GEOSAGE

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DOS-based *HighView* (Version 3.1, Released 2 Feb. 2010)

The latest version of *HighView* for rapidly processing the recent high-resolution satellite imagery – WorldView-2, QuickBird, GeoEye-1 and IKONOS.

A dedicated utility program in the form below

```
C:\Fuse.exe <optimization_method> <output_image_type> -e
<enhanced_spatial_filter_option> <enhanced_green_color_option>
<enhanced_pixel_offset_x_option> <enhanced_pixel_offset_y_option> -s
<image_stretch_band1_left_cut> <image_stretch_band1_right_cut>
<image_stretch_band2_left_cut> <image_stretch_band2_right_cut>
<image_stretch_band3_left_cut> <image_stretch_band3_right_cut>
<nonlinear_stretch_band1> <nonlinear_stretch_band2>
<nonlinear_stretch_band3> <in_PAN.tif> <in_MS.tif>
<out_PanSharpened.tif>
```

- Processing WorldView-2, QuickBird, GeoEye-1 and IKONOS imagery DIRECTLY from DigitalGlobe and GeoEye data vendors. Both 16-bit panchromatic and multispectral inputs in GeoTIFF format contain full 11-bit dynamic ranges. Pan-sharpened R/G/B output in GeoTIFF format can be directly used by GIS software (e.g., ArcGIS, MapInfo) and popular image manipulation software (e.g., PhotoShop). Maximum image size is about 36,500 x 36,500 pixels, and max file size for the output is 4Gb.
- Global and local optimization methods
- Natural- or false-color R/G/B composites
- Options for spatial and spectral enhancements
- Options for pixel offset adjustment in X/Y directions
- Options for both linear and non-linear image stretching
- Low memory usage, highly efficient in processing
- RGB Band Combination and Image Stretching tools included

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(Continued)


Fuse.exe Help Version 3.1.txt - Notepad

File Edit Format View Help

```
<nonlinear_stretch_band2>
Nonlinear stretching coefficient/weight for band2
Value range [0.0-20.0], typical value 2.0
<nonlinear_stretch_band3>
Nonlinear stretching coefficient/weight for band3
Value range [0.0-20.0], typical value 2.0

Parameters - Specific to input and output GeoTIFF files

All GeoTIFF files should be untiled, uncompressed.

<in_PAN.tif>
Panchromatic input must contain 16-bit, single-band data.
Pixel data range [0-2047] (or 11-bit) is expected.
<in_MS.tif>
Multispectral input must contain 16-bit, four-band data (e.g., QuickBird,
GeoEye-1 and IKONOS) or eight-band data (e.g., WorldView-2).
Pixel data range [0-2047] (or 11-bit) is expected.
<out_PanSharpened.tif>
Pan-sharpened output file name. Output will be 8-bit, three-band GeoTIFF file.

Examples/Tips

1. This tool targets WorldView-2, QuickBird, GeoEye-1 and IKONOS imagery
   directly supplied by DigitalGlobe and GeoEye data vendors. Generally, both
   panchromatic and multispectral inputs are 16-bit GeoTIFF files, and
   meet the EXACT image size ratio of 4:1. Maximum image size for PAN
   band is about 36500 x 36500 pixels, and max file size for output is 4GB.
2. Before pan-sharpening, users may wish to perform simple band combination
   and produce R/G/B true-color composite using the multispectral input:
   RGB_Stretch.exe 3 2 1 -s 2 1 2 1 2 1 2 2 2 in_QB_MS.tif QB_MS_RGB.tif
   RGB_Stretch.exe 5 3 2 -s 2 .5 2 .5 2 .5 2 2 2 in_WV_MS.tif WV_MS_RGB.tif
3. For WorldView-2 and QuickBird imagery, use pan-sharpening commandlines:
   Fuse.exe 1 0 -e 2 0 0 0 -s 2 1 2 1 2 1 0 0 0 in_PAN.tif in_MS.tif out.tif
   Fuse.exe 1 0 -e 2 0 0 0 -s 2 1 2 1 2 1 2 2 2 in_PAN.tif in_MS.tif out.tif
4. For GeoEye-1 and IKONOS imagery, since multispectral data are provided with
   four separate bands - blue, green, red and near-infrared, users need to
   combine all multispectral bands together in order to make a new, four-band
   multispectral input file first, using RGB Image Composition Tool included
   in the package, i.e.,
   RGB_Make.exe blue.tif green.tif red.tif nir.tif in_MS.tif
   Then, use this tool for image pan-sharpening, e.g.,
   Fuse.exe 1 0 -e 2 0 0 0 -s 2 1 2 1 2 1 2 2 2 in_PAN.tif in_MS.tif out.tif
5. To highlight vegetation in TOTAL green based on NDVI threshold, use
   Fuse.exe 0 0 -e 0 0.2 0 0 -s 2 1 2 1 2 1 0 0 0 in_PAN.tif in_MS.tif out.tif
   Just to highlight vegetation greener, use
   Fuse.exe 0 0 -e 0 4 0 0 -s 2 1 2 1 2 1 0 0 0 in_PAN.tif in_MS.tif out.tif
6. To produce a color-infrared output, use
   Fuse.exe 0 1 -e 2 0 0 0 -s 2 1 2 1 2 1 0 0 0 in_PAN.tif in_MS.tif out.tif
7. For more examples and tips, please refer to software features and tutorials
   on the website.

Software Full Name:

HighView - An Advanced Image Fusion and Pan-Sharpening Tool
(RGB Band Combination and Image Stretching Tool included)

DOS-based command-line utility programs for rapidly pan-sharpening the recent
high-resolution satellite imagery such as WorldView-2, QuickBird, GeoEye-1
and IKONOS.

Developer: http://www.GeoSage.com/
```

Example:

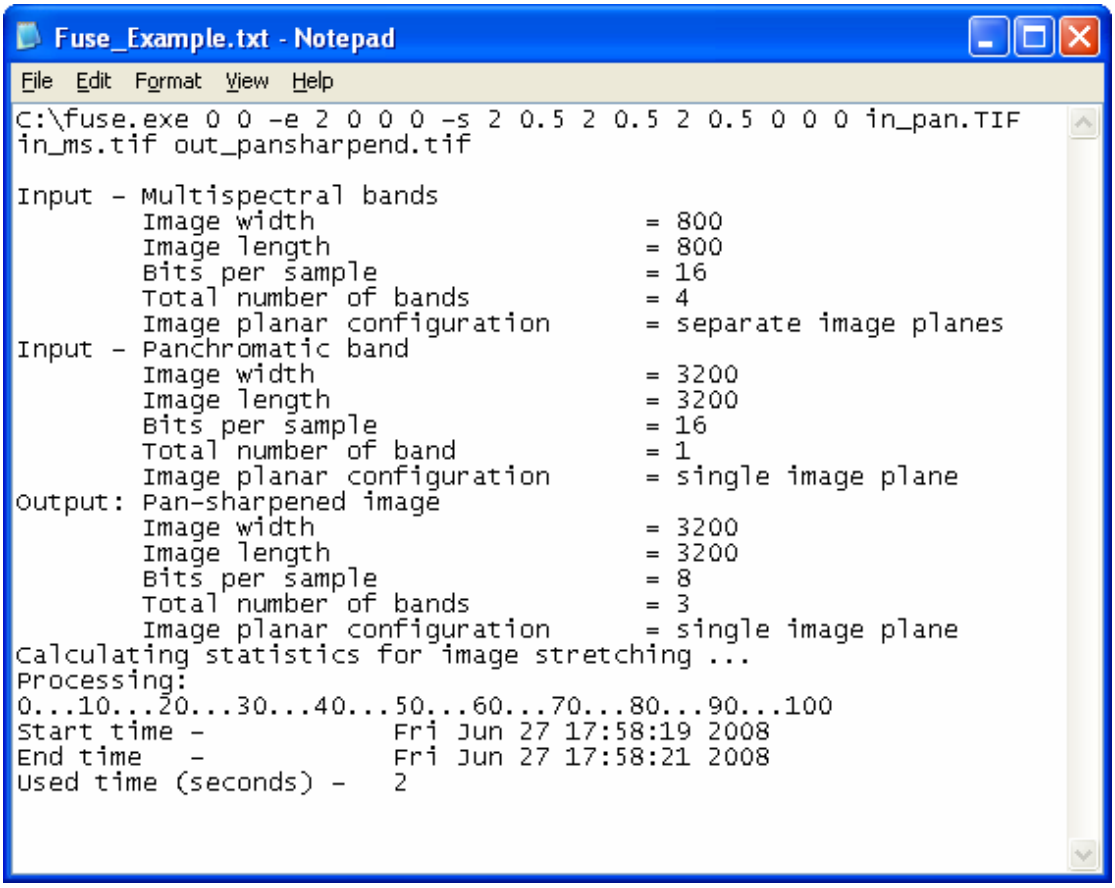

Fuse_Example.txt - Notepad
File Edit Format View Help
C:\fuse.exe 0 0 -e 2 0 0 0 -s 2 0.5 2 0.5 2 0.5 0 0 0 in_pan.TIF
in_ms.tif out_pansharpend.tif
Input - Multispectral bands
Image width = 800
Image length = 800
Bits per sample = 16
Total number of bands = 4
Image planar configuration = separate image planes
Input - Panchromatic band
Image width = 3200
Image length = 3200
Bits per sample = 16
Total number of band = 1
Image planar configuration = single image plane
Output: Pan-sharpened image
Image width = 3200
Image length = 3200
Bits per sample = 8
Total number of bands = 3
Image planar configuration = single image plane
Calculating statistics for image stretching ...
Processing:
0...10...20...30...40...50...60...70...80...90...100
Start time - Fri Jun 27 17:58:19 2008
End time - Fri Jun 27 17:58:21 2008
Used time (seconds) - 2

Image source: USGS GloVIS, Landsat ETM+ bands 3/2/1. Washington, D.C.

RGB Band Combination and Image Stretching Tool:

Containing a hybrid of linear and nonlinear stretching methods

Highlights:

A powerful, easy-to-implement utility tool in the form below

```
C:\RGB_Stretch.exe
<band_selection_red> <band_selection_green> <band_selection_blue> -s
<image_stretch_band1_left_cut> <image_stretch_band1_right_cut>
<image_stretch_band2_left_cut> <image_stretch_band2_right_cut>
<image_stretch_band3_left_cut> <image_stretch_band3_right_cut>
<nonlinear_stretch_band1> <nonlinear_stretch_band2>
<nonlinear_stretch_band3> <in.tif> <out.tif>
```

1. **Directly processing multiple bands (>=3), 8- or 16-bit input imagery in untiled, uncompressed GeoTIFF format. R/G/B output is in GeoTIFF format as well, without losing any georeference information.**
2. **Selection of any band combinations making true- or false-colour imagery**
3. **Settings of linear stretching specific to each R/G/B band**
4. **Nonlinear image stretching option designed to improve overall brightness of the output and rendering effect**
5. **Applicable to all types of remotely sensed imagery**
6. **Processing input files up to 4Gb in size**
7. **Super fast in running (e.g., processing 8,500+ Landsat ETM+ scenes with a global coverage takes less than 24 hours on a typical office PC)**
8. **Support of batch processing, without limit on the # of images to be processed.**
9. **Great tips and generous technical support.**

RGB Band Combination and Image Stretching Tool:

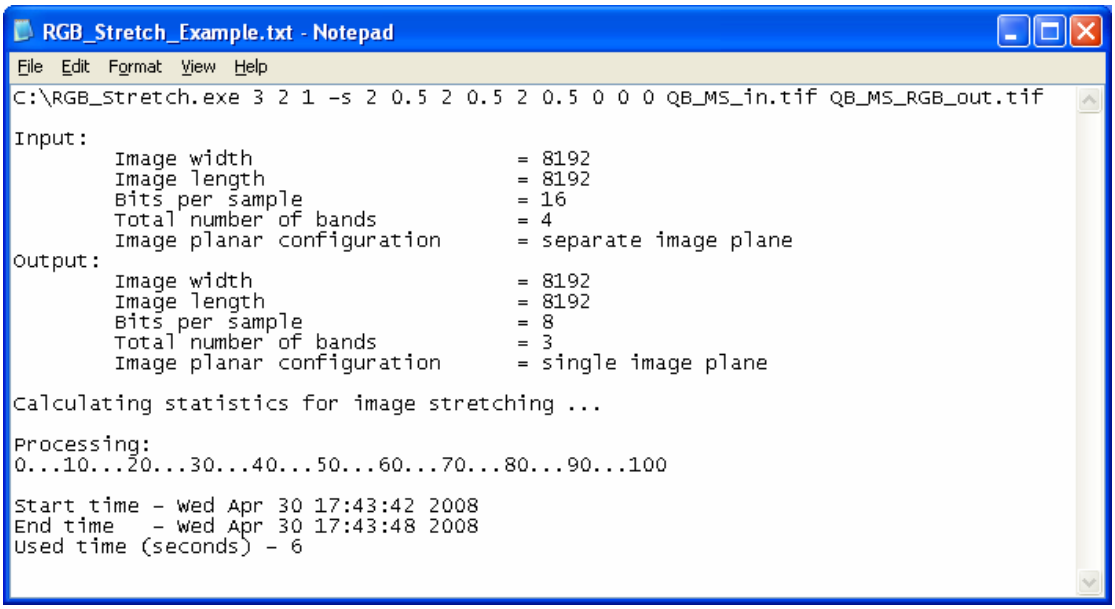
Containing a hybrid of linear and nonlinear stretching methods

RGB_Stretch.exe Help Version 3.1.txt - Notepad

File Edit Format View Help

```
C:\RGB_Stretch.exe
 <band_selection_red> <band_selection_green> <band_selection_blue> -s
 <image_stretch_band1_left_cut> <image_stretch_band1_right_cut>
 <image_stretch_band2_left_cut> <image_stretch_band2_right_cut>
 <image_stretch_band3_left_cut> <image_stretch_band3_right_cut>
 <nonlinear_stretch_band1> <nonlinear_stretch_band2> <nonlinear_stretch_band3>
 <in.tif> <out.tif>
 Version 3.1, Released 2 February 2010

Parameters

<band_selection_red>:
Band selection number for the Red band from input, range [1-256]
<band_selection_green>:
Band selection number for the Green band from input, range [1-256]
<band_selection_Blue>:
Band selection number for the Blue band from input, range [1-256]

<image_stretch_band1_left_cut>:
Linear stretching, % of pixels to be excluded at left-end for band1
Value range [0.0-40.0], typical value 2.0
<image_stretch_band1_right_cut>:
Linear stretching, % of pixels to be excluded at right-end for band1
Value range [0.0-40.0], typical value 2.0
<image_stretch_band2_left_cut>:
Linear stretching, % of pixels to be excluded at left-end for band2
Value range [0.0-40.0], typical value 2.0
<image_stretch_band2_right_cut>:
Linear stretching, % of pixels to be excluded at right-end for band2
Value range [0.0-40.0], typical value 2.0
<image_stretch_band3_left_cut>:
Linear stretching, % of pixels to be excluded at left-end for band3
Value range [0.0-40.0], typical value 2.0
<image_stretch_band3_right_cut>:
Linear stretching, % of pixels to be excluded at right-end for band3
Value range [0.0-40.0], typical value 2.0

<nonlinear_stretch_band1>:
Nonlinear stretching coefficient/weight for band1
Value range [0.0-20.0], typical value 2.0
<nonlinear_stretch_band2>:
Nonlinear stretching coefficient/weight for band2
Value range [0.0-20.0], typical value 2.0
<nonlinear_stretch_band3>:
Nonlinear stretching coefficient/weight for band3
Value range [0.0-20.0], typical value 2.0

Examples/Tips

1. If a scene contains a small percentage of information-rich white pixels
   (e.g. those showing built-up areas), try to use smaller right-end cut-off
   values. Such data are popular, including Landsat ETM+ imagery in NASA
   GeoCover series and 16-bit WorldView-2, QuickBird, GeoEye-1, IKONOS
   imagery with populated areas.
   IMPORTANT: This option will probably work best for the majority of scenes.
   RGB_stretch.exe 3 2 1 -s 2 0.2 2 0.2 2 0.2 0 0 0 in.tif out.tif
   RGB_stretch.exe 5 3 2 -s 2 0.2 2 0.2 2 0.2 2 2 2 in.tif out.tif
   RGB_stretch.exe 7 5 2 -s 2 0.5 2 0.5 2 0.5 2 2 2 in.tif out.tif
2. If a full scene or its large part is about desert land cover, try to
   use smaller right-end cut-off values, e.g.
   RGB_stretch.exe 3 2 1 -s 2 0.2 2 0.2 2 0.2 0 0 0 in.tif out.tif
   RGB_stretch.exe 5 3 2 -s 2 0.1 2 0.1 2 0.1 2 2 2 in.tif out.tif
3. If a scene contains a large proportion of white areas (e.g. clouds, snows),
   try to increase the right-end cut-off values for their exclusion, e.g.
   RGB_stretch.exe 1 2 3 -s 2 4 2 4 2 4 0 0 0 in.tif out.tif
   RGB_stretch.exe 1 2 3 -s 2 6 2 6 2 6 0 0 0 in.tif out.tif
4. If an initial image stretching result appears bluish, try to increase
   the left-end cut-off values for the BLUE band only, e.g.
   RGB_stretch.exe 1 2 3 -s 2 2 2 2 5 2 0 0 0 in.tif out.tif
5. Input GeoTIFF file should be untiled, uncompressed, 8-/16-bit.
6. Planar configuration for the output: single image plane.

Full Name: RGB Band Combination and Image Stretching Tool
Containing a hybrid of linear and nonlinear stretching methods
Developer: http://www.GeoSage.com/
```

Example



Tutorial

Step 1 (optional): Download GeoTIFF files and combine all separate bands into a single file (common for Landsat ETM+, GeoEye-1 and IKONOS imagery sources).

Many tools are available in the public domain for this task, e.g.,

- Use RGB_Make.exe (next page)
  RGB_Make.exe tm_band3.tif tm_band2.tif tm_band1.tif out.tif
- Or, use versatile GDAL_merge.py (http://www.gdal.org/gdal_merge.html)
  GDAL_merge –o out.tif –separate tm_band3.tif tm_band2.tif tm_band1.tif

Step 2: Perform band combination and image stretching, e.g.,

Landsat ETM+ multi-band, multispectral imagery in NASA GeoCover series

C:\RGB_Stretch.exe 3 2 1 –s 2 0.5 2 0.5 2 0.5 0 0 0 in.tif rgb_out.tif

QuickBird multispectral imagery (Data directly from data vendors usually have four MS bands in a single file and use 16-bit data type for 11-bit pixel values ranging from 0 to 2047)

Natural color composite -
C:\RGB_Stretch.exe 3 2 1 –s 2 0.5 2 0.5 2 0.5 2 2 2 in.tif rgb_out.tif

False color composite -
C:\RGB_Stretch.exe 4 3 2 –s 2 0.5 2 0.5 2 0.5 2 2 2 in.tif rgb_out.tif

WorldView-2 multispectral imagery (Data directly from data vendors usually

have eight MS bands in a single file and use 16-bit data type for 11-bit pixel values ranging from 0 to 2047)

Natural color composite -

C:\RGB_Stretch.exe 5 3 2 –s 2 0.5 2 0.5 2 0.5 2 2 2 in.tif rgb_out.tif

False color composite -

C:\RGB_Stretch.exe 7 5 3 –s 2 0.5 2 0.5 2 0.5 2 2 2 in.tif rgb_out.tif

RGB Image Composition Tool (free)