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Authoring Organization: Del Mar College

Written by: Nate Jennings

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Overview of Remote Sensing

- **Remote Sensing and GIS**, Created by author, Nathan Jennings. Creative Commons CC BY 3.0 license applies: <http://creativecommons.org/licenses/by/3.0/>. [Earth Image](#) Accessed on Feb 3, 2013, and used under Public Domain.
- **CropScape**, http://adl.brs.gov.au/data/warehouse/9aac/9aacm/rsfcm99abcm004201209/TR_12.3_IntgrtCrpFrcst_v.1.0.0.pdf, used under Public Domain.
- **Monitoring Forest and Fire**, <http://www.fs.fed.us/eng/rsac/>) accessed on Feb 3, 2013, and used under Public Domain.
- **UAV Imaging for USGS Surface Mining Proof-of-Concept Mission and Surface mine image** http://rmgsc.cr.usgs.gov/UAS/images/mineSurveysWV/2012/flt6_surfacemine3_ponds_000789021_350.jpg http://rmgsc.cr.usgs.gov/UAS/images/mineSurveysWV/2012/flt6_surfacemine3_ponds_000789021_350.jpg Accessed on Feb 3, 2013, and used under Public Domain.
- **Grand Teton National Park** <http://landsat.gsfc.nasa.gov/images/archive/f0010.html> Accessed f0010.jpg on Jan 26, 2013 renamed image GrandTetonNationalPark.jpg from "Landsat imagery courtesy of NASA Goddard Space Flight Center and U.S. Geological Survey"
- **Belcher Islands** <http://en.wikipedia.org/wiki/File:Belcherislands.jpg>, Author: NASA, Public Domain Accessed on Jan 26, 2013
- **AL KHUFRAH OASIS, AGR., ROADS - ISS010-E-5266.jpg** Recommended Citation: Image Science and Analysis Laboratory, NASA-Johnson Space Center. "The Gateway to Astronaut Photography of Earth." <<http://earth.jsc.nasa.gov/sseop/EFS/printinfo.pl?PHOTO=ISS010-E-5266>>01/26/2013 15:01:24 Accessed Jan 26, 2013
- **Hyperspectral Cube** <http://en.wikipedia.org/wiki/File:HyperspectralCube.jpg>, Author: Dr. Nicholas M. Short, Public Domain Accessed Jan 26, 2013
- **Spaceborne Imaging Radar Image** <http://photojournal.jpl.nasa.gov/catalog/PIA01349> 115px-Death-valley-sar.jpg, Courtesy NASA/JPL



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- **Landsat 7 orbit image**
http://landsat.gsfc.nasa.gov/images/lg_jpg/landsat7_orbit2.jpg, Courtesy NASA/JPL-Caltech
Accessed on Feb 18, 2013
- **Alaska Wetlands derived from JERS RADAR Satellite**
Screenshot http://wetlands.jpl.nasa.gov/products/alaska_wetland.html
Accessed on Feb 3, 2013
- **Mississippi Flood 1993**
<http://www.earthobservatory.nasa.gov/IOTD/view.php?id=5422>
Accessed Feb 3, 2013. NASA. Public domain.
- **Ice monitoring**
http://polynya.gsfc.nasa.gov/seaice_amsr_south.html
Accessed Feb 3, 2013
- **Feature Based mapping**
<http://letters-sal.blogspot.com/search/label/eCognition>
Creative Commons reference, <http://creativecommons.org/licenses/by-sa/2.5/>: <http://letters-sal.blogspot.com/2012/12/basic-feature-extraction-tutorial.html>
Accessed on Feb 10, 2013
<http://letters-sal.blogspot.com/search/label/automated%20feature%20extraction>
Accessed on Feb 10, 2013
- **Timeline**
- **NADAR and Balloon Photograph**
http://en.wikipedia.org/wiki/File:Brooklyn_Museum_-_Nadar_%C3%89levant_la_Photographie_%C3%A0_la_Hauteur_de_l%27Art_-_Honor%C3%A9_Daumier.jpg
Accessed on Jan 29, 2013
- **San Francisco Earthquake from a Kite mounted camera**
http://en.wikipedia.org/wiki/File:San_Francisco_in_ruin_edit2.jpg
Accessed on Jan 29, 2013
- **Pigeon mounted camera**
<http://upload.wikimedia.org/wikipedia/commons/thumb/8/83/Kronberger-burg-museum010.jpg/361px-Kronberger-burg-museum010.jpg>
Accessed on Jan 29, 2013
- **Pigeon mounted camera photograph**
<http://commons.wikimedia.org/wiki/File:Pigeonimg.jpg>, Julius Neubronner (1852–1932). Original uploader was Jennavecia at en.wikipedia, Public Domain.



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- **German trenches in France, 1916**
http://commons.wikimedia.org/wiki/File:Schwaben_Redoubt_aerial_photograph_10-05-1916_IWM_HU_91107.jpg, Public Domain
Accessed on Feb 3, 2013
- **QuickBird Example**
http://gdsc.nlr.nl/gdsc/en/information/earth_observation/sensor_examples/multispectral
Accessed on Feb 3, 2013
- **Landsat 7 Image, July 28, 2001**
<http://atlas.ca.gov/imagerySearch.html>
Accessed on Feb 3, 2013. Author created this overview image for this slide from the source imagery. This image can be used as part of the Creative Commons license:
<http://creativecommons.org/licenses/by/3.0/>.
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- **High Resolution Air Photo Example**
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- **Quad Copter**
<http://www.dolookdown.org/>, all content [CC BY-NC-SA](#) unless otherwise specified.
Accessed on Feb 9, 2013
- **Balloon Mapping**
<http://publiclaboratory.org/tool/balloon-mapping>. This work is licensed under a [Creative Commons Attribution-ShareAlike 3.0 Unported License](#).
Accessed Feb 9, 2013
- **Fixed Wing Drones**
<http://diydrones.com/photo/the-fleet-2>; Author: Drone Savant
[Creative Commons CC BY 3.0](#)
<http://diydrones.com/profiles/blog/show?id=705844:BlogPost:17789>
Accessed on Feb 10, 2013
- **Kite mounted remote sensor**
http://upload.wikimedia.org/wikipedia/commons/thumb/7/7c/Picavet_cross.jpg/292px-Picavet_cross.jpg



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Physical Foundations

- **Remote Sensing Energy Interaction**

http://upload.wikimedia.org/wikipedia/commons/thumb/f/ff/Remote_Sensing_Energy_Interaction_Schematic.svg/1000px-Remote_Sensing_Energy_Interaction_Schematic.svg.png

- **Photon Wavelength** - [Creative Commons Attribution 3.0 Unported](#)

http://commons.wikimedia.org/wiki/File:500px-Photon_wavelength.svg.png

Accessed January 27, 2013

- **Electromagnetic Spectrum**

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- **Atmospheric Opacity**

http://en.wikipedia.org/wiki/File:Atmospheric_electromagnetic_opacity.svg

Accessed Feb 18, 2013

- **Spectral Curve**

Viewing1.jpg

<http://erdas.wordpress.com/2007/12/30/2-viewing-and-investigating-features/#more-6>

Accessed on Feb 3, 2013

- **Non infested vs. Infested fir trees spectral response**

<http://www.hindawi.com/journals/ijfr/2010/498189/>

<http://www.hindawi.com/journals/ijfr/2010/498189/fig1/>

Stephen P. Cook, Karen S. Humes, Ryan Hruska, Grant Fraley, and Christopher J. Williams, "Identifying Subalpine Fir (*Abies lasiocarpa*) Attacked by the Balsam Woolly Adelgid (*Adelges piceae*) Using Spectral Measurements of the Foliage," International Journal of Forestry Research, vol. 2010, Article ID 498189, 8 pages, 2010. doi:10.1155/2010/498189 (Copyright © 2010 Stephen P. Cook et al. This is an open access article distributed under the [Creative Commons Attribution 3.0 Unported License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Accessed on Feb 18, 2013



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- **Active v. Passive Remote Sensors**
<http://ls7pm3.gsfc.nasa.gov/whatsRM/measureem.html>
 Accessed Feb 10, 2013. NASA: Public Domain.

Sensor Platforms and Image Processing Basics

- **High Resolution Air Photo Example**
 Created by the author using public domain high-resolution aerial photography collected in 2009, Nathan Jennings is the primary contact for this image and it is public domain as part of the Creative Commons CC BY 3.0 license: <http://creativecommons.org/licenses/by/3.0/>.
- High resolutions images from the City of Sacramento. The right image is from a 2011 collection. The image on the right is from a 2009 image collection. All image data is public domain and be accessed by contacting the author, Nathan Jennings at the City of Sacramento, or through the USGS National Map Viewer. A Creative Commons CC BY 3.0 license applies: <http://creativecommons.org/licenses/by/3.0/>.
- **Landsat 7 Image, July 28, 2001**
<http://atlas.ca.gov/imagerySearch.html>
 Accessed on Feb 3, 2013. Author created this overview image from the source imagery. This image can be used as part of the Creative Commons CC BY 3.0 license: <http://creativecommons.org/licenses/by/3.0/>.
- **QuickBird Example**
http://gdsc.nlr.nl/gdsc/en/information/earth_observation/sensor_examples/multispectral
 Accessed on Feb 3, 2013
- **San Francisco Bay 2007 oil spill**
<http://visibleearth.nasa.gov/view.php?id=36104>
 RADARSAT sample accessed from the Visible Earth website from NASA.
 Accessed on Feb 3, 2013.
- **Shuttle Imaging RADAR sample**
<http://southport.jpl.nasa.gov/>
<http://southport.jpl.nasa.gov/pio/srl2/sirc/srl2-wadik.html>
 Image was created by the author based on imagery ordered from NASA JPL. This imagery is public domain as per NASA release. See website for more details. Website accessed Feb 3, 2013.
- **LiDAR example**
 Created by the author using public domain LiDAR data collected in 2004. Nathan Jennings is the primary contact for this image and it is public domain as part of the Creative Commons CC BY 3.0 license: <http://creativecommons.org/licenses/by/3.0/>.
- **Lidar Operation**



<http://lidar.cr.usgs.gov/earl/>

Accessed Feb 18, 2013

- **LiDAR examples**

Images derived from raw LiDAR data by the author, Nathan Jennings. These screenshots are provided as part of the Creative Commons CC BY 3.0 license:

<http://creativecommons.org/licenses/by/3.0/>.

- **AVIRIS Hypercube Example of Moffett Field**

<http://www.ltid.inpe.br/html/pub/docs/html/imcube.htm>

Accessed Feb 3, 2013

- **Hyperion sample image**

http://eo1.gsfc.nasa.gov/new/general/imagery/Imagery/Aspen_Fire-Hyp-fullHyperAspen.jpg

Accessed on Feb 3, 2013.

- **Spectral Curve**

Viewing1.jpg

<http://erdas.wordpress.com/2007/12/30/2-viewing-and-investigating-features/#more-6>

Accessed on Feb 3, 2013

All other images are created by the author, Nathan Jennings. Satellite imagery is from public domain sources. CalAtlas, Landsat 7 Image, July 28, 2001.

<http://atlas.ca.gov/imagerySearch.html>

- Screen shots of ArcGIS interface for Image Analysis Window, ArcToolbox Raster Calculator, ModelBuilder, and Python scripting IDLE interface. All of the images are available under the Creative Commons CC BY 3.0 license: <http://creativecommons.org/licenses/by/3.0/>.

- **Polar and geosynchronous orbits** (two different images)

<http://spaceplace.nasa.gov/geo-orbits/>

Accessed Feb 24, 2013

- Lesson 3 – Section, Using Software to Process Remotely Sensed Imagery, All images are created by the author, Nathan Jennings. Satellite imagery is from public domain sources. CalAtlas, Landsat 7 Image, July 28, 2001. <http://atlas.ca.gov/imagerySearch.html>

Screen shots of ArcGIS interface for Image Analysis Window. All of the images are available under the Creative Commons 3.0 license.

- Lesson 3 – Section, Band Ratios and Transformations, All images are created by the author, Nathan Jennings. Satellite imagery is from public domain sources. CalAtlas, Landsat 7 Image, July 28, 2001.

<http://atlas.ca.gov/imagerySearch.html>



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- **LiDAR Operation**, <http://lidar.cr.usgs.gov/eaarl/>, Accessed Feb 18, 2013
- **LiDAR Examples**
Additional LiDAR elevation and surface examples provided by the author, Nathan Jennings. These images are provided with the Creative Commons 3.0 license: <http://creativecommons.org/licenses/by/3.0/>.
- **Contours Overlaid on Aerial Imagery**
Screenshot of contours overlaying aerial imagery created by the author, Nathan Jennings. These images are provided with the Creative Commons 3.0 license: <http://creativecommons.org/licenses/by/3.0/>

Accuracy Assessment

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