ArcGIS Enterprise: Raster Analytics in Image Server

Jie Zhang, Nirupam Dey
ArcGIS Has Five Core Capabilities for Imagery and Remote Sensing

Management & Dissemination
- Image Analyst
- Image Server

Content
- Aerial Photos
- Small Sats
- High-Resolution Satellites
- Community Imagery
- Radar
- Video
- Sentinel
- Drones
- All Major Sensors

Visualization & Exploration
- Image Space and Mensuration
- Full-Motion Video
- Charting
- Temporal Profile
- Spectral Profile

Oriented Imagery
- Street Views
- Stereo

Map Production
- Drone Mapping
- Ortho Mapping
- DTM Generation
- Drone2Map
- Seamlessly Orthophotos
- Ortho Maker

Analysis
- Change Analysis
- Raster Processing Functions
- AI / Deep Learning
- Classification

Integrated and Massively Scalable
- Indexes
- Change Analysis
- Raster Processing Functions
- AI / Deep Learning
- Classification

Image Server

Content
- All Major Sensors

Management & Dissemination
- Image Analyst
- Image Server
Analysis
Integrated and Massively Scalable

Exploitation & Visualization
ArcGIS Pro
Image Analyst
Image Server

Analysis
Apps (Excalibur)
Image Analyst Ortho Mapping
Map Production
Image Management

Exploitation

Indexes
Classification
AI / Deep Learning
Raster Processing Functions

Change Analysis
What is Raster Analytics?

• The ArcGIS way to create and execute spatial analysis models and image processing chains which leverage distributed storage and analytics

• Requires: ArcGIS Enterprise + ArcGIS Image Server
## Comprehensive suite of Functions

### Analysis: Band Math & Indices
- NDVI / NDVI Colorized
- SAVI / MSAVI / TSAVI
- GEMI
- GVI (Landsat TM)
- PVI
- Tasseled Cap (Kauth-Thomas)
- Binary Thresholding
- Heat Index
- Wind Chill

### Statistics
- ArgStatistics

### Visualization & Appearance
- Contrast and Brightness
- Convolution
- pansharpening
- Resample
- Statistics and Histogram
- Stretch

### 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
- Region Group
- Lookup

### Multiband Math
- Arithmetic
  - Band Arithmetic

### Correction
- Apparent Reflectance
- Geometric Correction
- Speckle Filtering (Lee,Frost,Kuan)
- Thermal noise
- Radiometric Calibration

### Interpolation
- Interpolate Irregular Data
  - Nearest Neighbor
  - IDW
  - EBK

### Round Down

### Round Up

### Analysis: Image Segmentation & Classification
### Analysis: Overlay

### Analysis: Distance & Density
- Euclidean Distance
- Cost Distance
- Least Cost Path
- Kernel Density
- Path Allocation
- Path Distance
- Corridor
- Path Distance backlink

### Analysis: Hydrology
- Fill
- Flow Accumulation
- Flow Direction
- Flow Distance
- Stream Link
- Watershed

### Analysis: Overlay
- Weighted Overlay

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

### Python
- Custom Algorithms

### Analysis: Band Math & Indices
- Mean Shift

### Analysis: Overlay
- Weighted Overlay

### Statistics:
- Zonal Statistics
- Cell Statistics
- Focal Statistics

### Math
- Round Down
- Round Up
- TanH
- Greater Than

### Calculator
- Square
- Square Root
- Cos
- Sin
- Tan

### Divide
- Times
- Left Shift
- Not

### Exp
- ACos
- ACosh
- Not Shift

### Exp10
- ASin
- Or

### Exp2
- ATan
- And

### Float
- ATan2
- Boolean

### Ln
- Log2
- Cos

### Log10
- Log2
- CosH

### Minus
- SinH
- Not

### Mod
- Sin
- Or

### Negate
- SinH
- xor

### Plus
- SinH
- Equal To

### Power
- Tan
- Greater Than
Raster Analytics System Configuration
Raster Analytics User Experiences

ArcGIS Pro

ArcGIS Enterprise Webmap

ArcGIS Notebook

ArcGIS API for Python

arcpy
Raster Analytics

Workflows
## Raster Analytics User Experiences

<table>
<thead>
<tr>
<th>Users</th>
<th>Developers</th>
</tr>
</thead>
<tbody>
<tr>
<td>• ArcGIS Pro &quot;Out of the Box&quot; Analysis</td>
<td>• arcpy</td>
</tr>
<tr>
<td>• ArcGIS Pro Custom Analysis</td>
<td>• ArcGIS API for Python</td>
</tr>
<tr>
<td>• ArcGIS Enterprise &quot;Out of the Box&quot; Analysis</td>
<td>• Notebooks (arcpy, Notebook Server)</td>
</tr>
<tr>
<td>• ArcGIS Enterprise Custom Analysis</td>
<td>• ArcGIS REST API</td>
</tr>
</tbody>
</table>

Notebooks can be created using the `arcpy` module, the `ArcGIS API for Python` and `ArcGIS REST API`.
ArcGIS Pro "Out of the Box" Analysis

- **Local Processing**
  - "on the desktop"
  - Image Analyst Tools
  - enhanced parallel processing tools
  - geoprocessing Model Builder
  - leverage all geoprocessing tools
  - single raster functions

- **Distributed Processing**
  - "on the server"
ArcGIS Pro Custom Analysis

- **Local Processing**
  - "on the desktop"
  - "on-the-fly" results
  - Raster Function Editor
  - Output Layer Type = Raster Layer

- **Distributed Processing**
  - "on the server"
  - full resolution persistent results
  - Raster Function Editor
  - Output Layer Type = Web Image Layer
ArcGIS Pro Demo
Nirupam Dey
ArcGIS Enterprise "Out of the Box" Analysis

- **Distributed Processing**
  - "on the server"
  - full resolution persistent results
  - via Map Viewer
ArcGIS Enterprise Custom Analysis - Raster Function Editor

complete web user experience for visual modeling - "raster function editor for Map Viewer“  
(New Feature – ArcGIS Enterprise 10.7)
ArcGIS Enterprise Custom Analysis

develop custom processing models and share to Portal from Pro

Raster Function Template item

browse and search for Raster Function Template items

form generated, user supplies parameters and runs the custom analysis
ArcGIS Enterprise Demo
Nirupam Dey
Python for Developers and Systems Integrators

ArcGIS API for Python

```
import numpy as np
```

```python
class HelloWorld():
    def __init__(self):
        self.name = "Hello World Function"

    def getParameterInfo(self):
        return [{
            'name': 'r',
            'dataType': 'raster'
        }]

    def updatePixels(self, tlc, shape, props, **pixelBlocks):
        r = pixelBlocks['r_pixels'] * 10
        pixelBlocks["output_pixels"] = r.astype(props["pixelType"])
        return pixelBlocks
```

distributed as part of the arcgis conda package

custom algorithms
leverage Python package ecosystem
use in ArcGIS Pro and ArcGIS Enterprise

enterprise automation
enterprise integration
models built from existing functions

Python Raster Function API

https://github.com/Esri/raster-functions
ArcGIS Notebook

- display Image Layers
- apply dynamic on-the-fly processing
- construct raster function chain (i.e. models in code)
- run models using distributed processing
- design, develop, prototype
- has arcpy (from 10.7.1)

<table>
<thead>
<tr>
<th>Analysis Environment</th>
<th>Data</th>
<th>No. of workers</th>
<th>Time used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster (5 nodes)</td>
<td>SRTM 30m</td>
<td>32</td>
<td>1 min</td>
</tr>
<tr>
<td>Cluster (5 nodes)</td>
<td>NED 10m</td>
<td>40</td>
<td>4 min 53 sec</td>
</tr>
<tr>
<td>Single node</td>
<td>SRTM 30m</td>
<td>6</td>
<td>3 min 27 sec</td>
</tr>
<tr>
<td>Single node</td>
<td>NED 10m</td>
<td>6</td>
<td>41 min 10 sec</td>
</tr>
</tbody>
</table>
ArcGIS REST API for Web Developers

- run out of the box analytics
  - [http://esriurl.com/rarestapi](http://esriurl.com/rarestapi)

- model analysis in JSON and run using distributed processing
  - [http://esriurl.com/rasterfunc](http://esriurl.com/rasterfunc)
Jie Zhang

Notebook & ArcGIS API for Python

Jie Zhang
Recommended Imagery Enterprise Demo Theatres/Workshops

- 2:30 PM - 3:30 PM, Thursday, July 11
  ArcGIS Enterprise: Raster Analytics in ArcGIS Image Server (2nd)
- 8:30 AM - 9:30 AM, Thursday, July 11
  ArcGIS Enterprise: Deploying Distributed Raster Analytics
- 10:00 AM – 10:45 AM, Thursday, July 11
  Image Processing Using Raster Functions
- 10:00 AM – 10:45 AM, Wednesday, July 10
  ArcGIS Enterprise: Sharing Imagery
- 12:15 PM – 1:00 PM, Wednesday, July 10
  ArcGIS Enterprise: Ortho Mapping for Drone Imagery with Ortho Maker
- 1:00 PM – 2:00 PM, Tuesday, July 9
  Using Machine Learning and Deep Learning with Imagery in ArcGIS (1st)
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