Change Detection using the Python Raster Function

Hua Wei

hwei@esri.com
Background: change detection

- Land cover change detection
  - Deforestation, urban crawl, impervious surface, ice cap, etc…
  - Can be detected in image

- Example
  - Search “change matters esri”
  - Search “global forest change”
Background: raster function

• A recipe of processing in XML or JSON understood by ArcGIS
  - See all functions: search “what are the functions used by a raster or mosaic dataset”
  - Can be chained together

• On-the-fly processing
  - How possible? Process your screen not whole image.

• Where to use?
  - Mosaic dataset
  - Preview before saveAs
Basics of python raster function

• Why
  • ArcGIS ships with built-in raster functions
  • You want your python object to participate in that processing pipeline
  • Adapter – wrap your python into raster function

• How to write one?
  • Search “github esri raster function” (https://github.com/Esri/raster-functions)
  • Writing image processing algorithms using the python raster function
    • 5:30 – 6:30 PM | Demo Theater 3
Demo 1, Entropy

- **What is entropy**
  - \( E = \sum(p \times \log_2(p)) \), where \( p \) is histogram
  - Measure complexity, or texture
  - [http://scikit-image.org/docs/dev/auto_examples/filters/plot_entropy.html](http://scikit-image.org/docs/dev/auto_examples/filters/plot_entropy.html)

- **It is useful, because…**
  - Different land cover has different texture
**Demo 2: Normalized Burn Ratio (NBR)**

\[
NBR = \frac{NIR - SWIR}{NIR + SWIR}
\]

NIR light: 700 to 1,100 nanometers
- Plants (chlorophyll in leaves) reflect near infrared light strongly
- **AFTER FIRE:** less plants, less chlorophyll to reflect NIR \( \rightarrow \) NIR decrease

SWIR light: 1,100 to 3,000 nanometers
- Water absorbs shortwave infrared light
- **AFTER FIRE:** less moisture in soil, less absorption of SWIR \( \rightarrow \) SWIR increase

NIR & SWIR respond the most to burning; the changes is greatest in magnitude comparing to other bands
Measuring the relative changes in NIR & SWIR \( \rightarrow \) distinguish burned area from unburned areas

**Differenced Normalized Burn Ratio (ΔNBR)**

\[
\Delta NBR = NBR_{prefire} - NBR_{postfire}
\]

Courtesy of Zou Yi
yzou@esri.com
Demo 3, Block change detection

- **Major challenges**
  - Image registration
  - Shadows
  - Angle of camera
  - Reflection
  - Moving objects (vehicles…)

- **Methods**
  - Color differences
    - Luminance effects elimination, color models, band statistics…
  - Texture differences
    - Pixel entropy, edge information…

Courtesy of Joe McGlinchy and Yiqun Xie
jmcglinchy@esri.com
Use python raster function on ArcGIS server

- Install 3\textsuperscript{rd} party libraries on server
- Upload .py and .rft.xml to \(\text{ArcGIS}\textbackslash \text{Server}\textbackslash \text{resources}\textbackslash \text{Raster}\textbackslash \text{Functions}\textbackslash \text{System}\)
- Call as well-known raster function (avoid built in names)
Questions?

• Hua Wei
  - hwei@esri.com

• For more info on Python Raster Function
  - *Writing image processing algorithms using the python raster function*
  - 5:30 PM – 6:30 PM
  - Demo Theater 3