5 Key Imagery Capabilities of ArcGIS

Visualization & Exploitation

Management

Analysis

Map Production

Content
Analysis
Extracting Information from Imagery

ArcGIS Pro
Core capabilities
Raster Functions

ArcGIS Spatial Analyst
Raster Functions
Distance modelling
Hydrological modelling

ArcGIS Image Analyst
Raster Functions
Deep Learning
Pixel Editor
Multidimensional data
Stereo
Image Space
Full Motion Video

ArcGIS Image Server
Raster Functions
Scaling using Raster Analytics

ArcGIS API for Python

System of Insight
Map Production from Imagery
Creating precise imagery derived products

Satellite, Aerial Cameras & Drones

Orthophoto production
  Aerotriangulation & Block Adjustment
  Digital Elevation Model Generation (DSM & DTM)

Photogrammetric data model supporting *many* use cases
  Dynamic image services (orthorectify on the fly)
  Creation of custom basemaps
  Stereo display and 3D feature extraction
  Oblique imagery
  Image coordinate system & Mensuration

ArcGIS Pro Advanced - Ortho Mapping
ArcGIS Image Server - Ortho Maker
ArcGIS Image Analyst – Stereo
Drone2Map for ArcGIS

System of Record
Image Visualization and Exploitation

Integrating imagery into dynamic applications to aid understanding

ArcGIS Pro
Core imagery capabilities
ArcGIS Image Analyst
  Image Space, Mensuration
  Stereo
  Motion Video
Oriented Imagery

Web
Map Viewer – Imagery features
Image Configurable Apps (Image Viewer / Mask / Visit)
WABIS – WebAppBuilder Widgets for Image Services
ArcGIS Excalibur
Oriented Imagery

Mobile
Focused Apps
LT Mosaic Dataset in RunTime
# Raster Functions

## ArcGIS Pro
- ~50 Raster Functions

### Math Operators
- Statistics
- Conversion
- Multiband Math
- Interpolate
- Band Math & Indices
- Surface Generation & Analysis
- Correction
- Python Raster Functions

### Image Segmentation
- Classification
- Overlay (Sum)
- Statistics
- Math

### New functions in Pro 2.5 (IAe Only)
- Generate Trend
- Predict Using Trend

## ArcGIS Image Analyst
- ~60 additional Raster Functions

### Distance & Density
- Hydrology
- Overlay (weighted)
- Viewshed
- Nibble

### ArcGIS Spatial Analyst
- ~15 additional Raster Functions

## New functions in Pro 2.5
- Aggregate (SA)
- Multidimensional Filter (Basic)
- Multidimensional Raster (Basic)
- Random (Basic)
- Process Raster Collection (IA/SA)
- Linear Spectral Unmixing (IA/SA)
- Find Argument Statistics (IA/SA)
- Distance Accumulation (SA)
- Distance Allocation (SA)

## Updated functions in Pro 2.5
- Cost Path (SA)
- Cell Statistics (IA/SA)
- Zonal Statistics (IA/SA)

All functions are available on ArcGIS Image Server.
Additional Raster Functions
Raster analysis and image processing

Distance functions
Wildlife corridor assessments
Determining Routes

Spatial functions
Calculate band-wise maximum between two Landsat scenes
Calculate Mean Monthly maximum temperature from 1895 to 1995

Multidimensional functions
Trend analysis
Predict sea surface temperature

Cross Country Mobility

Functions also implemented as optimized distributed processing in ArcGIS Image Server on ArcGIS Enterprise – Raster Analytics
What is the Image Analyst extension?

• The Image Analyst extension (IA) is an application extension which extends **ArcGIS Pro** with advanced imagery analysis tools, workflows, and user experiences.

• IA is for Image Analysts and Geospatial Analysts who focus on:
  • visual enhancement and exploitation of imagery
  • creation of derived products from imagery
  • taking **measurements** from imagery
  • capturing features from **stereo** imagery
  • advanced **analysis** and **image processing**
  • advanced analysis of **multidimensional** raster datasets
  • exploitation and analysis of **motion imagery** (FMV)
  • extracting information from imagery using **deep learning** models
  • **editing** of imagery and raster datasets
Image Analyst extension Product Information

• Availability
  • first release was ArcGIS Pro 2.1
  • available for
    • ArcGIS Pro Basic
    • ArcGIS Pro Standard
    • ArcGIS Pro Advanced

• Pricing
  • the same as the Spatial Analyst extension

• Licensed
  • Category B (addition to Enterprise Agreements)

• ArcGIS Image Server
  • All Image Analyst capabilities which are available on the server come with Image Server, there is no additional purchase required!
ArcGIS Image Analyst
Extract information from imagery

Advanced Raster Functions
Perform real-time raster analysis and image processing on an extensive suite of remote sensing data types, and save your results if desired.

More functions in 2.5

Image Classification
Perform object-based and traditional image analysis using image segmentation and classification tools and capabilities.

Advanced Multidimensional Analysis
Perform advanced raster modeling with multidimensional geospatial data using geoprocessing tools, Python, Notebooks, and the ArcPy API

Deep Learning
Perform image feature recognition using deep learning techniques.

Enhancements to training workflows in 2.5

Pixel Editor
Redact sensitive areas from images, clean up raster analysis results, and edit DEMs. Support for function rasters

Stereo Mapping
Visualize imagery and capture 3D feature data in a stereo viewing environment.

Perspective Imagery
Work with oblique imagery oriented in a natural perspective mode to facilitate effective image interpretation applications.

Motion Imagery
Work with geospatially enabled video data together with your GIS data to assist in timely, well-informed decision support.

Enhancements in 2.5
Pixel Editor

- DEM editing
- Analysis cleanup
- Redaction
- Apply custom processing
- Interpolate from edges
Image Analyst Pixel Editor

Redaction
- Redact (black out)
- Pixelate
- Blur
- Set NoData

Analysis Cleanup
- Expand
- Shrink
- Reclass
- Majority Filter
- Set NoData

DEM Editing
- Set Average
- Set Constant
- Add To
- Pixelate
- Blur
- Set NoData
- Fill Voids
- Interpolate from Vertices

Average Filter
- Median Filter
- Constrained Filter
- Outlier Filter
- Terrain Filter
Deep Learning
Deep Learning

Key imagery tasks for deep learning

- Impervious Surface Classification
- Palm Tree Detection
- Building Footprint Extraction
- Damaged House Classification
- Pixel Classification
- Object Detection
- Instance Segmentation
- Image Classification
Deep Learning with Imagery in ArcGIS

ArcGIS supports end-to-end deep learning workflows

• Tools for:
  • Labeling training samples
  • Preparing data to train models
  • Training Models
  • Running Inferencing

• Supports all 4 imagery deep learning categories

• Supports image space, leverage GPU

• Clients
  • ArcGIS Pro
  • Map Viewer
  • Notebooks

Part of ArcGIS Image Analyst
Run distributed on ArcGIS Image Server
Deep Learning Workflow in ArcGIS

1. Label
2. Prepare
3. Train
4. Inference

- Training Samples
- Training Data
- Trained deep learning model
- Inference results
Collect Training Samples / Label data

- **Different methods**
  - Label Objects for Deep Learning – ArcGIS Pro (2.5)
  - Training sample manager – ArcGIS Pro
  - Feature editing
    - ArcGIS Pro
    - Map Viewer
    - JS Web Apps

- **Different data models**
  - Feature class (local single user)
  - Feature services (collaborative experience)
  - Classified thematic rasters
Export Training Data for Deep Learning

- Exports samples to training images
- Images have associated labels/metadata
- Writes out an EMD
- Used as inputs for model training
- Supports various formats

```
# Export training data
chips = export_training_data(sentinel_data,
   well_pads,
   "PNG", {"x":448,"y":448},
   {"x":224,"y":224},
   "PASCAL_VOC_rectangles", 75,
   "well_pads")
```
Train Deep Learning Model

- ArcGIS Pro “Train Deep Learning Model” tool
- `arcgis.learn` module in ArcGIS API for Python
- Supported Models:
  - Object Detection - SSD, RetinaNet, MaskRCNN
  - Object Classification – Feature classifier
  - Pixel Classification – UNET, PSPNet
- External Deep Learning Frameworks
  - TensorFlow
  - CNTK…

Collect Samples → Export Training Samples → Train → Perform Inference
Perform Inference

- Run on desktop and enterprise
- Leverage multiple servers and GPUs - enterprise
- Types of inferencing
  - Object detection
  - Classify objects
  - Pixel classification

```
detect_objects(input_raster=input_layer,
               model=detect_objects_model,
               output_name="Well_PAD_Detection_Sentinel",
               context=context,
               gis=gis)
```
Deep Learning Workflow in ArcGIS
End-to-end from raw imagery to structured information products

ArcGIS being used for each step of the deep learning workflow
Demo
AI for disaster response
Multidimensional Analysis
Multidimensional Analysis

- **New contextual Multidimensional Tab**
- **Charting tools** updated to take advantage of multidimensional CRF
- **Apply raster functions to a slice of multidimensional mosaic datasets**
  - **Apply Raster Functions along a dimension**
    - Out of the box for all local functions
- **ArcGIS Pro – Geoprocessing**
  - Aggregate data
  - Detect anomalies
  - Predictive analysis
  - Trend analysis
- **ArcPy enhanced to work with Multidimensional rasters**
Multidimensional Analysis – ArcGIS Enterprise 10.8

- Support Multidimensional Raster input and output in Raster Analytics tools
- New Raster Analysis service tools
  - Aggregate Multidimensional Raster
  - Build Multidimensional Transpose
  - Find Argument Statistics
  - Generate Multidimensional Anomaly
  - Predict Using Trend Raster
  - Generate Trend Raster
  - Subset Multidimensional Raster
- Enhanced ArcGIS API for Python for multi-dimensional raster analysis
ArcPy Enhancements
Enhanced arcpy.raster and arcpy.ia modules

New Classes
- arcpy.ia.RasterCollection
  - rasters_list, mosaic_dataset
  - mdim_raster, image_service
- arcpy.ia.PixelBlock
- arcpy.ia.PixelBlockCollection

New Functions
- arcpy.ia.Merge()
- arcpy.ia.Render (inRaster, rendering_rule={...})
- All raster functions for arcpy.ia

Enhanced arcpy.Raster (supports multidimensional dataset)
ArcGIS API for Python
Scripting for distributed raster analysis

Multidimensional analysis functions
Classification functions
Distance analysis functions
arcgis.raster.functions
arcgis.raster.functions.gbl
arcgis.learn

**Multidimensional analysis functions**
- Math Operators
- Statistics
- Conversion
- Multiband Math
- Interpolate
- Band Math & Indices
- Surface Generation & Analysis
- Correction
- Python Raster Functions

**Classification**
- linear_spectral_unmixing

**Distance analysis functions**
- costpath_as_polyline

**arcgis.raster.functions.gbl**
- euclidean_back_direction
- flow_length
- sink
- snap_pour_point
- stream_order
- expand
- shrink
- distance_accumulation
- distance_allocation

**arcgis.raster.functions**
- constant_raster
- random_raster

**arcgis.learn**
- classify_objects
- More.....
Demo – Multidimensional Analysis
Multidimensional tab
Multidimensional analysis
Motion Imagery (FMV) - ArcGIS Pro 2.5
Visualization, Exploitation, and Management of georeferenced video

- Play video files or live streams, with moving video footprints and sensor location
- Extract georeferenced frames for reporting or analysis
- Capture important features on the map or in the video
- Integrated 2D and 3D displays for situational awareness

Part of the ArcGIS Image Analyst Extension
Motion Imagery (FMV) - ArcGIS Pro 2.5

Increased integration of video into GIS

- VMTI attributes written to GDB
Motion Imagery (FMV) - ArcGIS Pro 2.5

Increased integration of video into GIS

- VMTI attributes written to GDB
- Measure objects in video player, including vertical mensuration
Motion Imagery (FMV) - ArcGIS Pro 2.5
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- VMTI attributes written to GDB
- Measure objects in video player, including vertical mensuration
- North arrow displayed on video

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- VMTI attributes written to GDB
- Measure objects in video player, including vertical mensuration
- North arrow displayed on video
- Video enhancement for better interpretation
  - Brightness, contrast, saturation, gamma
  - Invert colors

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- Measure objects in video player, including vertical mensuration
- North arrow displayed on video
- Video enhancement for better interpretation
  - Brightness, contrast, saturation, gamma
  - Invert colors
- Synchronize multiple videos
- Video feed manager to easily recall previous videos

Part of the ArcGIS Image Analyst Extension
FMV Demo
Print Your Certificate of Attendance

Print Stations Located in 150 Concourse Lobby

**Tuesday**
12:30 pm – 6:30 pm
Expo
Hall B

5:15 pm – 6:30 pm
Expo Social
Hall B

**Wednesday**
10:45 am – 5:15 pm
Expo
Hall B

6:30 pm – 9:30 pm
Networking Reception
Smithsonian National Museum of Natural History
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Select the session you attended

Scroll down to “Survey”

Log in to access the survey

Complete the survey and select “Submit”