

# **New Method for Calibration for Hyperspectral Pushbroom Imaging Systems\***

*Robert Ryan, Dan Olive, Duane O'Neal, Chris Schera, Thomas Nixon  
Lockheed Martin Stennis Operations*

*Chengye Mao  
Institute for Technology Development*

*Jim Ryan, Tom Stanley  
NASA CRSP*

## **Abstract**

A new, easy-to-implement approach for achieving highly accurate spectral and radiometric calibration of array-based, hyperspectral pushbroom imagers is presented in this paper. The equivalence of the plane of the exit port of an integrating sphere to a Lambertian surface is utilized to provide a field-filling radiance source for the imager. Several different continuous wave lasers of various wavelengths and a quartz-tungsten-halogen lamp internally illuminate the sphere. The imager is positioned to "stare" into the port, and the resultant data cube is analyzed to determine wavelength calibrations, spectral widths of channels, radiometric characteristics, and signal-to-noise ratio, as well as an estimate of signal-to-noise performance in the field. The "smile" (geometric distortion of spectra) of the system can be quickly ascertained using this method. As the price and availability of solid state laser sources improve, this technique could gain wide acceptance.

---

\* Abstract prepared for submittal to the 1999 International Symposium on Spectral Sensing Research. This work was supported by the NASA Commercial Remote Sensing Program Office, under contract number NAS 13-650 at the John C. Stennis Space Center, Mississippi.

**REPORT DOCUMENTATION PAGE**

Form Approved  
OMB No. 0704-0188

The public reporting burden for this 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 Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 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 any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

**PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.**

1. REPORT DATE (DD-MM-YYYY) 01-04-1999		2. REPORT TYPE		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE New Method for Calibration for Hyperspectral Pushbroom Imaging Systems				5a. CONTRACT NUMBER NAS13-650	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Robert Ryan Jim Ryan Dan Olive Tom Stanley Duane O'Neal Kem Withcer Chris Schera Thomas Nixon ChengyeMao				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Lockheed Martin Space Operations  Remote Sensing Office				8. PERFORMING ORGANIZATION REPORT NUMBER  SE-2003-05-00038-SSC	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Earth Science Applications Directorate				10. SPONSORING/MONITOR'S ACRONYM(S)	
				11. SPONSORING/MONITORING REPORT NUMBER	
12. DISTRIBUTION/AVAILABILITY STATEMENT Publicly Available STI per form 1676					
13. SUPPLEMENTARY NOTES Conference - Abstract					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19b. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Robert Ryan
	U	U	UU	1	19b. TELEPHONE NUMBER (Include area code) (228) 688-1868