Working with Historical Imagery

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Historic Aerial Imagery - Objectives

• Manage & Share Collections of Historic Aerial Imagery

• View & use best imagery
  - By geography
  - By date, other attributes

• Geometric and Radiometric accuracy requirements vary

• Initial product:
  - Mosaic Dataset or Image Service
  - Approximate Georeferencing
  - Accuracy may be improved over time.

• Value:
  - Understand past
  - Legal ownership
  - Environmental reporting
  - Water rights
  - Property Boundaries
  - Finding UXO (Europe WWII)
Using Historical Imagery

Sample Data Provided by: geoDyn
Historic Aerial Imagery - Sources

• Film imagery from archives
  - Rolls of aerial film (typically 24 cm), Cut films, Contact Prints
  - Panchromatic, True Color, Color IR
  - 1930’s – 2000’s

• Large collections exist

• Being Scanned
Scanning

• Typically scanned by
  - Photogrammetric scanner
  - Table top scanner

• Scan at about 20 microns / 1200 ppi
  - Higher resolution rarely needed

• Record scan direction →

• Optimize Format and Compression
  - TIF with JPEG_YCbCr compression (Q80 ~ 7x)
  - Tiled with pyramids
  - Use OptimizeRasters on GitHub (https://github.com/Esri/OptimizeRasters)

• No need to generate statistics
Metadata

• Georeferencing
  - None  -  Needs Manual Georeferencing
  - Poor  -  Index Map Needs to be digitized
  - Good  -  Digital Index from navigation data (> 1990)
  - Excellent  -  Output from AT

• Film Metadata
  - Date (s)
  - Camera Type (Optional)
  - Camera Calibration (Optional)
  - Run Numbers (Optional)

• DTM - Digital Terrain Model
  - Suitable may exist  -  Export from World Elevation on ArcGIS Online
  - Else need advanced workflow (see later)
Workflow Options

• Basic
  - Manually Georeference
  - If a small number of images in flat areas

• Standard
  - Obtain/Create PhotoIndex
  - Create Mosaic Dataset using workflow

• Advanced
  - Perform Aerial Triangulation
  - For Large Numbers of Images
Basic Workflows

- Set TIF images to ReadOnly
- Georeference individual frames using Georeferencing tool
  - Try Approx and then Auto Georeference to World Imagery (or other base)
  - Else manually measure tie points using imagery base map
  - Typically 6 spread out are sufficient
  - Use Projective Transform
  - Use “Save”, Do NOT use “Save As”
    - This results in set of georeferenced images with no sampling applied
- Optional
  - Create Mosaic
  - Create Tile Cache
  - Publish to ArcGIS Online
Standard Workflow

- **Create Mosaic Dataset - Recommend to use ArcGIS Pro 2.0**
  - Using best available georeferencing
  - Use one of following
    - Imagery created in Basic Workflow
    - Frame Camera Raster type if orientation available (eg if Aerial Triangulation already exists)
    - Use Historical_Imagery_GP_Tools if photoindex available (See next slide on creating digital photo index)

- **Optionally**
  - Publish as an Image Service
  - Refine geometry
  - Refine footprints
  - Refine color correction
  - Generate seamlines
  - Generate Overview
  - Create Tile Cache and publish to ArcGIS Online (or your portal)
  - Create Derived Mosaic Dataset that Combines all
Creating Digital PhotoIndex

• From Photo Index or Print Laydown
  - Digitize locations and frame numbers by run & film number
  - Build feature class $\rightarrow (x,y)$ point for approximate photo center
  - “How??” will depend on your data. Easiest method typically to:
    - Scan & georeference the Photo Index/Print Laydown
    - Manually create points for photo centers
  - Populate “Key Historic Imagery Parameters” Table (next slide)

• Create Film Report
  - Include other metadata about the flight - date, type of film, etc.
Build “Key Historic Imagery Parameters” Table

Approximate X,Y (Geometry)

COG (course over ground) - this will be calculated

‘Raster’ field: path and file name to each scanned file

PhotoScaleF - Scale factor e.g. 5000 for 1:5000

FocalLength - In microns; e.g. 152400 for 6 inch

ScanDirection - per previous diagram

ScanResolution - in microns. If not known, can be estimated as 240000/Min(Cols,Rows)

FrameSize - in microns e.g. 180000 for 18cm. If undefined then assumed to be 23cm

Frame - As a 4 digit string, e.g. 0023 (not stored as an integer)

Run - As a string

Film - As a string

Cols,Rows - Number of Cols and Rows of the image. Will be obtained from Image if not defined

OffsetC, OffsetR - in microns. This is the offset of the camera center from the center of the scan. If undefined then assumed to be 0

Other parameters optional - from Film Report
   e.g. AcquisitionDate, ScanDate, ScannerModel, FilmType, etc.
Using Historical_Imagery_GP_Tools

- Geoprocessing Tools “Historical Imagery.pyt” available for download
- Get from esriurl.com/imageryworkflows, ImageManagement
- [http://www.arcgis.com/home/item.html?id=d1b4e3afeda7405fb34578207f0ad256](http://www.arcgis.com/home/item.html?id=d1b4e3afeda7405fb34578207f0ad256)

- Will build table(s) required as input to the Frame Camera Raster Type
  - *Frame Table and Camera Table* corresponding to Exterior orientation and Interior orientation
  - Can be separate geodatabase tables, or combined into one.

See in ArcGIS Help System:
- [http://esriurl.com/FrameSchema](http://esriurl.com/FrameSchema)
- [http://esriurl.com/CameraSchema](http://esriurl.com/CameraSchema)
Using Historical_Imagery_GP_Tools (2)

- **Run EstimateCOG → Input KHIP table**
  - This populates COG field

- **Run Check Estimate Orientation Parameters**
  - This verifies required *schema* is populated before beginning a lengthy run.

- **Run Estimate Orientation Parameters**
  - This builds single Frame & Camera Table required as input to *Frame Camera Raster Type* (workflow step 4)
Using Historical_Imagery_GP_Tools (3) Create Mosaic Dataset

- Use *Frame Camera* Raster Type
  - Input Frame+Camera table as input
- Measure amount of shrink to reduce footprints
- Shrink footprints using Calculate footprints by Geometry
- Set Mosaic Method = Closest to Center
- Create Overviews
(Workflow step 5 - optional) Block adjustment in ArcPro

- Calculate tie points between images
- Input ground control points
- Adjust with 1\textsuperscript{st} Order Transform (Frame camera requires Desktop Advanced)
Advanced Workflow

• Create Frame Table as per Standard Workflow

• Use OrthoMapping
  - Block Adjustment
    - GPS AccuracyLow
  - DTM Generation

• Optionally (similar to standard)
  - Publish as an Image Service
  - Refine color correction *
  - Generate seamlines *
  - Generate Orthophotos *
  - Create Tile Cache and publish to ArcGIS Online (or your portal)
  - Create Derived Mosaic Dataset that Combines all

* Part of OrthoMapping workflow
Publishing

• As Image Services
  - Highest Image Quality (No data loss)
  - Provide Metadata
  - Access to All Overlapping data
  - Clip to Footprints

• As Raster Tile Cache (Provides Static Backdrop)
  - Generate in Desktop or Server
  - Publish through Server or to ArcGIS Online
For More Details:  www.esriurl.com/imageryworkflows

ArcGIS Imagery Workflows
Tools and best practices to help you manage, analyze, and use your imagery and rasters

Manage Imagery