY97, and will be completed in FY98. The new telemetry boards have been designed and fabricated. The software has been ported to VxWorks, and most of the new code has been written. The modified sensor is due back from the contractor in November. It will be tank tested in a stand-alone mode in December, followed by integration into GEM. Shakedown testing of the entire VSW package will be performed before the ACTD demonstration in May 1998.

Several sensor deficiencies have also been corrected. This includes some software fixes (e.g., in the continuous recording mode, occasional data lines were lost), and correction of a scanner alignment problem. Upon sensor disassembly it was discovered that the alignment problem was due to crack in a mirror. This crack developed after

sensor assembly. A spare mirror had a similar crack, indicating a flaw in the manufacturing process for the mirrors. The sensor was repaired using a second spare mirror.

RESULTS

The tank testing, shakedown testing, and ACTD demonstration will provide the demonstrable results from this effort.

IMPACT/APPLICATIONS

The goal of the Electro-Optic Identification Sensors Project is to develop and demonstrate high-resolution underwater electro-optic (EO) imaging sensors for rapid visual identification of mines and mine-like contacts (MLCs). Identification of MLCs is a pressing Fleet need. During MCM operations, sonar contacts are classified as mine-like if they are sufficiently similar to signatures of mines. Each contact classified as mine-like must be identified as a mine or not a mine. During MCM operations in littoral areas, tens or even hundreds of MLCs must be identified. This time consuming identification process is performed by EOD divers or ROVs, and is the rate limiting step in many MCM operations. A method to provide rapid visual identification of MLCs would dramatically speed up such operations.

The demonstration of the EOID Sensor to the Fleet at CJTFEX96[3] allowed the Fleet to directly evaluate the impact of deployment of EOID Sensors on MCM operations. Fleet assessment was overwhelmingly positive, as expressed in Naval messages[4,5]. The factor by which MCM operations would be accelerated through rapid visual identification with EOID Sensors was estimated in the first message. The second message includes the statement “(U) STRONGLY CONCUR WITH REF A RECOMMENDATION TO PROCEED WITH EOID PROGRAM AND FIELD EOID SYSTEMS ASAP” from COMINWARCOM.

TRANSITIONS

The Fleet has recommended immediate commencement of programs to field EOID Sensors as soon as possible. Deployment methods to support both Air MCM (AMCM) and Surface MCM (SMCM) have been requested. For AMCM, the EOID Sensor technology would be inserted into an AMCM tow body, such as the AN/AQS-14 or the AN/AQS-20, and deployed from a helicopter. This would allow identification of MLCs to proceed at AMCM speeds. To support SMCM, the EOID Sensor would be a part of the Remote Minehunting System (RMS) to allow rapid visual identification of MLCs detected and classified by the RMS sonars. This is very similar to what this project will demonstrate at the JCM ACTD in FY98.

Both of these deployment methods are technically quite feasible. Both would have significant operational pay-offs. RMS is a funded program which plans to include an

EOID sensor type identification capability. A future AN/ASQ-XX airborne mine reconnaissance system will very likely include a similar EOID sensor type identification capability. EOID Sensor technology will transition to both programs.

The EOID sensor will be utilized in the Mobile Underwater Debris Survey System (MUDSS) Program, PE 0603716D, sponsored by the Strategic Environmental Research and Development Program (SERDP), Dr. Ron DeMarco, ONR 331. The objectives of this program are to demonstrate technology for underwater surveys of Formerly Used Defense Sites for munitions and ordnance prior to environmental clean up of the sites. MUDSS plans to use a sensor suite consisting of acoustic, magnetic, and electro-optic sensors for this demonstration. This demonstration will take place in FY98 after the ACTD.

RELATED PROJECTS

This project will transition to the JCM Advanced Sensors ACTD[2] in FY98.

The EOID sensor is part of the Mobile Underwater Debris Survey System[6] (MUDSS) Program, PE 0603716D, sponsored by the Strategic Environmental Research and Development Program (SERDP), Dr. Ron DeMarco, ONR 331.

The EOID Sensor was developed by the Electro-Optic Identification Sensors Project[7], which also developed image processing and image enhancement algorithms[8,9] which will support the Advanced Sensors ACTD.

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