Working with Imagery in ArcGIS

Christopher Patterson
October 11, 2018
Imagery What’s New Overview

Providing Advanced Processing, Analysis, and Management

GOES
Worldview 4
Sentinel-1
Sentinel-2
Landsat 8
Radar

New Sensor Support
All Major Sensors

Dynamic Image Processing
Desktop and Web
Full-Motion Video
Mensuration
Image Space
Pro Imagery Tab
Drone2Map

NDVI
Classification
Change Analysis
Powerful Analytics
Imagery Workflows in ArcGIS

Access & Visualization

Management

Analysis & Dissemination

Map Production

ArcGIS
Imagery Content Projects

- Sentinel 2
- World Elevation
- Landsat
- NAIP

- Partners
  - DigitalGlobe, Deimos Imaging, Vexcel, NearMap, ClarkLabs, …
Visualization and Charting Tools in ArcGIS Pro

Exploit and interpret patterns in imagery

• Image Selector
  - Easy UX for finding/selecting an image or set of images
  - Treats a mosaic dataset/Image service like an image Library

• Temporal Profile
  - For time-series based imagery
  - Monitor features or areas of interest over time spectrally
  - Designed to explore multidimensional raster data.
  - Supports multiple variables, multiple bands of a variable and multiple dimensions of a variable

• Spectral Profile
  - Plots the spectrum of all bands for a selected pixel.
  - Given the band wavelengths, spectral reflectance from any multispectral dataset can be charted.
  - Easily separate features or areas of interest

• Scatter Plot
  - Used to examine the association between image bands and their relationship to features and materials of interest
Demo Visualization
Management

Cataloging and Making Imagery Accessible
Mosaic Dataset
Optimum Data Model for Image Management

- Highly Scalable, from Small to Massive Volumes of Imagery
- Defined in GeoDatabase (File or Enterprise)
- References sources
- Maintains metadata
- Defines processing to be applied
MANAGEMENT

Working with Imagery in ArcGIS Pro
Sensors and format support
ArcGIS Image Server

Image Services
  On-The-Fly Processing
  Dynamic Image Services
  Persisting Products using Raster Analytics

Image Management Workflows

On Premise and Cloud
  Support for AWS, Azure
  Many Cloud Storage Options
Sensor Support

New or Updated Raster Products & Types

- Sentinel-1 (Radar)
- Worldview-4
- GOES L1B,L2
- Kompasat-3 Level1
- Sentinel-2 level2
- SkySat
- TeLEOS-1
- ADS40 – LV1

Improved Multidimensional Data Support

- add data
- pick variables
- work with multidimensional raster layers

+ Python Raster Types (GitHub)
Imagery Workflows
Imagery Best Practices

- **Image Management Workflows**
  - Preprocessed
  - Elevation
  - HighRes Satellite,
  - …

Includes: MDCS – Mosaic Datasets Configuration Scripts
Automation of Image Service Creation
Demo

Image Management
Map Production
Creating Professional Grade Image Products

Precise and according to specs

Satellite, Aerial, Drones

Orthophoto production
  Block Adjustment
  Digital Elevation Model Generation

Drone2Map, Ortho Mapping, Ortho Maker
  OrthoMosaics, DTM, DSM
  Tile Cache Generation
  Dynamic Image Services

Stereo Display and Feature Extraction
  Satellite, Frame Camera, ADS
Ortho Mapping

Drone2Map
Stand Alone App for Windows

ArcGIS Pro
Ortho Mapping Workflow

Ortho Maker
WebApp on ArcGIS Image Server
Drone2Map in ArcGIS

Generate 2D and 3D Products from Drone Imagery

- Orthorectified mosaics
- Terrain models
- Point clouds
- 3D meshes
- Process in the field or in the office (laptop)
- Batch processing of multiple collects
- Share flight data and derivative products to ArcGIS Online or ArcGIS Enterprise

Version 1.3.1
- Better multispectral camera support
- Point cloud improvements
- Automated point cloud classification
- Improved DTM generation
- OSGB mesh output (in addition to I3S)
- Processing speed improvements
Ortho Mapping

Ortho mosaics & DEMs from Satellite, Aerial & Drone Imagery
Rapid streamlined processing

ArcGIS Pro Advanced

ArcGIS Pro Advanced + ArcGIS Image Server

App + ArcGIS Image Server

Input image collection → Create ortho mapping workspace → Perform block adjustment → Generate ortho mapping products

Pro 2.2 – Scanned Aerial Imagery Support
Demo
Ortho Mapping
Ortho Maker

Web based user interface for uploading and processing Ortho Mapping workflows on Drone Imagery

*Ortho Maker is not a product sold separately, it is a capability of ArcGIS Enterprise + ArcGIS Image Server*
Demo
Ortho Maker
ANALYSIS

*Extracting Information from Imagery*

ArcGIS Pro Image Analyst Extension

- Classification
- Machine Learning
- Deep Learning

Deep Learning

- Integration with External Toolkits

Scaling using Raster Analytics
Image Classification and Deep Learning

Improvements

• Distributed image classification and segmentation
  - No change to the existing workflow
  - Inputs and outputs are web image layers
  - Create persisted products - accessible via Enterprise portal

• Deep learning
  - ‘Export training data for deep learning’ GP tool
Deep Learning in ArcGIS

Built-in Tools within ArcGIS
- Maximum Likelihood Classification
- Random Trees
- Support Vector Machine

Integration with External Toolkits
- Access Training Data
- Consuming Model Outputs
- APIs to build solutions
ArcGIS Pro - Image Analyst Extension
All-in-one Imagery Analysis Workstation at your fingertips

- **ArcGIS Pro 2.1**
  - Stereo Display and Capture
  - Image Space Display, Capture, and Mensuration
  - Advanced Image Analysis

- **ArcGIS Pro 2.2**
  - Full Motion Video (FMV)
Raster Functions
Processing imagery in ArcGIS

- Primary information model component which processes raster data
- Takes input pixels and transform output pixels into meaningful products
- Raster functions to process:
  - Pixels/block of pixels
  - Raster datasets or a collection of raster datasets
  - Mosaic datasets
- Geometric or Radiometric
- 100+ out-of-the-box
- Chained together to create “processing chains”
- Extensible [https://github.com/Esri/raster-functions](https://github.com/Esri/raster-functions)
ArcGIS Pro Spatial Analyst - New Raster Functions

**Pro 2.1**

- Hydrology functions:
  - Fill
  - Flow accumulation
  - Flow direction
  - Flow distance
  - Stream link
  - Watershed

- Analysis function:
  - Nibble

- Scalable using enterprise

**Pro 2.2**

- Aspect Slope (Basic)
- Additional Spectral Indices (Basic)
- Cost path link
- Cost back link
- Euclidean direction
### Pre-Built Raster Functions

<table>
<thead>
<tr>
<th>Analysis: Band Math &amp; Indices</th>
<th>Statistics</th>
<th>Visualization &amp; Appearance</th>
<th>Python</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDVI / NDVI Colorized</td>
<td>ArgStatistics</td>
<td>Contrast and Brightness</td>
<td>Custom Algorithms</td>
</tr>
<tr>
<td>SAVI / MSAVI / TSAVI</td>
<td></td>
<td>Convolution</td>
<td></td>
</tr>
<tr>
<td>GEMI</td>
<td></td>
<td>pansharpening</td>
<td></td>
</tr>
<tr>
<td>GVI (Landsat TM)</td>
<td></td>
<td>Resample</td>
<td></td>
</tr>
<tr>
<td>PVI</td>
<td></td>
<td>Statistics and Histogram</td>
<td></td>
</tr>
<tr>
<td>Tasseled Cap (Kauth-Thomas)</td>
<td></td>
<td>Stretch</td>
<td></td>
</tr>
<tr>
<td>Binary Thresholding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat Index</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind Chill</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Interpolation                 |                  |                             |        |
| Interpolate Irregular Data    |                  |                             |        |
| Nearest Neighbor              |                  |                             |        |
| IDW                           |                  |                             |        |
| EBK                           |                  |                             |        |
| Swath                         |                  |                             |        |

| Data Management & Conversion |                  |                             |        |
| Raster to Vector             |                  |                             |        |
| Vector to Raster             |                  |                             |        |
| Colormap                     |                  |                             |        |
| Colormap To RGB              |                  |                             |        |
| Complex                      |                  |                             |        |
| Grayscale                    |                  |                             |        |
| Remap / Reclass              |                  |                             |        |
| Spectral Conversion          |                  |                             |        |
| Unit Conversion              |                  |                             |        |
| Vector Field                 |                  |                             |        |
| LAS to Raster                |                  |                             |        |
| LAS Dataset to Raster        |                  |                             |        |
| Clip                         |                  |                             |        |
| Composite                    |                  |                             |        |
| Extract Bands                |                  |                             |        |
| Mask                         |                  |                             |        |
| Mosaic Rasters               |                  |                             |        |
| Rasterize Features           |                  |                             |        |
| Reproject                    |                  |                             |        |

| Surface Generation & Analysis|                  |                             |        |
| Aspect                       |                  |                             |        |
| Curvature                    |                  |                             |        |
| Elevation Void Fill          |                  |                             |        |
| Hillshade                    |                  |                             |        |
| Shaded Relief                |                  |                             |        |
| Slope                        |                  |                             |        |
| Contour                      |                  |                             |        |

| Image Analyst ~60 Raster Functions |                  |                             |        |
| Analysis: Image Segmentation & Classification |                  |                             |        |
| Segmentation (Mean Shift)        |                  |                             |        |
| Training (ISO, SVM, ML, Random trees) |                  |                             |        |
| Supervised Classification        |                  |                             |        |

| Spatial Analyst ~13 Raster Functions |                  |                             |        |
| Analysis: Distance & Density     |                  |                             |        |
| Euclidean Distance               |                  |                             |        |
| Cost Distance                    |                  |                             |        |
| Least Cost Path                  |                  |                             |        |
| Kernel Density                   |                  |                             |        |

| Analysis: Overlay               |                  |                             |        |
| Weighted Overlay                |                  |                             |        |

| Analysis: Hydrology             |                  |                             |        |
| Fill                           |                  |                             |        |
| Flow Accumulation               |                  |                             |        |
| Flow Direction                  |                  |                             |        |
| Flow Distance                   |                  |                             |        |
| Stream Link                     |                  |                             |        |
| Watershed                       |                  |                             |        |

| Analysis: Overlay               |                  |                             |        |
| Weighted Overlay                |                  |                             |        |

| Surface Generation & Analysis   |                  |                             |        |
| Viewshed                       |                  |                             |        |

| Data Management                 |                  |                             |        |
| Nibble                         |                  |                             |        |
Demo – Raster Functions

Terrain Ruggedness Index
- Client side
- Server Side
Dissemination and Consumption
ArcGIS Image Server

- **Dynamic Image Services**
  - Providing Access
  - Dynamic Mosaicking and On-The-Fly Processing

- **Raster Analytics**
  - Persisting Products using Distributed Compute and Storage

- **Ortho Mapping**
  - Creating imagery products from Satellite, Aerial and Drones
Configurable Imagery Apps

- Focused apps to work with imagery
- Common Tasks
- No programming required
- Make collections of imagery easily accessible
- Query, visualize, and interpret imagery layers through time and space

**WABIS** – Web App Builder for Image Services
Library of Open Source Widgets
https://github.com/Esri/WAB-Image-Services-Widgets

Image Visit (Beta)
Inspect and record observations for a predetermined sequence of locations
Web Maps and Apps

- **JavaScript API 4.0 Improved:**
  - Client side renderer
  - Image Coordinate System Support

- **Map Viewer**
  - Image Filter
Oriented Imagery

Access imagery at any angle, for any location

Pro Add In
Web App Widget
Management and Publishing Tools

Integration with many Content Providers

Available from the Marketplace, free

Early Adopter Release - UC 2018