

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE 2006		2. REPORT TYPE N/A		3. DATES COVERED -	
4. TITLE AND SUBTITLE Extended-Range Underwater Laser Imager				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Aculight Corporation, 22121 20th Ave. SE, Bothell, WA 98021				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES The original document contains color images.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 3	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Extended-Range Underwater Laser Imager

Roy D. Mead
Aculight Corporation, 22121 20th Ave. SE, Bothell, WA 98021
phone: (425) 482-1100 x106 fax: (425) 482-1101 email: roy.mead@aculight.com

Contract Number: N00014-06-0083
<http://www.aculight.com> (general information about Aculight)

LONG-TERM GOALS

Our goal is to develop and demonstrate a laser underwater imager capable of imaging through 7 – 8 attenuation lengths. The system will be designed to provide ¼” resolution, and be compatible with nominal 12” diameter AUV systems. Eventually we plan to produce ruggedized versions for deployment in AUVs.

OBJECTIVES

The near-term objective for the project (being carried out with SBIR funding) is to develop a breadboard prototype of the imager, and test and demonstrate the imager in a turbid-water test tank at Scripps Institution of Oceanography.

APPROACH

The imager uses novel technology for both the transmitter and receiver. The transmitter is a frequency-doubled, 1 MHz repetition rate pulsed fiber laser producing about 6-8 Watts at 532 nm, whose beam quality enables excellent spatial resolution. A distinctive large-aperture, directional receiver discriminates against scattered light while efficiently collecting photons.

Dr. Jules Jaffe of Scripps is providing invaluable assistance with the project, including advice on underwater imaging, developing data systems, testing the imager, and analyzing the results.

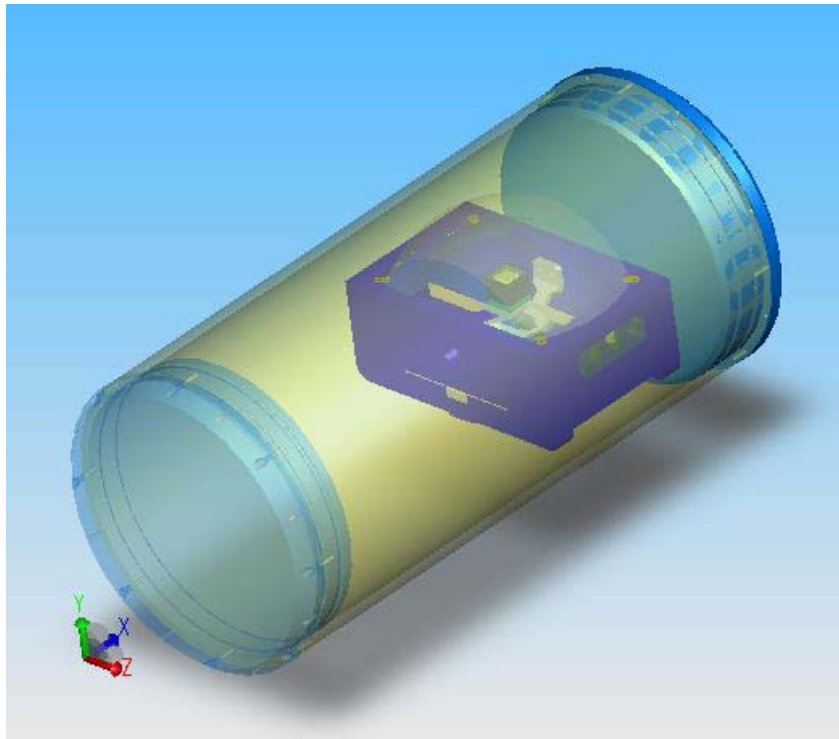


Figure: Concept drawing of the laser imager now in development, depicted within a 12-inch diameter AUV.

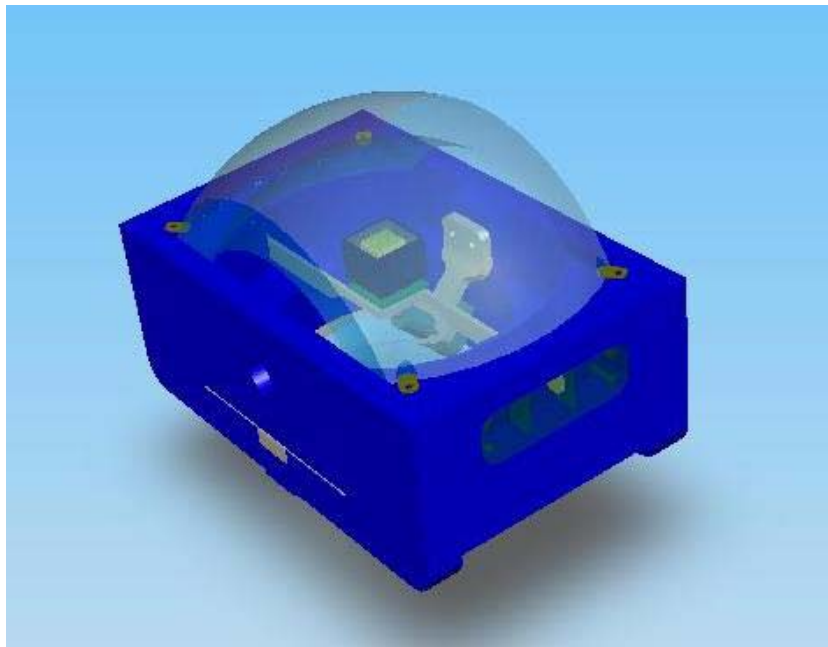


Figure: The hemispherical optical system of the receiver allows unusually large light collection aperture in a small-diameter payload. The transmitted laser beam is projected from the center of the hemispherical optical system, to provide a monostatic configuration.

WORK COMPLETED

The entire receiver optical system has been assembled and tested. Recent revisions to the receiver electronics design have been successful. The laser design and breadboard assembly is completed and the final version of the laser is ready for integration into the system.

RESULTS

Early optical and electronic results are supportive of the eventual sensitivity goals for the project. The receiver's optical performance in light collection capacity and resolution meets the design goals. A unique photomultiplier and drive circuit is used to discriminate against photons scattered from the near-field of the imager system. With each laser pulse (at a 1 MHz repetition rate) the photomultiplier is gated off, then gated back on to detect and amplify photons scattered from targets of interest more than a few meters from the imager. The photomultiplier system is able to provide more than four orders of magnitude of discrimination against photons scattered from the seawater near the detector, while still providing high sensitivity for photons scattered of the slightly more distant targets.

The laser can now produce >5 Watts of green output with prime power input <150 Watts, which makes the design promising for use in UUVs. The system is undergoing final integration, and will soon be tested in a 10-meter tank at SIO.

IMPACT/APPLICATIONS

Development of an imager capable of operating in extremely turbid water will facilitate both marine science studies, and tactical military operations as well. The spatial resolution of the system will greatly exceed that of sonar systems, enabling higher quality images for science, and unequivocal identification of potential munitions or other targets.

RELATED PROJECTS

Other versions of the green laser used in the imager are being developed under contract N00039-06-C-0040 with SPAWAR, with the goal of providing efficient, multiwatt, high pulse repetition rate green lasers for undersea data communications. Another project under contract N68335-07-C-0291 has developed a modulated pulsed laser which could later provide a further upgrade in rejection of scattered light for the imaging system.