Lidargrammetry

GeoCue Corporation
9668 Madison Blvd., Suite 101
Madison, AL 35758
01-256-461-8289
www.geocue.com

Martin Flood
mflood@geocue.com

USGS National Lidar Initiative - February 15, 2007

Legal Note

The techniques discussed here are based on algorithms developed by GeoCue Corporation and implemented in their GeoCue software suite. GeoCue Corporation has a patent pending on its imaging techniques, including lidar stereo or 'lidargrammetry' and related 'synthetic stereo' generation methods.

Outline

- Production Tools
- Production Framework
- National Program Requirements
- Observations

Why Lidargrammetry?

- A specific example of a new tool that is impacting overall production efficiency for lidar data producers.

- Demonstrates the benefits of integrating two distinct workflows to improve throughput and scalability of established techniques.

Motivation for This Tool

- Investigate improvements to overall lidar workflow efficiencies.
- Determine if an end-to-end ‘lidar-only’ workflow for creating established mapping products is practical.
- Capture any cost reductions.

Inferred Stereo Pairs (ISP)

- Traditionally in normal stereo vision systems a pair of 2D images, each taken from a slightly different perspective, is used to derive 3D object space points.

- Or, by creating a second image from a orthorectified source image and an elevation model, an inferred stereo pair can be inferred (‘stereo mate’).

Lidar Data – No 'True' Image

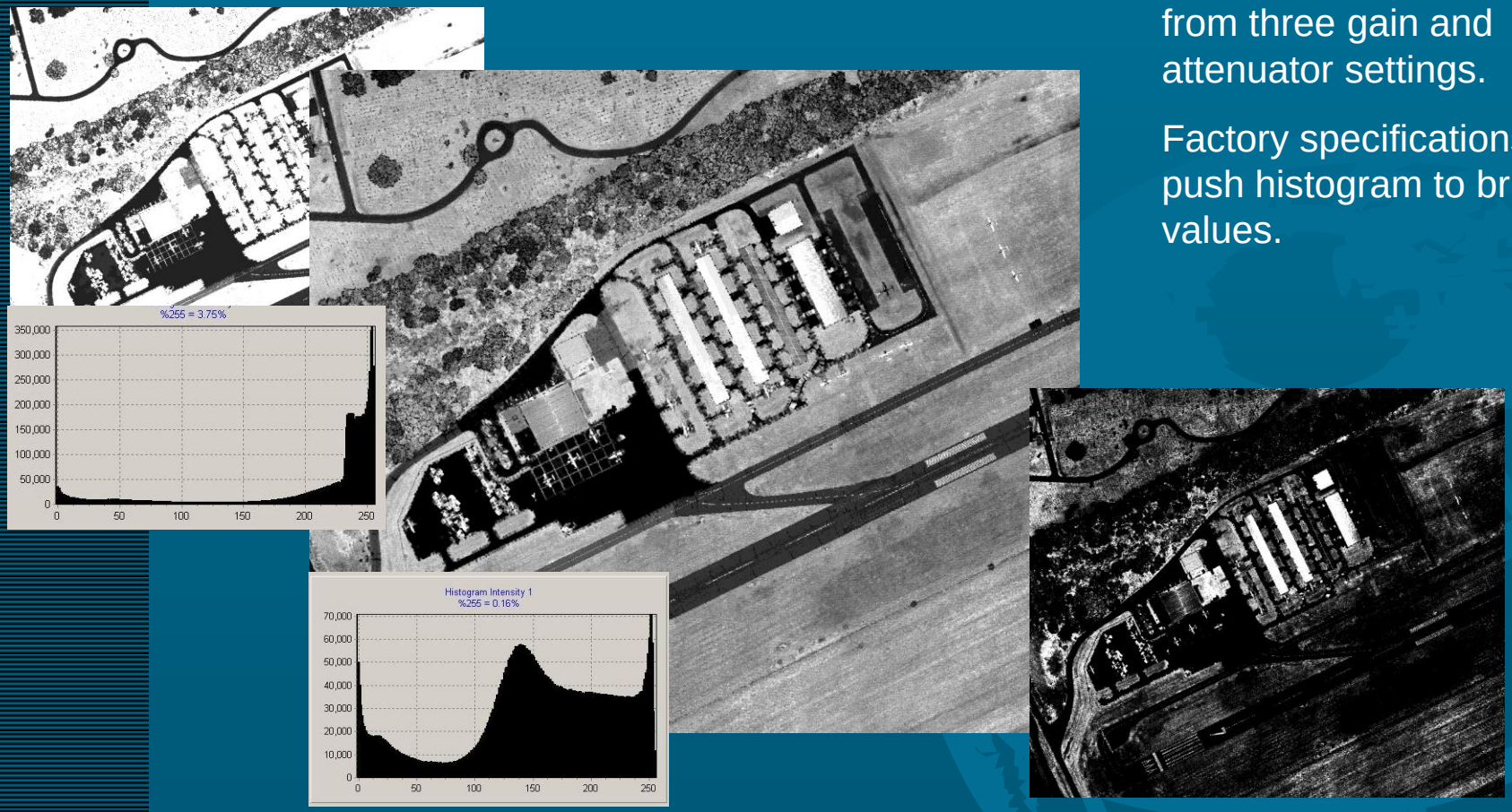
- The source data consists of actual 3D points in object space.
- May also capture additional object information /attributes.
- 'Lidargrammetry' works by reversing the traditional process, taking 3D object space points and rendering an inferred pair of 2D images from an additional object attribute.

ISP

- The inferred images are generated as if captured at positions determined via a pseudo base-height parameter and related parameters of the data set.

- The object information being used to generate the image, usually the intensity, determines the value of the pixel.

In-Flight Parameters



Lidar intensity samples from three gain and attenuator settings.

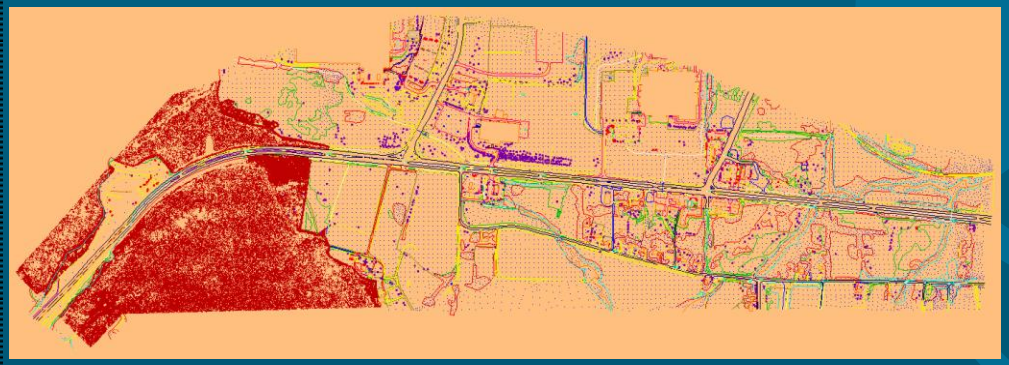
Factory specifications push histogram to bright values.

Current Applications in Production

- Breakline delineation for terrain modeling (improved contou
- Planimetric featu
- Classification QA/

Comparing Photogrammetry Enhanced Lidar to 2D and Lidar Stereo Breakline Techniques; (ILMF 2007 Proceedings)

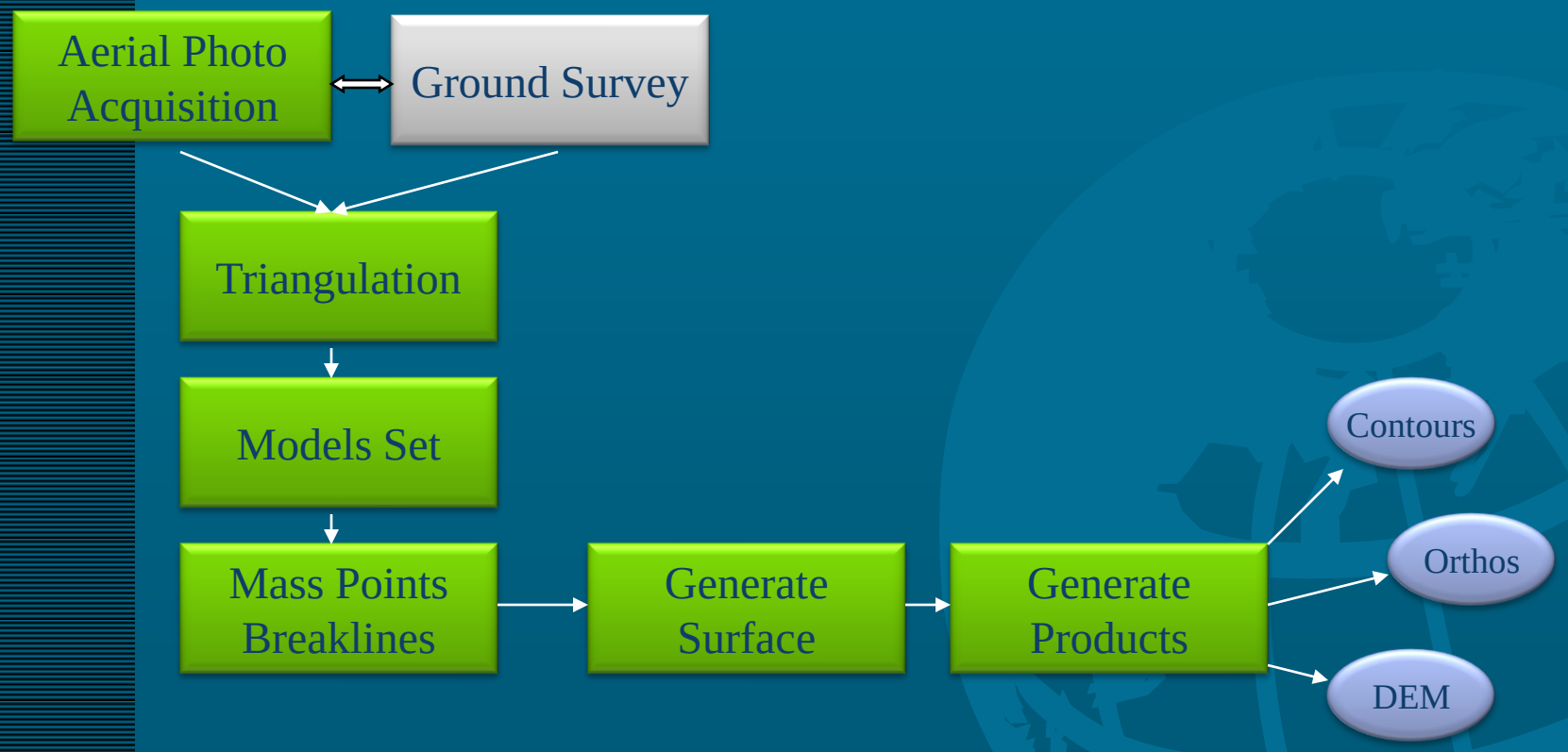
Layton Hobbs (Woolpert)



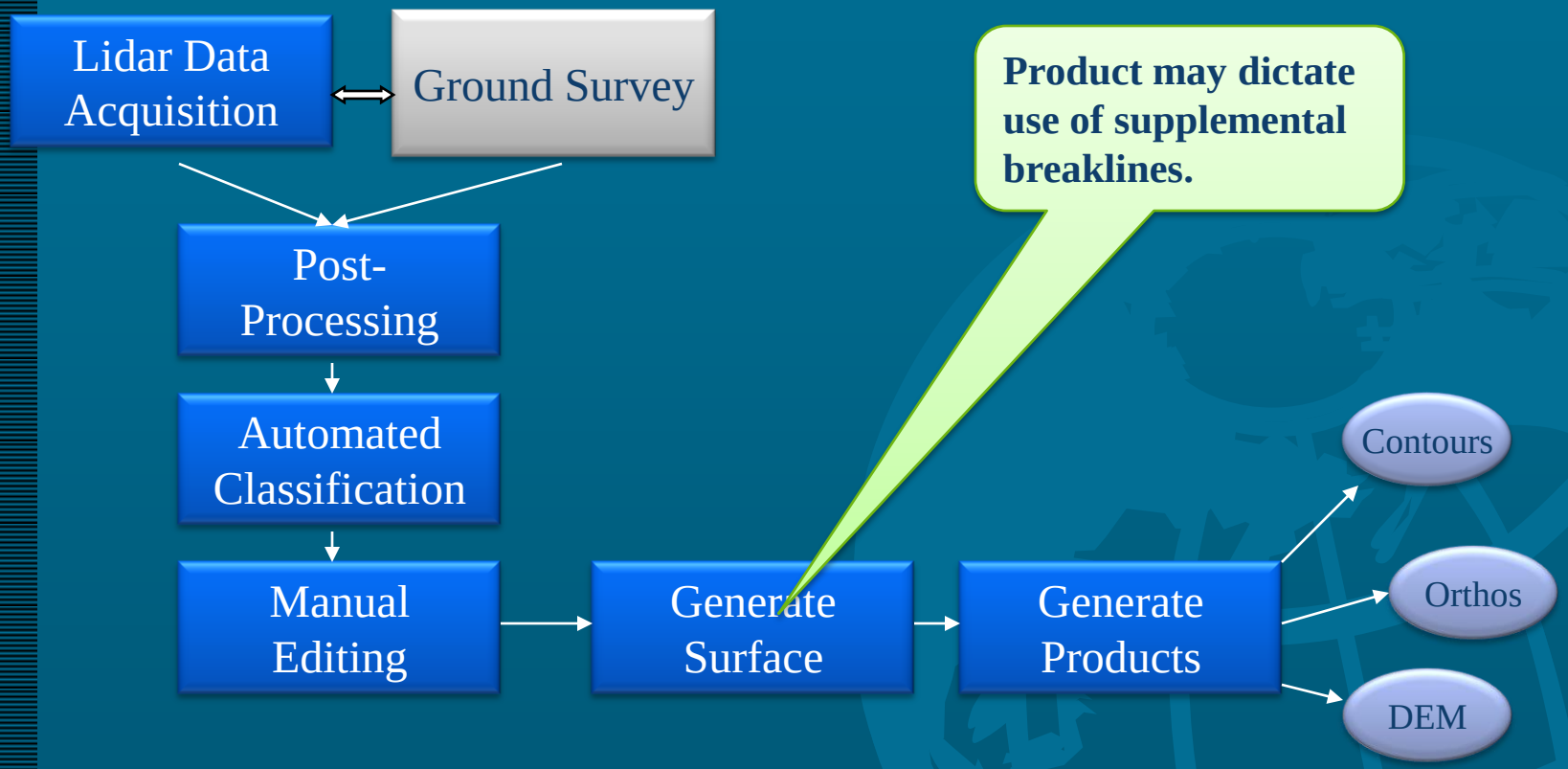
Advantages

- Removes need for separate imagery collection.
- Lidar data can be viewed as a stereo model in standard photogrammetric software.
- Production technicians can use established viewing, measurement and compilation techniques.

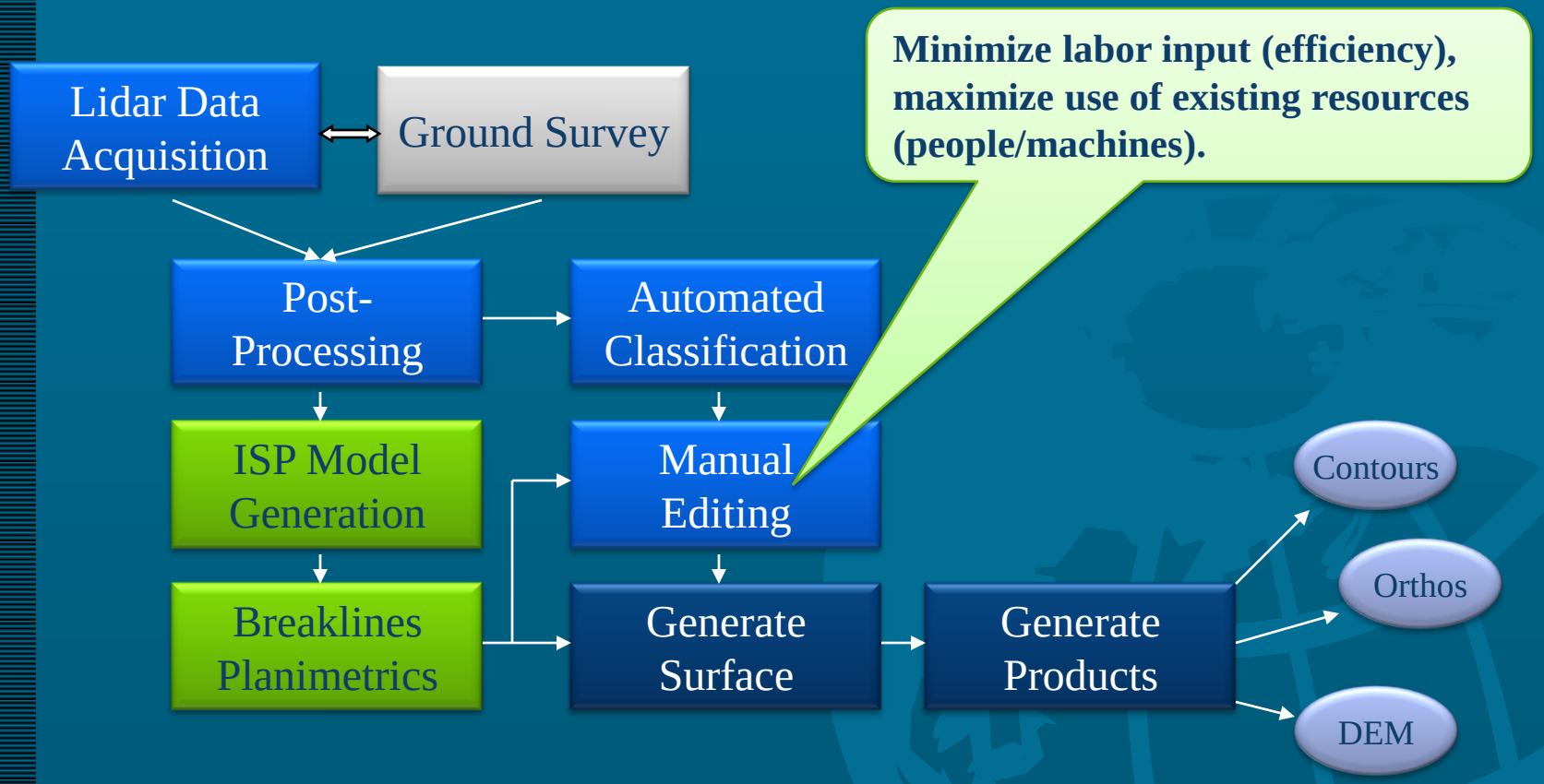
Photogrammetric Workflow



Lidar Workflow



‘Lidargrammetric’ Workflow



Observations on the Technology

- Pulse rates up; data density up. For airborne data collection, may outrun any 'minimum' post-spacing specification.
- Waveforms (large and small footprint) enable much greater information content.
- Data consistency vastly improved due to dissemination of best practices.
- New tools and techniques, hardware and software, always being considered.
- Commercial sector highly competitive with significant downward pressure on pricing.

PRODUCTION FRAMEWORK

20 Questions …

- How can Q/C be done in a nationally consistent manner?

Workflow

- What timetable is acceptable?

Scheduling

- How do we prioritize orders of collection?

Management

- How are costs shared / distributed?

Auditing

Problems with Data Production

- Geospatial production:
  - Addresses numerous end-user applications.
  - Uses a wide variety of software tools.
  - Has dynamic workflows.
  - Is difficult to effectively manage over large or numerous projects (who works on what and when).
  - Is generally workstation-centric, data-flow oriented, <u>not</u> process-driven.
  - Producers are building one-off project management systems that are difficult to scale, not extendable and becoming cost-prohibitive compared to industry expansion.

Part of the Solution

- Integrated Production Framework:
  - Encompasses all workflows in common framework.
  - Standardized on best practices and procedures.
  - Combines disparate input data into a managed program data set.
  - Reuses existing software tools.
  - Provides easy integration of new tools.
  - Remains vendor neutral for both software tools and hardware capabilities.
  - Inherently multi-user.
  - Optimized for large volume, multiple technician, multiple product geospatial data production
  - Graphical.
  - End-user customizable.
  - Affordable to deploy and maintain.

Workflow Integration Goals

Application Model
Which Tools Support Which Activities?

Process Model
What Happens When?

Data Model
What Conditions Have to be Met?

Organization Model
Who Does What?

1. Review (or create), validate and test workflow model.
2. Integrate, integrate, integrate.

A National Program Framework

- A framework that integrates all tasks into a single efficient, manageable environment.

- A framework that supports technology growth by integrating current production tools, is extensible to future software solutions, and allows dynamic integration of ad-hoc tools.

Observations on A National Program

- What we are doing today, we will not be doing tomorrow.
- A common infrastructure is as beneficial as a common technical specification.
- Scalability, extensibility, interoperability are not just buzz words.
- Production of geospatial data uses workflow tools and management methods that are out-dated compared to other commodities.