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14. ABSTRACT
This quarterly report describes the work done for the "Passive Imaging System for Measuring Atmospheric Scattering and CFLOS", under ONR Contract N00014-07-1-1060, between 1 November 2008 and 31 January 2009.

15. SUBJECT TERMS
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University of California, San Diego
JTO/ONR HEL MRI Quarterly Report January 2009

Project Title: Passive Imaging System for Measuring Atmospheric Scattering and CFLOS

Grant Number: N00014-07-1-1060

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1. Activities for Current Quarter, November 08 – January 09

Task 1: (Experimental test site)

Having acquired a good data set at the experimental site in the previous quarters, we felt it was time to optimize the MSI. In October, we had taken down the MSI to test the dark noise issue, and then sent it to the manufacturer for repair. Photometrics is no longer allowed to repair their own cameras; this work is now down by QImaging. (Both Photometrics and QImaging are owned by Roper, which apparently did this as a cost-cutting measure.) I worked with Q-Imaging in November and December to help them understand the problem and how to view images. Finally in January they said it was repaired. However, when we got it back, we found that they had not in fact solved the problem, and I verified from their test images that it was not working right when they did their final tests. The problem is that the least significant 4 bits in the 16 bit digital output are frozen, which means that the camera essentially acts like a 12 bit camera. We did more trouble-shooting at MPL, and believe we have isolated the problem to two bad chips on the electronics. The replacement chips are on order, and we expect to be able to do the repair ourselves. In the meantime, we have tested another camera, and will use it if we cannot resolve this issue soon.

Our hosts at the site had replaced the trailer housing the transmissometer receivers. We were concerned that it may or may not be sufficiently stable. At this time, we have reinstalled the transmissometer receivers, and also stabilized the floor. At the moment, the alignment is not as stable as we would like, but our hosts are also moving instruments into the trailer, and this may affect it. We will continue monitoring the situation when they are done with their moving, to determine whether we need to further stabilize the trailer.

Task 2: (Weather at test site)

The ground weather station installed by the NPS team in Feb continues to operate well. There was a problem with the link to NPS, but this has been repaired now, and no data were lost. The buoy planned for deployment in Year 2 by NPS had been deployed by another program during early March through 5 May 08 and again on 22 October 08, and operated well during this quarter at no expense to our project. Although the location was adequate for our project, we realized that the mooring acoustic release is only good for a few more months, and thus needed to be removed soon. The other sponsor removed the buoy at his expense on January 23. NPS is evaluating the best location for the next buoy deployment, and will build a new mooring, and plan to redeploy in the April to May time frame.

Task 3: (Purchase IR system components)

We have completed our analysis of IR systems, and ordered the camera for this system. The top choices were the AlphaNIR provided by FLIR, and the SU320KTSX-1.7RT provided by Goodrich. The cameras are quite similar; both are 320 x 256 12 bit sensors that are active at 1.6 μm , as we need for the project. The AlphaNIR had the advantage in

cost, and more importantly, we have spent several weeks understanding its radiometric characteristics in an earlier project. These CMOS devices have much more complex calibration characteristics than most CCD devices, and it's important to understand them in order to do our development work.

Task 4: (Data analysis)

Extensive data analysis was completed and reported on in the previous quarter, but we did not complete any additional work this quarter.

Task 5: (Visibility algorithm)

Significant work on this topic was completed and reported on in the previous quarter, but we did not complete any additional work this quarter.

(Tasks 6, 7, and 8 are primarily funded for year 3)

Task 9: (Research military needs)

Two potential Navy applications have come up in this quarter. We are working with a graduate student at UCSD who has a program with SSC in which they wish to correct surveillance images of the harbor for weather. I believe we can essentially work the MSI equations backward to do this, and we will be looking at that approach. Also, we spoke with a group from China Lake about future applications of the MSI for HEL test support.

2. Events

There were no events this quarter.

3. Technical Results/Accomplishments

Task 1: (Experimental test site)

We have isolated the camera problem that the manufacturer was unable to understand, and ordered the needed electronic components. We also reinstalled the transmissometers. In previous quarters, we acquired a useful data set from all instruments to use in analysis.

Task 2: (Weather at test site)

We have acquired more useful data set from the ground weather station and the buoy. At no cost to us, the buoy was brought back after 3 months, so that a new mooring can be built, as the existing mooring did not have a sufficiently long life expectancy.

Task 3: (Purchase IR system components)

We have finished our evaluation of the best IR camera to buy for this experiment, and have ordered the camera. This involved fairly extensive evaluation, as the camera is nominally a \$23k component.

Task 4: (Data analysis)

In previous quarters, we have developed methods to extract the extinction coefficient from the MSI, Transmissometers, and PSM. The data have been extracted and analyzed and look very good.

Task 5: (Visibility algorithm)

In previous quarters, we have programmed an initial version of the visibility algorithm. We have verified that use of data below the horizon can be used to further extend the

anticipated visibility ranges over which the MSI might be expected to operate, and gotten good results using two regions. We have determined that the inherent contrast for the red filter in the south direction is reasonably well behaved over a wide range of sun angles and conditions, and determined that the visibility algorithm returns good results for these test cases.

Tasks 6, 7, and 8 are primarily funded for year 3

Task 9: (Research military needs)

In previous quarters, we have researched some of the needs, and also determined things such as the accuracy of pitch and roll information that we will need.

4. Issues

There are no issues we are aware of at this time. Year 2 funding was received 10 October 2008. We appreciate this and will reassess our spending rates. Our spending rates have been somewhat slow, but we have now completed all tasks from Year 1, and we are on schedule for the technical tasks.

5. Activities for Upcoming Quarter: (Nov 08 – Jan 09)

Task 1: (Experimental test site)

We plan to complete the redeployment of the MSI with a repaired camera. We will verify whether the new trailer is sufficiently stable, and if not stabilize it. Ongoing monitoring of all systems will continue.

Task 2: (Weather at test site)

Ongoing monitoring of shore systems will continue. The buoy mooring will be built, and we hope to redeploy the buoy toward the end of this quarter.

Task 3: (Purchase IR system components)

We plan to work on the optical system and the environmental housing that will go with the IR system. We should receive the IR camera early in this quarter, and will also be working on the software to control the system.

Task 4: (Data analysis)

We plan to document our earlier data analysis, and extend our analysis of MSI data to additional angles and filters and time periods.

Task 5: (Visibility algorithm)

We plan to upgrade the algorithms to provide more sophisticated determination of the apparent contrast, for use with the data analysis in Task 4.

Tasks 6, 7, and 8 are not funded primarily for year 3

Task 9: (Research military needs)

We plan to explore the use of the MSI technique for surveillance imaging by the Navy.

6. Cost Report

The cost report will be sent by 10 February.

7. Milestone Status

The milestone for Year 1 was completed in a timely manner, as reported in the July quarterly report. The Year 2 milestone is to complete the IR system deployment by the end of March, although if a correction is made for the fact that Year 2 funding was received in October 08 instead of July 08, it would be reasonable to similarly delay this milestone 3 months to June 09. We will continue working on the IR system in the next few months.

8. Summary

Having made excellent progress in the data analysis and algorithm arenas last quarter, we concentrated on hardware this quarter. The MSI camera needed repair. The camera manufacturer had the MSI camera for 3 months, and was unable to repair it, but we believe we have isolated the problem, and have ordered the parts we need for the repair. The transmissometers were reinstalled in the new trailer, and we are evaluating the stability. We have completed the evaluation of the IR camera needed for the IR scattering imager, and ordered the camera.