New Photogrammetric Tools for Highway Mapping

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First - a Little History
Photogrammetric Mapping

The “Plane Table” era of photogrammetry

Meydenbauer Metric Cameras 1890

Finsterwalder phototheodolite 1895

Zeiss Jena Phototheodolite 1904
Photogrammetric Mapping

The “Analog” era of photogrammetry

Pulfrich, stereocomparator, 1901

Wild-Heerbrugg A7 Stereoplotter 1950s

Multi-plex Stereoplotter 1940s
Photogrammetric Mapping

The “Analytical” era of photogrammetry

Wild BC1

Kern DSR12

Zeiss P1
Photogrammetric Mapping

The “Airborne” era of photogrammetry
Photogrammetric Mapping

The “Airborne” Film era photogrammetry cameras
Photogrammetric Mapping

The “Digital” era of Airborne photogrammetry sensors
Photogrammetric Mapping

Three new photogrammetric data collection tools for the Highway Mapping community

- Unmanned Aircraft System (UAS)
- Tripod Mounted camera System
- Land Mobile System

- Unmanned Aircraft System (UAS)
  - UX5 HP
  - New software

- Tripod Mounted Survey Imagery Tool
  - V10
  - New software

- Land Mobile Imaging/Laser System
  - MX7
Trimble Photogrammetry

UX5 HP Unmanned Aerial camera system

- Onboard high accuracy GNSS for precise position data
- 36 MP camera - 1 cm GSD
- Multiple lens options
- RGB or NIR Camera
- Up to centimeter level position accuracy (PPK)
- Point cloud density up to 1000 pts. per m²
Trimble UX5 HP Specifications

- Weight: 6.4 lbs
- Wingspan: 39.4 inches
- Launch Type: Catapult
- Cruise Speed: 55 MPH
- Endurance (flight time): 40 min
- Flight Height (AGL): 245 ft to 2,500 ft
- Image GSD: 1.0cm to 25cm
- Flight Ceiling: 16,500 ft
- Wind Speed: 35 MPH
- Landing Type: Belly
- Camera: 36 MP, Sony a7R (multiple lens available)
- GNSS: L1/L2 (GPS, Glonass, Beidou, Galileo Ready)
UX5 Camera

- Sony a7R digital camera
- 36MP full frame image
- Customized lenses, 15mm, 25mm, 35mm
- Standard RGB color & near Infra-Red versions
- Lens Distortion Correction
Launcher Components

- Ramp
  - Bungee
  - Winching tool
  - Release handle
  - Safety pin
- Launcher Dock
- Bi-pod Support
Launcher

- **Consistent launch**
  - Speed
  - Launch angle
  - No risk of stall
  - Short learning curve for operator
  - Less stressful (user has to control speed & angle with a hand launch)

- **Safety**
  - Consistent & controlled launch sequence
  - User not exposed to running motor
  - Complies with Machinery Directive 2006/42/EC
Ground Control

- Rugged Tablet
- Flight Planning & Control Software
- Communications Link
- Download Connector
Route Planning Example

Belgium
462 Images
150 m Flight Height
5 cm GSD
0.8 km²
Progress Monitoring Example

United Kingdom
150 m Flight Height
5.7 cm GSD
2.4 km²
3D View – Flight plan w/ GCPs
Control Point Registration
Control Point Registration
Control Point Registration
Orthophoto Mosaic (3D view)
Create Digital Point Cloud
Introducing - Trimble Mobile Mapping

MX8 – Precision Mobile Surveying

MX7 – Mobile Photogrammetric Imager

MX2 – Imaging and Laser Mapping System
Introducing the Trimble MX7

Mobile Mapping and Survey:

- 360° Mobile Imagery
- Applanix AP15 – GNSS/INS
- POSPac post-processing engine
- Trimble Trident s/w workflow
- Trimble TBC – software options
- Accurate measurements, X,Y,Z
- Data Export to most GIS and CAD systems
- Intuitive Capture Software
MX7 – Product Introduction

Features and Concept:

• Mobile video – with high accuracy (cm level)
• Raise / lower for collection and transport
• Flexible mounting options
• No need for dedicated vehicle
• All computers and sensors in one housing
• Complement to current field survey workflows
• Collect once – no need to return to the site
• 360° intuitive field of view
• Full photogrammetric accuracy across images
• Designed for future laser upgrade
• Mobile Imaging based data collection software
• Simple and easy to operate – i.e. touch screen
Wireless Tablet Operation

- WLAN
- Trimble Mobile Imaging Software
- 3D Map moving map for monitoring
- Images viewed in real time
High Resolution 360° Imagery
Trimble Trident Workflow

- Enhanced support for the Trimble MX7 spherical camera
- Easily visualize, interpret and extract information from Trimble MX7
- Export geo-referenced .jpg images
CHANGING THE BUSINESS LANDSCAPE WITH IMAGING ROVERS
Product Vision Statement

The Trimble V10 Imaging Rover is an integrated camera system that precisely captures 360° digital panoramas used to visually document and measure the surrounding environment. The latest tool in the Land Surveyors toolbox.

Trimble V10 – Precise Positions from Pictures
System Overview

- Position sensor (optional)
- Camera Head
- Power Rod
- Bipod
- Tablet 2 w/ Trimble Access Software
- TBC (advanced) software for processing
Trimble V10 Imaging Rover

- Position sensor (optional)
- Camera Head
- Power Rod
- Bipod
- Tablet / TSC3
- Trimble Access
- Trimble Business Center
Basic Statistics

- 12 Calibrated 5MP cameras
- Auto white balance
- System weight = ~12.8 lbs
  (Camera, Rod, Tablet, Bracket, Bipod, Batteries)
- Operating temperature, -5°F to +122°F
- 2 Hot Swappable batteries @ 4 hours ea.
- Quick release attaching point for total station or GPS receiver
Photogrammetric Properties

- New Panoramic Bundle Adjustment Software
- Camera integration and stability
- Camera calibration
- The Use of:
  - Stereo Imagery
  - Tie Points
    - Manual
    - Automated
  - Surveyed control points
  - Quality GPS hardware
- New photogrammetric applications software
V10 Value

- **Visualization**
  - See the asset in the field
  - AND in the office
  - Make decisions based on precise pixel positions

- **Data**
  - Points, Lines, Polygons
  - 3D Models
  - Drawings
  - Surface
  - Contours
  - Attributes
High Dynamic Range Imagery (HDR)

Normal exposure

Overexposed

Underexposed
Bridge Inspection

Benefits

• Comprehensive data
• Meets or exceeds compliance standards
• Allows inspection by domain experts in the office
• More information faster
Land Survey

Right of Way Survey
THANK YOU