The Future of Photogrammetric Production

David Loescher
Solution Definition Manager – Earth Imaging Solution Center

Security, Government & Infrastructure
The evolution of Photogrammetry

- Analogue
- Analytical
- Digital
  - now
  - tomorrow
  - What’s coming next?
Intergraph Visions and goals

Provide solutions across the whole range of Earth Imaging requirements, to help our customers see their world clearly.
Customer workflows

Data Management
- Data Acquisition
  - Airborne Imagery
  - Airborne LIDAR/SAR
  - Spaceborne Sensors
  - Scanning of Analogue Images

Data Exploitation
- Geo-reference
- DTM Generation/Edit
- Ortho-rectify/Mosaic
- Map compilation/Feature Extraction
- Image Processing/Remote Sensing

Data Distribution
- Distribute/Sell Products
Market forces

- The Earth Imaging market is currently in change
  - Transition to fully digital workflows
  - Use of aerial digital sensors is becoming commonplace
  - Increasing dependency on the Global GIS Market
  - Demand for open systems and data interoperability

- Being all-digital introduces new challenges
  - How to manage, store, view, archive and distribute the data?
  - Demand for instant access to enterprise data through intranet as well as internet
  - Automated tools and efficient production
  - Stereo-based GIS editing and updating
Customer demands today

- **Productivity**
  - Automation of workflows
  - Efficiency, reduction in production cost

- **Ease of use**
  - Consistent interface
  - Easy to learn
Digital Photogrammetry Today...

- End-to-end Digital Workflow
- Single Sensor
- Automatic Operations
- Manual 2D/3D Feature Collection

Photogrammetry & GIS are Merging
Digital Photogrammetry Trend...

New Sensors

Integrated Real-time Sensors

Photogrammetry and Geospatial are Integrated

Image Analysis Change Detection

Speech recognition Voice Synchronisation
Digital Photogrammetry Trend…

From: Desktop Production

To: Distributed Production
Open Interoperability Trend…

- Any Sensor
- Any Process
- Any Workflow
- Any Data
- Anywhere
Trends Affecting Earth Imaging… (1/2)

- Rapid production mandates …
- More earth imaging sensors…
- In-flight calibrations…
- Global geospatial data sets…
- Photogrammetry integrated within GIS…
- Image & elevation data repositories…
- 3D Visualization…
- Image analysis/change detection…
- Automated feature extraction (again)…
- Spatially enabled enterprises…
  - Distributed processing
  - Seamless spatial computing
- Standards and interoperability…
- Web services…
Project Duration for Statewide Mapping

- Ground surveys (and the first set of nationwide 1:50,000 USGS quadrangle maps) - 100 years
- Aerial Surveys (and the completed set of USGS DOQQs) - 10 years
- Satellite imagery - 1 year
- Unmanned Aerial Vehicles (UAVs) - 1 day
<table>
<thead>
<tr>
<th>Category</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Management</td>
<td>ISPM</td>
<td>ImageStation Photogrammetric Manager</td>
</tr>
<tr>
<td>Orientation/Triangulation</td>
<td>ISMS</td>
<td>ImageStation Model Setup</td>
</tr>
<tr>
<td></td>
<td>ISDM</td>
<td>ImageStation Digital Mensuration + Satellite sensors</td>
</tr>
<tr>
<td></td>
<td>ISAT</td>
<td>ImageStation Automatic Triangulation</td>
</tr>
<tr>
<td>Stereo 3D Feature Capture</td>
<td>ISFC-M</td>
<td>ImageStation Feature Capture - MicroStation</td>
</tr>
<tr>
<td></td>
<td>ISFC-G</td>
<td>ImageStation Feature Capture – GeoMedia</td>
</tr>
<tr>
<td></td>
<td>ISSD</td>
<td>ImageStation StereoDisplay</td>
</tr>
<tr>
<td>DTM Collection &amp; Edit</td>
<td>ISAE</td>
<td>ImageStation Automatic Elevations</td>
</tr>
<tr>
<td></td>
<td>ISDC</td>
<td>ImageStation DTM Collection</td>
</tr>
<tr>
<td></td>
<td>ISSD</td>
<td>ImageStation StereoDisplay</td>
</tr>
<tr>
<td>Orthophoto Production</td>
<td>ISOP</td>
<td>ImageStation OrthoPro</td>
</tr>
<tr>
<td></td>
<td>ISBR</td>
<td>ImageStation Base Rectifier</td>
</tr>
</tbody>
</table>
Our Response today (1/2)...

- Aerotriangulation enhancements
- Distributed processing
- Unique TerraShare image & elevation management
Our Response today (2/2)

- Automated DEM Generation & Editing
- Smart seamlines
- New production management tools
Enterprise Exploitation

- One-button Orthorectification and Mosaicking
- Distributed Processing for Orthorectification/Mosaicking
- Distributed Processing for DMC Post-processing
- Consistent/Easy-to-Use User Interface
- Customizable Workflow
- Production Tracking
One-button Rectification & Mosaicking
OrthoPro Distributed Processing (DP)

Production Applications

Applications

TerraShare Framework

Data Management

Distributed Processing

Submit Execute

Processing Services

Raster Processing

Production Applications

Applications

Desktop

Server

Processing nodes
Performance of DP

- Comparison of the rectify process in a test project of 819 images, 294 DTM's

- 1 workstation: 32 hours (no distributed processing)
- 2 workstations: 17 hours
- 4 workstations: 9 hours

Note, Poor server and network performance may affect DP performance
DMC, Digital Mapping Camera

- Image size 13.5k x 7.5k pixels
- Panchromatic and Multispectral
- 12 Bit radiometric resolution
- 864 Gigabytes of data storage

See presentation by Hartmut Rosengarten
- Using TerraShare Advanced Server – Distributed Processing
- Reduce time taken for data to be available for exploitation
- Scaleable, the more processing nodes you have the fast it goes

See presentation by Christoph Dörstel
Geo-referenced background maps and images can be displayed.
Simplified, single entry point to create, view, and run a full Photogrammetric Workflow.
The features in the map and data views are linked together.
TerraShare Production Manager
Production project dashboard

![Microsoft Excel - Production Progress.xls](image)

<table>
<thead>
<tr>
<th>WBS</th>
<th>Task</th>
<th>EV Method</th>
<th>Deliverable</th>
<th>Weight</th>
<th>Total Products</th>
<th>Products Completed</th>
<th>Percent of Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Acquisition</td>
<td>WM</td>
<td>WM</td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>A.1</td>
<td>Aerial Photography Acquisition</td>
<td>FF</td>
<td>Film</td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>A.2</td>
<td>Film Scanning</td>
<td>FF</td>
<td>Images</td>
<td>100%</td>
<td>902</td>
<td>902</td>
<td>100%</td>
</tr>
<tr>
<td>B</td>
<td>Aerial Triangulation</td>
<td>WM</td>
<td>WM</td>
<td></td>
<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>B.1</td>
<td>Bulk Orientation</td>
<td>PC-MG</td>
<td>Models E/O</td>
<td>75%</td>
<td>885</td>
<td>885</td>
<td>100%</td>
</tr>
<tr>
<td>B.2</td>
<td>Single Image Resection</td>
<td>PC-MG</td>
<td>Images E/O</td>
<td>25%</td>
<td>902</td>
<td>902</td>
<td>100%</td>
</tr>
<tr>
<td>C</td>
<td>Collection</td>
<td>WM</td>
<td>WM</td>
<td></td>
<td></td>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>C.1</td>
<td>Feature Collection</td>
<td>PC-MG</td>
<td>Mappoints</td>
<td>66%</td>
<td>48</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>C.2</td>
<td>Elevations</td>
<td>WM</td>
<td>Mappoints</td>
<td>33%</td>
<td>48</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>C.2.1</td>
<td>DTM Collection</td>
<td>PC-MG</td>
<td>Mappoints</td>
<td>66%</td>
<td>48</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>C.2.2</td>
<td>DEM Generation</td>
<td>PCE</td>
<td>DEM</td>
<td>33%</td>
<td>24</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>D</td>
<td>Orthophoto Production</td>
<td>WM</td>
<td>WM</td>
<td></td>
<td></td>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>D.1</td>
<td>Rectification</td>
<td>FF</td>
<td>Ortho</td>
<td>50%</td>
<td>1,248</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>D.2</td>
<td>Image Dodging</td>
<td>PCE</td>
<td>Ortho</td>
<td>35%</td>
<td>1,248</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>D.3</td>
<td>Ortho Mosaic</td>
<td>FF</td>
<td>Ortho</td>
<td>15%</td>
<td>1,248</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

**EV Methods**
- WM: Weighted Milestones
- FF: Fixed Formula
- PCE: Percent Complete Estimates
- PC-MG: Percent Complete with Milestone Gates
The evolution of Photogrammetry

- Analogue
- Analytical
- Digital
  - now
  - tomorrow
  - What’s coming next?
Our Response to More Sensors

- Support for more airborne & satellite sensor triangulations
- Improve processing tools for elevation data
- Enhancements to GeoMedia Terrain
GeoMedia Terrain

- Shaded relief, color coded elevation, and contours.
- Profile and 3D perspective views.
- Slope and aspect polygons, line of sight, visibility polygons.
- 3D visualization and fly-throughs.
- Benefit: enhances the use of elevation data.
In-flight Camera Calibrations
Provide customers tools (ISAT) to do self calibrations

Working with USGS to define in-flight calibration process and acceptance criteria
Global Geospatial Data Sets
Image Data Repositories.

- Satellite Images.
- Aerial Imagery.
- LIDAR and Radar Images.
- Federal, State and Local data repositories.
Global Geospatial Data Sets

Essential Elements

- Open (metadata)
- Accessible (catalog)
- Served (web services)
- Licensed (in many cases, free)
- Standardized
TerraShare
Image Analysis/Change Detection
Enhanced GeoMedia Imaging

- Advanced Image processing capabilities in optimized Image Window
- Image enhancement capabilities for precise information extraction
- Image comparison – change detection capabilities
- Automatic image roam for systematic search
Coming in 2005:
Feature Analyst for GeoMedia

1. Automated feature extraction
2. Multi-class features
3. 3-D feature extraction
4. Stereo extraction
5. Smart vector editing
6. Auto extraction of buildings, bare earth, and trees from DEMs
7. Change detection from multi-date images
Spatially Enabled Enterprises...
Enterprise Geospatial Integration

1. Within corporate IT environment
2. Integrated with other applications
3. Using distributed processing
4. Includes standard development tools
5. Data shared in distributed environment
6. Managed from within a single, integrated environment
Our Response: TerraShare Product Suite
Seamless Access on the Desktop
A Look to the Future…

From:
- Film processing.
- Serial Processing.
- Models.
- Proprietary files
- Stand-Alone
- Single vender focus
- Workstations
- GIS-centric
- Enterprise-wide

To:
- Digital Imaging.
- Seamless Computing
- Blocks.
- Open standards
- Interoperable
- Multi-vender reality
- Web
- IT-centric.
- World-wide