Drone Imagery: Creating Orthomosaics, DEMs, and 3D Mesh

Cody Benkelman, Nico Bonnafoux, Mark Buie, Mark Barker, & Chris Patterson
Imagery & Remote Sensing Capabilities

Comprehensive Imagery System

- Hosted Imagery
- Tiled Imagery
- Dynamic Imagery
- Image Processing

- Ortho Mapping
- Reality Mapping

- Image Analysis
- Raster Analytics

- Image Exploitation

- Analysis

- Visualization

- Content

- Management
  - Hosted Imagery
  - Tiled Imagery
  - Dynamic Imagery
  - Image Processing
Imagery & Remote Sensing Capabilities

Comprehensive Imagery System

Mapping

- Ortho Mapping
- Reality Mapping
Image Mapping in ArcGIS
From sensor to accurate derived products

Data Capture
- Drone Flight Planning
- Drone Piloting
- Drone Fleet Management
- Ground Control

Processing
- Block Adjustment
- Aerial Triangulation

Output Products
- Orthophotos
- Ortho mosaics
- DSM
- DTM
- 2.5D Mesh
- 3D Mesh
- 3D Point Clouds

Feature Extraction & Editing
- Stereo Feature Capture
- Point Cloud Classification
- Automated Feature Extraction
- Point Cloud Editing
- Pixel Editing

Automated Feature Extraction & Editing
Image Mapping in ArcGIS
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Output Products
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- Drone2Map
- Ortho Map
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Feature Extraction & Editing
- Automated Feature Extraction
- Point Cloud Classification
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- Pixel Editing
Digitize your world with ArcGIS
From sensor to accurate derived products

Orthomosaics
Dynamic Orthomosaics
3D Point Clouds & Meshes

Digital Surface Models
Multispectral Orthomosaics
Inspection with Video (FMV) & Oriented Imagery

Thermal Orthomosaics
360º Panoramas
# Drone processing options in ArcGIS

## Processing Environment
- **Web / Cloud**
- **Desktop**
- **Web (ArcGIS Enterprise)**

## Drone Flight app included
- **Site Scan Flight**
- **Site Scan LE**

## Input data
- **Drone**
- **Drone**
- **Drone**
- **Drone, Satellite, Scanned Film, Digital Camera**
- **Drone**

## Data Products
- **2D (orthomosaic, DSM, DTM)**
- **3D (point cloud, mesh)**

## Cloud connection from flight app
- ✓

## Drone Fleet Management
- ✓

## Analysis Capabilities
- Some focused tools; Connect with ArcGIS for advanced analysis
- Extensive (part of ArcGIS Pro)
- Some focused tools + ArcGIS Enterprise

*Advanced license*
Drone flight planning and execution

Nico Bonafoux
Site Scan Flight for ArcGIS
Badouzi Port, Taiwan

Credits and thanks to
Site Scan Flight for ArcGIS

Site Scan Flight for ArcGIS
Cloud-connected flight planning and execution, automated fleet management

Requires a Site Scan license

Site Scan LE (Limited Edition)
Disconnected flight planning and execution

Available to all ArcGIS users for free
Site Scan Flight and LE

- iPadOS application
- Plan automated mapping & inspection flights in 2D & 3D
- Geospatial Video Log recording
- Terrain Follow capability
- Offline basemap download
- Display 2D & 3D data from ArcGIS Online or Enterprise
- QuickMap offline photo-mosaic stitching
- Field data management
Site Scan Flight for ArcGIS

- **Cloud connected** functionalities requiring a Site Scan license:
  - Saving and **sharing of flight plans** between users
  - Display of previously processed flight data
  - **Automated Fleet management**
  - Organization-mandated **custom preflight checklist forms**
  - **Field-to-Cloud imagery upload**
Site Scan Flight Execution
Post-Flight

- Uploading Images and Fleet Management Data

1. Complete Image Capture using Site Scan Flight app
   Or a third-party app

2. Transfer Images:
   A. to iPad wirelessly
   B. to iPad via SD Card Reader, or
   C. To a computer

3. Upload to Site Scan Manager Cloud for Automatic Processing

Fleet Management and Checklist data: sync to Site Scan Cloud
(Site Scan Operator license required)
Drone Data Processing
Site Scan Manager for ArcGIS
Site Scan Manager for ArcGIS

- Web application
- Unlimited cloud processing of drone imagery
- Secure hosting in the U.S. or E.U.
- Visualization, first-phase analysis and collaboration tool
- Publishing of processed outputs into ArcGIS Online or ArcGIS Enterprise
- Local export and sharing functionalities
Site Scan Manager

- Perform linear, volumetric and cut/fill analysis with one click
- Display CAD and PDF overlays to perform Quality Control
- Generate inspection reports as PDF documents
- Navigate through inspection photos in 3D using the point cloud
- Easily share 2D & 3D Data outputs, or 360° Panorama photos with project teams and collaborators
Site Scan Manager

- Computer vision Ground Control Point detection
- Accuracy validation through checkpoints
- Processing & accuracy reports
- RTK and PPK support
Site Scan Manager - Fleet Management

- Automatic recording of all flights conducted with the Site Scan Flight app & manual flight logging:
  - Pilot
  - Aircraft
  - Batteries
  - Weather...
- Dynamic operations dashboard
- Maintenance scheduling and tracking
- Data exports for reporting
- Pilot certificate and aircraft document tracking
- Incident tracking and administrator notifications
Site Scan Manager: Processing Complete Email Notification

Area & Crosshatch (Badouzi Port) processing complete

Hi Nico Bonnaleux,

Area & Crosshatch (1360 photos) in project Badouzi Port has just finished processing. Sign into Site Scan to view your new flight data.

View flight
Processing in the cloud

Nico Bonnafoux
Site Scan Manager for ArcGIS
ArcGIS Drone2Map
Mark Buie
ArcGIS Drone2Map

- Standalone Desktop Application
  - Does not require ArcGIS Pro
  - Licensed with Creator Users Type
  - Open projects in ArcGIS Pro for advanced analysis
- Accurate high-resolution 2D & 3D products
  - Ground Control Points, Manual Tie Points, Check Points
  - RTK/PPK
- Secure local processing
- Import and publish data from ArcGIS Online or ArcGIS Enterprise
ArcGIS Drone2Map
Compatible with the drone that fits your needs and budget

- Low operation cost
  - Compatible with entry-level and professional mapping drones

- Supports multiple payloads
  - RGB Cameras (<55 MP)
  - Multispectral Cameras
  - Calibrated Cameras
  - RTK/PPK
    - Integrated or external module
ArcGIS Drone2Map
Process geolocated images from any source

Optimized for Site Scan LE

Compatible with third-party flight planning apps
ArcGIS Drone2Map
Accurate high-resolution products

• 2D Products
  - Orthomosaics
  - Digital Elevation Models (DSM & DTM)
  - Contours
• 3D Products
  - Point Clouds
  - Integrated Mesh
• Save products locally or share to ArcGIS Online and ArcGIS Enterprise
Processing on Desktop & In the Field

Mark Buie
ArcGIS Drone2Map
ArcGIS Pro Advanced

Chris Patterson & Cody Benkelman
Ortho Mapping in ArcGIS Pro
Optional Ortho Maker in ArcGIS Enterprise with Image Server

- Ortho Mapping is a capability built into ArcGIS Pro (Advanced license required)
  - Create Orthomosaics & DEMs from Satellite, Aerial (digital & film) & Drone Imagery
  - Mosaic dataset of source images, orthorectified on-the-fly based on DTM
    - Enables multiple views from different perspectives, Stereo models for Image Analyst
  - Fine-grained control over output products (seamline & pixel editing)
  - Geoprocessing (GP) tools for process automation
**Ortho Mapping in ArcGIS Pro**

Optional Ortho Maker in ArcGIS Enterprise with Image Server

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- **Ortho Maker** is a web-based user interface for uploading and processing drone imagery through Ortho Mapping on Enterprise with Image Server
  - Output data products appear as web layers
Processing in ArcGIS Pro
Chris Patterson
Ortho Mapping in ArcGIS Pro
### Image Mapping options in ArcGIS

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Some focused tools; Connect with ArcGIS for advanced analysis | Extensive (part of ArcGIS Pro) | Some focused tools + ArcGIS Enterprise |
Summary - Esri software for Image Mapping

• Output data products
  - 2D orthomosaics, 3D point clouds & meshes, Inspection images

• Operational environments
  - Field, Desktop, Enterprise, Cloud, Web

• Key considerations
  - Scalability
  - Automation
  - Drone fleet management
  - Drone based sensors
    - RGB, Thermal, Multispectral, Video
We want your feedback

Click on the Session Survey link below this video window
MONDAY
- Getting Started with Imagery (12:30 – 1:30 PM)
- ArcGIS Image for ArcGIS Online: An Introduction (1:45 – 2:45 PM)
- ArcGIS Image Analyst: An Introduction (3:00 – 4:00 PM)

TUESDAY
- ArcGIS Image Server: Image Management & Analysis at Scale (7:15 – 8:15 AM)
- Imagery in ArcGIS: What’s New (11:45 AM – 12:45 PM)
- Living Atlas: Imagery and Elevation (11:45 AM – 12:45 PM)
- Imagery in ArcGIS: Working with Time Series Data (2:15 – 3:15 PM)

WEDNESDAY
- Drone Imagery: Creating Orthomosaics, DEMs & 3D Mesh (10:00 – 11:00 AM)
- ArcGIS: Introduction to Deep Learning (7:30 – 8:30 AM)
- Geospatial Deep Learning Using the ArcGIS API for Python (1:45 – 2:45 PM)