Geospatial Accuracy Evaluation Processes for DigitalGlobe QuickBird 1B and Orthorectified Products

Paul Basgall & Mary Glauber, Precision Engagement Division

May 19-21, 2003

JACIE 2003 High Spatial Resolution Commercial Imagery Workshop
Support to Collection Systems
- metric assessment
- exploitation capabilities
- system performance

Technology Assessment
- USAF
Initiatives: Emphasis on Geospatial Accuracy

NIMA Geospatial Assurance
- Certification of Mensuration Process (DPPDB & Tools)
- Validation/Certification of non-traditional processes (Tactical/Commercial/Radar Imagery)
- Commercial Imagery Process Assurance Program

Geopositioning of Tactical/Commercial/Radar Imagery to Support Time-Critical Targeting
"A Transformation is under Way…"

“From production to purveyor of on-line content”
Commercial Imagery as primary source
Precision Engagement Division’s (PTNT) mission
- Accuracy assessment and improvement
- Data integrity
NIMA Geospatial Accuracy Evaluators - Working jointly with Civil and Commercial Applications Program (CCAP) – A Single Voice

Precision Engagement Division Digital QuickBird Evaluation Team consists of 10 analysts from PTNT and one from IDR.
Presentation of NIMA’s Accuracy Evaluation Techniques and the Accuracy Characteristics of Quickbird Imagery

High Spatial Resolution Commercial Imagery Workshop
May 19-21, 2003
Overview

Accuracy Evaluation through . . .
- Data Collection, Analysis, and Reporting for CCAP
- Quickbird Triangulation and Ortho-photo Production

Continuing Efforts . . .
- Sensor Calibration/Accuracy Improvement
- NITF Image Accuracy Reporting (Er and Eb)

Summary
Data Collection, Analysis, and Reporting for CCAP

Single Images and Stereo Pairs are collected over survey areas
A Stereo Control Base is built over the test images

- Survey control points are transferred to the Stereo Base
- The Stereo Base is held to the survey via triangulation
- Evaluation points can be derived from this Stereo Control Base
**Data Collection, Analysis, and Reporting for CCAP**

Derived Evaluation Points are transferred to the Quickbird Image

- Evaluation points transferred via image correlation
- Using Socet Set’s multi-sensor mensuration/triangulation functionality
Quickbird Ground Coordinates Derived and Analyzed

- “Coordinate Drop” Using Socet Set’s HATS software
- Mono image: evaluation point elevation held fixed
- Stereo pair: parallax removed, sensitive parameter weighting
- Geographical difference computed and analyzed

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Data Collection, Analysis, and Reporting for CCAP

Statistical Data accumulated
- Analysis can reveal integrity in the image, support data, or software.

Quickbird Mono Pan Basic 1B
NITF with RPC (St. Simons)

<table>
<thead>
<tr>
<th>GEODIFF</th>
<th>Lat</th>
<th>Lon</th>
<th>Ht</th>
<th>Hrz</th>
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<tbody>
<tr>
<td>Points: 25</td>
<td>m</td>
<td>m</td>
<td>m</td>
<td>m</td>
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<tr>
<td>Mean</td>
<td>0.42</td>
<td>-13.30</td>
<td>0.00</td>
<td>13.34</td>
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<tr>
<td>Sigma (68)</td>
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Vector scale: 15 meters
Data Collection, Analysis, and Reporting for CCAP

Absolute and Relative Accuracy Reported
- Reports summarizing evaluation results
- Results displayed for technical and non-technical analysis

<table>
<thead>
<tr>
<th>Basic 1B Scene</th>
<th>Item No.</th>
<th>Abs CE (m)</th>
<th>Rel max (m)</th>
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Accuracy: 100% within 23 m (25 pts)
90% within 17 m (22 pts)
Quickbird Evaluation from the Ortho-photo Production Process

Overview of the ortho-photo production process

- Mono Quickbird pan
- NITF with RPC support
- Control/Triangulate (RPC)
- Evaluate Triangulation Results
- Import DEM data
- QC DEM data
- Create Ortho-photos
- QC Ortho
Quickbird Evaluation from the Ortho-photo Production Process

Triangulation results can highlight accuracy trends
- Parameters needed for successful adjustment
- Total correction to those parameters
- Control point corrections and image residuals
- Successful “block” triangulation versus single image triangulation

Triangulation Weighting:
CL0: 20.0; CLS: 5e-3; CLL: 5e-3
CS0: 20.0; CSS: 5e-3; CSL: 5e-3

Parameter Corrections:
qb12838
CL0: 29.7; CLS: 1.7e-4; CLL: 1.1e-4
CS0: -15.3; CSS: 6.4e-4; CSL: 28.1e-4
qb12844
CL0: 27.1; CLS: 2.0e-4; CLL: 2.2e-4
CS0: -83.3; CSS: 6.1e-4; CSL: 17.1e-4
qb12840
CL0: 30.6; CLS: 1.8e-4; CLL: 1.1e-4
CS0: -122.8; CSS: 5.6e-4; CSL: 12.9e-4

Ground point corrections:
Max latitude: 2.7 m
Max longitude: -7.2 m
Max height: -0.8 m

Image point RMS: .338
Quickbird Evaluation from the Ortho-photo Production Process

Summary of parameter corrections from triangulation

- 117 Individual Images
- Wide range of collection dates: March, 2002 - April, 2003
- Representative of Basic 1B available on CSIL

Parameter Correction from Triangulation

Horizontal Correction Frequency Plot
Continuing Efforts

- Sensor Calibration/Accuracy Improvement
  - Provide feedback for sensor calibration and exterior orientation refinement
  - Recollect and/or Reprocess same sites with improved estimates
- NITF Image Accuracy Reporting (Er and Eb)
  - Text values embedded in the header of the NITF image
  - These values give information to compute accuracy when exploiting the image
  - Effort underway to re-define these values
Summary

• Brief explanation of . . .
  – NIMA FPE’s evaluation process
  – NIMA FPE’s triangulation and orthophoto production process
  – Continuing efforts to provide accuracy improvement support
  – Continuing work on NITF accuracy terms: Er and Eb
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Presented by Paul Basgall & Mary Glauber