

PROCEEDINGS OF SPIE

High-Performance Computing in Remote Sensing

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Antonio J. Plaza
Editors

19–20 September 2011
Prague, Czech Republic

Sponsored by
SPIE

Cooperating Organisations
EOS— European Optical Society
Remote Sensing and Photogrammetry Society (United Kingdom)

Published by
SPIE

Volume 8183

Proceedings of SPIE, 0277-786X, v. 8183

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Please use the following format to cite material from this book:

Author(s), "Title of Paper," in *High-Performance Computing in Remote Sensing*, edited by Bormin Huang, Antonio J. Plaza, Proceedings of SPIE Vol. 8183 (SPIE, Bellingham, WA, 2011) Article CID Number.

ISSN 0277-786X
ISBN 9780819488107

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445
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Contents

- vii *Conference Committee*
ix *The evolution of airborne chemical and radiological remote sensing for emergency and natural disaster response (Plenary Summary)*
P. E. Lewis, National Geospatial-Intelligence Agency (United States)

HPC FOR REMOTE SENSING AND ASTRONOMICAL DATA PROCESSING

- 8183 02 **Fuzzy clustering of large satellite images using high performance computing** [8183-01]
D. Petcu, D. Zaharie, S. Panica, West Univ. of Timisoara (Romania); A. S. Hussein, Ain Shams Univ. (Egypt); A. Sayed, H. El-Shishiny, IBM Ctr. for Advanced Studies in Cairo (Egypt)
- 8183 03 **3D-processor arrays accelerators for high-performance computing in remote sensing applications** [8183-02]
A. Castillo Atoche, Autonomous Univ. of Yucatan (Mexico); J. Vazquez Castillo, Univ. of Quintana Roo (Mexico); L. Rizo Dominguez, Univ. of Caribe (Mexico); J. Sandoval Gio, Merida Institute of Technology (Mexico)
- 8183 04 **A GPU-accelerated extended Kalman filter** [8183-03]
S.-C. Wei, Tamkang Univ. (Taiwan); B. Huang, Univ. of Wisconsin-Madison (United States)
- 8183 05 **Efficient data storage of astronomical data using HDF5 and PEC compression** [8183-04]
J. Portell de Mora, Institute for Space Studies of Catalonia (Spain), Univ. de Barcelona (Spain), and Institut de Ciències del Cosmos (Spain); E. García-Berro, C. Estepa, Institute for Space Studies of Catalonia (Spain) and Univ. Politècnica de Catalunya (Spain); J. Castañeda, M. Clotet, Institute for Space Studies of Catalonia (Spain), Univ. de Barcelona (Spain), and Institut de Ciències del Cosmos (Spain)
- 8183 06 **An efficient framework for Java data processing systems in HPC environments** [8183-05]
A. Fries, J. Castañeda, Y. Isasi, Univ. of Barcelona (Spain), Institute for Space Studies of Catalonia (Spain), and Institute of Cosmos Sciences (Spain); G. L. Taboada, Univ. of A Coruña (Spain); J. Portell de Mora, Univ. of Barcelona (Spain), Institute for Space Studies of Catalonia (Spain), and Institute of Cosmos Sciences (Spain); R. Sirvent, BSC-CNS Barcelona Supercomputing Ctr. (Spain)

HPC FOR REMOTE SENSING DATA COMPRESSION

- 8183 07 **Geostatistical analysis of Landsat-TM lossy compression images in a high-performance computing environment** [8183-06]
L. Pesquer, A. Cortés, I. Serral, X. Pons, Univ. Autònoma de Barcelona (Spain)
- 8183 0C **High-performance computing in remote sensing image compression** [8183-11]
A. Lin, C. F. Chang, National Space Organization (Taiwan); M. C. Lin, L. J. Jan, Chung-Shan Institute of Science and Technology (Taiwan)

HPC FOR HYPER- AND MULTISPECTRAL REMOTE SENSING I

- 8183 OD **Parallel implementation of linear and nonlinear spectral unmixing of remotely sensed hyperspectral images** [8183-12]
A. Plaza, J. Plaza, Univ. of Extremadura (Spain)
- 8183 OE **A comparative analysis of GPU implementations of spectral unmixing algorithms** [8183-13]
S. Sánchez, A. Plaza, Univ. of Extremadura (Spain)
- 8183 OF **FPGA implementation of endmember extraction algorithms from hyperspectral imagery: pixel purity index versus N-FINDR** [8183-14]
C. González, D. Mozos, Complutense Univ. of Madrid (Spain); J. Resano, Univ. of Zaragoza (Spain); A. Plaza, Univ. of Extremadura (Spain)
- 8183 OG **Lossy hyperspectral image compression with state-of-the-art video encoder** [8183-15]
L. Santos, S. López, G. M. Callicó, J. F. López, R. Sarmient, Univ. de Las Palmas de Gran Canaria (Spain)

HPC FOR HYPER- AND MULTISPECTRAL REMOTE SENSING II

- 8183 OH **GPU implementation of JPEG2000 for hyperspectral image compression** [8183-16]
M. Ciznicki, K. Kurowski, Poznan Supercomputing and Networking Ctr. (Poland); A. Plaza, Univ. of Extremadura (Spain)
- 8183 OI **Parallel implementation of RX anomaly detection on multi-core processors: impact of data partitioning strategies** [8183-17]
J. M. Molero, E. M. Garzón, Univ. of Almería (Spain); I. García, Univ. of Málaga (Spain); A. Plaza, Univ. of Extremadura (Spain)
- 8183 OJ **Real time orthorectification of high resolution airborne pushbroom imagery** [8183-18]
J. Reguera-Salgado, J. Martín-Herrero, Univ. of Vigo (Spain)
- 8183 OK **Design and analysis of algorithms for enhancing the quality and the resolution of Dubai Sat-1 images** [8183-19]
S. Al-Mansoori, Emirates Institution for Advanced Science and Technology (United Arab Emirates)

APPLICATIONS OF HPC IN REMOTE SENSING

- 8183 OS **GPU acceleration of WRF WSM5 microphysics** [8183-27]
J. Mielikainen, B. Huang, A. H.-L. Huang, Univ. of Wisconsin-Madison (United States); M. D. Goldberg, National Oceanic and Atmospheric Administration (United States)
- 8183 OV **Development of the GPU-based Stony-Brook University 5-class microphysics scheme in the weather research and forecasting model** [8183-30]
J. Mielikainen, B. Huang, A. H.-L. Huang, Univ. of Wisconsin-Madison (United States); M. D. Goldberg, National Oceanic and Atmospheric Administration (United States)

8183 0W

Calculating the electromagnetic scattering of vegetation by Monte Carlo and CUDA

[8183-31]

Z. Wu, X. Su, J. Wu, Xidian Univ. (China); B. Huang, Univ. of Wisconsin-Madison (United States)

Author Index

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Jiaji Wu, Xidian University (China)

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- 1 HPC for Remote Sensing and Astronomical Data Processing
Antonio J. Plaza, Universidad de Extremadura (Spain)
- 2 HPC for Remote Sensing Data Compression
Bormin Huang, University of Wisconsin-Madison (United States)
- 3 HPC for Hyper- and Multispectral Remote Sensing I
Jarno S. Mielikainen, University of Eastern Finland (Finland)
- 4 HPC for Hyper- and Multispectral Remote Sensing II
Yang-Lang Chang, National Taipei University of Technology (Taiwan)
- 5 GPU Processing of Remote Sensing Data
Antonio J. Plaza, Universidad de Extremadura (Spain)
- 6 Applications of HPC in Remote Sensing
Bormin Huang, University of Wisconsin-Madison (United States)

Plenary Summary

The Evolution of Airborne Chemical and Radiological Remote Sensing For Emergency and Natural Disaster Response

Summary of the September 19, 2011 SPIE Remote Sensing Plenary Session Presentation by

Paul E. Lewis

National Geospatial-Intelligence Agency, United States of America

First responders, joint operations centers, and recovery and remediation personnel consider timely and affordable airborne chemical, radiological, imagery analysis, and related mapping products essential in the formulation of a complete understanding of an incident and its potential impact on adjacent communities, and for recovery and remediation. Airborne remote sensing provides the flexibility to produce incident specific products and conduct over-flights at the frequencies needed to provide timely and relevant information for recovery and remediation operations, optimization of resources during an event, and for the safety of emergency response personnel.

The utility of airborne chemical remote sensing became apparent to the EPA during a chemical plant explosion, which occurred in Sioux City, Iowa in December of 1994. The facility produced ammonium nitrate fertilizer, and also produced its own ammonia for use in the process. In late December an explosion occurred rupturing the main storage tank and spilling three million gallons of ammonia. This resulted in lethal vapor levels in and around the plant and created a plume of ammonia vapors estimated to be 35 miles long. Approximately 3,500 people were evacuated over a 50 square mile area. The EPA sent in vehicles with ground sampling crews dressed in Level A hazmat suits with 30 minute air packs to monitor the site. Due to heavy snow coverage on the ground and saturated soil conditions underneath the snow, all of the EPA vehicles became stuck. Ground sampling crews had to be rescued before air supplies ran out. Consequently, no monitoring of vapor levels was accomplished.

The lessons learned from responding to the chemical explosion in Sioux City, Iowa in 1994 prompted the EPA to begin evaluating the application of airborne remote sensing infrared and gamma ray spectroscopy for emergency responses involving chemical and radiological incidents. Concurrently, with the evaluation process to determine the performance and feasibility of implementing infrared and gamma ray spectroscopy in an airborne platform came the evolution of a set of core requirements for an airborne operational capability: Standoff chemical and gamma ray detection and identification with low false alarm rates; High resolution ortho-rectified day-night imagery; Airborne data collection under cloud ceilings; Rapid dispatch-wheels up in under one hour after activation; Automated data processing –real or near-real-time chemical data analysis; Direct integration of data and information to local incident commanders-local and federal joint operations centers; Data telemetry to and from the aircraft.

According to the EPA, in the United States there are approximately 123 facilities where a release of chemicals could threaten more than one million people. There are approximately 750 additional facilities where a chemical release could threaten more than a hundred thousand people.

In 2001, the EPA implemented the United States only civilian operational airborne chemical detection and identification capability called the **A**irborne **S**pectral **P**hotometric **E**nvironmental **C**ollection **T**echnology (**ASPECT**) Program. Subsequently in 2003, the EPA and NGA agreed to collaborate in a cooperative research and development program focused on evolving the capabilities of the ASPECT Program to produce near-real-time state of the art chemical, radiological and imagery mapping emergency response products.

Plenary Summary

Airborne Spectral Photometric Environmental Collection Technology (ASPECT) Program
The United States Only Airborne
24/7 Operational CIVIL Emergency Response Chemical, Radiological, & Imaging Mapping Capability



The ASPECT model of operation combines an airborne operational remote sensing suite with a research and development support team to insure that analysis and products are validated and verified scientifically and are reviewed and checked before release. The research and development support team collaboration between the EPA and NGA to evolve the capabilities of the ASPECT Program has resulted in the following significant accomplishments: Near-real-time automated onboard chemical detection and identification of 78 chemical compounds with low false alarm rates; Near-real-time information on plume direction and concentrations; Automated software producing day/night ortho-rectified imagery rapid response maps; Automated software producing gamma ray survey information maps onboard the aircraft; Data and information telemetry to and from the aircraft facilitating turn-around times and seamless integration of vital situational awareness information from the aircraft to first responders or joint operation centers in 5 to 15 minutes.

Since 2001 the ASPECT Program has provided essential information during 115 emergency, disaster, and homeland security related incidents ranging from chemical plant explosions and train derailments to fires, floods, hurricanes, and special events. The ASPECT Program played key roles in providing essential information to first responders and joint operations centers in response to the following historical events: The Shuttle Columbia break up during re-entry over Texas in February of 2003; Hurricane Katrina in August of 2005; The Deepwater Horizon Oil Spill disaster in the Gulf of Mexico from April-August 2010.

Over the past decade in over 115 responses, the ASPECT program has demonstrated the utility of having timely, cost-effective operational airborne chemical and radiological remote sensing information integrated seamlessly into the local, state and federal emergency response and disaster recovery and remediation communities. What is needed next is the implementation of multiple aircraft strategically located throughout the United States so that ASPECT capabilities can be on the scene of a disaster or event in less than three hours.