Managing Imagery and Raster Data

Peter Becker
ArcGIS is a Comprehensive Imagery Platform
Empowering you to make informed decisions

System of Insight
Extract Information from Imagery

Professional Imagery & Geospatial Analysts
Content from: ArcGIS Online, Partners, Your Org.

System of Record
Manage and process all your imagery

System of Engagement
Share imagery products and information to those that need it

Enterprise
Imagery: System of Engagement
ArcGIS Applications Enable Intelligent Imagery

- Dynamic & Interactive
- Informative & Engaging
- Integrated

- Utilize Extensive ArcGIS APIs
- Develop applications to access Information Products
Imagery : System of Insight

Information from Imagery

• ArcGIS Pro 1.4
  - Imagery Tab – Access to many tools incl. Classification wizard
  - Georeferencing Tools
  - Orthomapping – Workflows for Satellite, Aerial and Drone sensors
  - Raster Function Editing with Raster Analytics
Manage and Serve Imagery from a Wide Range of Sensors

ArcGIS Integrates imagery from multiple sources

- Satellite
- UAS (Drone)
- Aerial
- Lidar
- Multi-Spectral
- Panchromatic
- Thermal
- Radar
- Full Motion Video (FMV)

Professional Imagery / Geospatial Analysts

Server

System of Record
Working with Imagery
Scaling from single local image to millions

- One image at a time
  - Individual Files

- Collections of images
  - Mosaic Datasets

- Imagery as a Service
  - Image Services
**Raster Dataset**
The primary information model to represent a basic image with simple behavior

- **Read and write images (pixels) and metadata**

- **Comprehensive Support**
  - 1 or N Bands
  - 1-64 bits per band
  - Compressed or uncompressed
  - > 80 formats supported
  - Pyramids (.ovr, internal, .rrd)

- **Read image files directly – no need to convert**

“It’s what you get if you drag a GeoTIFF into ArcGIS Desktop.”
**Raster Function**

Primary information model component which processes image data

- Takes input pixels and produces altered output pixels

- **A Raster Function**
  - processes a single pixel or block of pixels (not the full image)
  - can make geometric modifications to the pixels (orthorectify, project, clip,…)
  - can make radiometric modifications to the pixels (enhance, band math, convolution filters, Tasseled Cap,…)

- **Raster Functions are chained together to create simple or advanced processing chains**
  - pixels that flow through the chain are virtual in nature (“on-the-fly” processing)

- **100+ Raster Functions**
Raster Function
Enable On-The-Fly processing

Image

Pixel Block

Raster Function

Visualization or Analytical “Virtual” Product

Screen
Desktop, Mobile, Web

Cache or New Image

Raster Function
“Chain”
Raster Functions or Geoprocessing Tool?
Two Options for Processing Pixels

- **Raster Functions**
  - Processes pixel block on demand. Typically at screen resolution
  - For visualization or analysis
  - Have limited ‘scope’ (Local or Regional)

- **Geoprocessing Tools**
  - Processes complete datasets
  - Can invoke complex relations (Local, Regional or Global)
  - Run asynchronously
**Raster Product**

Applying Raster Functions based on Metadata

- Transforms a collection of files into product information
  - Defines the default processing chains
  - Defines the georeferencing (sensor model + parameters)
  - Defines pixel storage and metadata schema
  - Defines the rules for ingesting imagery into ArcGIS

- Enables interface shortcuts to well known band combination and processing chains
- Allows the user to think about products not files
- Sensor and/or Format Specification specific
- Visible in ArcMap Catalog window / ArcCatalog
Mosaic Dataset
Primary information model to manage massive collections of imagery

- Databased structure containing:
  - For each record (item)
    - References to source imagery/rasters data
    - Footprint defining extent
    - Metadata about each raster
    - Function chains for each item
  - Overviews
    - Additional Rasters used at small scales
  - Properties of the mosaic datasets
    - Function chains to apply to all rasters
    - Boundary, Extent, ........

- Scalable (1 to millions of images)
- Acts as a catalog of similar imagery
- Homogeneous or heterogeneous collections (one sensor or a mix)
Raster Type
Logical Equivalent of Raster Product for Collections

- Provides the logic for how to ingest collections of Raster Dataset or Raster Types.
- Crawler for Raster Products
- Sensor and/or Format Specification specific
- 60+ Raster Types

- Applanix
- CDRG
- ECRG
- CIB
- DMCii
- DTED
- Formosat-2
- GeoEye-1
- HRE
- IKONOS
- ISAT
- Kompasat-2
- Landsat 1-5
- MSS
- Landsat 7
- ETM+
- Landsat 8
- LAS
- NITF
- Pleiades-1
- Quickbird
- RapidEye
- Radarsat 2
- SOCET (SUP)
- WorldView-1
- WorldView-2
- WorldView-3
- WorldView-2
- WorldView-3
Creating a Mosaic Dataset

- Create New GeoDatabase
- Create Mosaic Dataset
- Add Rasters
- Define Overviews
- Build Overviews
- Set Properties – Eg Mosaic Method

Optional
- Use lower resolution imagery as Overview
- Define additional functions
- Utilize Extensive Tools to refine
  - Seamlines, Color Balancing, ……
Image Management Using Mosaic Datasets
An information model for managing large image and raster collections

- Create Mosaic Dataset
  - Reference Sources
  - Ingest & Define Metadata
  - Define Processing to be Applied
    - On-the-fly
    - Dynamic Mosaicking
    - Create Overviews
- Use directly in Desktop
- Serve as Image Service
  - Access from: Desktop, Web & Mobile Apps
  - Refine processing to be applied by Server
Image Management Workflows
Best Practices & Automation for Mosaic Dataset Creation

- **Best Practice Documentation**
- **Templates**
  - Geoprocessing Tools
  - Sample Data
  - Automation Scripts

**Focused on different types of imagery**
- Processed Orthophotos
- High Resolution Satellite
- Multispectral Satellite
- Elevation / Lidar
- Browse
- Aerial
- Drones
- Historic Aerial
- Oblique
- Scientific

http://esriurl.com/ImageManagement
Tile Cache
Provide Simple Background Basemaps

- Process images into single background image
- Useful if imagery is only as a static background
- Create from Mosaic Datasets using:
  - ‘Manage Tile Cache’ Geoprocessing Tool
  - Raster Tile Cache Tools

- Direct Access in Desktop/Pro
- Convert to TilePackage for use in Mobile
- Can be uploaded and served through ArcGIS Online
- Served through ArcGIS Server
Image Services
Provides Imagery as a Service
Image Services Make Imagery Accessible
Provide Web Access to Imagery for All Applications
Information Flow for an Image Service

Raster Types

Collection

Harvests Metadata

Mosaic Dataset

Raster Functions

References
Original Imagery

Imagery Native Form

Desktop
Web
Device

ArcGIS Image Server

ArcGIS Desktop

Publishing
Image Extension vs Image Server

ArcGIS Server (<= 10.4)

- Image Extension provides: Dynamic Image Services

ArcGIS Enterprise (> 10.5)

- Image Server Provides: Dynamic Image Services + Raster Analytics

For more detail on Raster Analytics - Come to Image Server: Imagery and Raster Analytics 4:15-5:15
Image Server – Stand Alone
Possible for users wanting backward compatibility with 10.4

Image Server Provides: Dynamic Image Services + Raster Analytics
Implementation Architectures

On Premises

Desktop

DAS or Enterprise GeoDatabase

SAN/NAS

Collections of Imagery & Rasters

Image Server

On Cloud

Upload

Blob Storage (Azure Blob / S3)

Optimize Rasters (Check GitHub)

ArcGIS Enterprise in the cloud

ArcGIS Enterprise on Microsoft Azure

Amazon Web Services

Microsoft Azure

ArcGIS S3a | Other versions...
Implementation Architectures

**On Premises**

- Desktop
- SAN/NAS
- DAS or Enterprise GeoDatabase
- Collections of Imagery & Rasters
- Image Server

**On Cloud**

- Image Server
- FileShare, DAS or Azure SQL/RDS
- Blob Storage (Azure Blob / S3)
- Upload
- Optimize Rasters (Check GitHub)
Optimize Rasters
Format and Structure and Storage of Raster has Biggest Effect on Performance

• Optimum Formats:
  - TIF
    - Internal tiles (256x256)
    - With Pyramids (Internal External)
    - Compression: None, LZW, JPEG (YCbCr for Natural Color), (12bit JPEG also available)
  - MRF – (Meta Raster Format)
    - Optimize for Cloud storage (Also optimizes performance on SAN/NAS)
    - Pyramids
    - Compression: None, LERC, JPEG (YCbCr for Natural Color), (12bit JPEG also available)

• Use Optimize Rasters to Convert
  - Fast Batch Conversion
  - Maintains all Metadata files
  - Option to Upload to Cloud Storage
Questions?
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