REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
	Technical Paper	

4. TITLE AND SUBTITLE

Please see attached

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

5d. PROJECT NUMBER
3503

5e. TASK NUMBER
000P

5f. WORK UNIT NUMBER
549807

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

ERC

8. PERFORMING ORGANIZATION REPORT

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Air Force Research Laboratory (AFMC)
AFRL/PRS
5 Pollux Drive
Edwards AFB CA 93524-7048

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S NUMBER(S)
Please see attached

12. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Leilani Richardson
Unclassified	Unclassified	Unclassified	A		19b. TELEPHONE NUMBER *(include area code)* (661) 275-5015

MEMORANDUM FOR PRS (Contractor/In-House Publication)

FROM: PROI (TI) (STINFO) 25 Aug 2000

SUBJECT: Authorization for Release of Technical Information, Control Number: **AFRL-PR-ED-AB-2000-169**
G. Scriven, N. Gat (OKSI), R. Lyons (ERC), "Monocular Passive Ranging Sensitivity Analysis and Error Minimization" (Abstract)

2001 Meeting of MSS Specialty Group on MD-SEA **(Statement A)**
(Monterey, CA, 30 Jan – 01 Feb 01) **(Submission Deadline: 25 Aug 00)**

1. This request has been reviewed by the Foreign Disclosure Office for: a.) appropriateness of distribution statement, b.) military/national critical technology, c.) export controls or distribution restrictions, d.) appropriateness for release to a foreign nation, and e.) technical sensitivity and/or economic sensitivity.
Comments:_____

Signature _____ Date _____

2. This request has been reviewed by the Public Affairs Office for: a.) appropriateness for public release and/or b) possible higher headquarters review
Comments: _____

Signature _____ Date _____

3. This request has been reviewed by the STINFO for: a.) changes if approved as amended, b.) appropriateness of distribution statement, c.) military/national critical technology, d.) economic sensitivity, e.) parallel review completed if required, and f.) format and completion of meeting clearance form if required
Comments:_____

Signature _____ Date _____

4. This request has been reviewed by PRS for: a.) technical accuracy, b.) appropriateness for audience, c.) appropriateness of distribution statement, d.) technical sensitivity and economic sensitivity, e.) military/ national critical technology, and f.) data rights and patentability
Comments:_____

APPROVED/APPROVED AS AMENDED/DISAPPROVED

_____

PHILIP A. KESSEL Date
Technical Advisor
Propulsion Science and Advanced Concepts Division

Monocular Passive Ranging Sensitivity Analysis and Error Minimization

Gordon Scriven[1], Dr. Nahum Gat[1], Dr. Robert Lyons[2]

[1]Opto-Knowledge Systems Inc. (OKSI)
[2]ERC, Inc Edwards AFB

Abstract

Monocular Passive Ranging (MPR) may allow accurate target range estimation even when active measurements or multiple views are not possible. Due to the inherent nature of the MPR solution, the uncertainties may degrade the utility of the range estimate. Proper spectral band selection is essential for error minimization. The study goes beyond the traditional CO2 red spike band for MPR. Featured in the current analysis are the following absorption bands: O2 at 0.76 microns, CO2 at 2.0 and 4.3 microns, and Ozone at 4.7 and 9.6 microns. More importantly, a sensitivity analysis procedure is presented that both minimizes these errors and provides an uncertainty assessment of the range measurement. The result is an improved ranging capability and a more accurate characterization of the intervening atmosphere. The solution technique is applied to an actual HALO/IRIS measurement (Black Brant). However, the MPR software is designed to provide real-time range estimations and atmospheric compensation. A research version of the code has been developed to support integration of this technology into the HALO/IRIS upgrade.

Outline

1. Introduction

2. Solution Technique
2.1 relevant physics
2.2 spectral band selection

3. Sensitivity Analysis
3.1 automatic differentiation (AD)
3.2 identifying key input parameters

4. Error Minimization
4.1 pre-flight onboard measurements(local atmosphere, star measurements, ground measurements)
4.2 response surface (from AD)
4.3 recursion analysis
4.4 uncertainty estimation

5. Data Comparison
5.1 Black Brant measurement from HALO/IRIS
5.2 data vs. model range estimation

6. Integration into HALO/IRIS Upgrade
6.1 HALO/IRIS instrumentation description and capabilites
6.2 Software architecture (HALO/IRIS + MPR)

7. Recommendations

8. Summary

Comments

State-of-the-art Advancement:
Automatic Differentiation (AD) is an emerging technology that is currently under utilized in the field of remote sensing and related phenomena. AD can be applied to existing models for sensitivity analysis. It can also be integrated into the model development itself for improved robustness and more expedient programming.

Key results:
The utilization of multi-spectral sensors, combined with a pre-flight measurement process, extend the envelope of MPR applicability. Previous techniques have broken down for up-looking scenarios. The technique presented in this paper will provide improved ranging capabilities even for some up-looking view geometries.

An accurate MPR technique provides the target trajectory and atmospheric compensation. Both of these are needed for improved target typing, discrimination and tracking.