

Converging Technologies to Understand the World Around Us

Remote Sensing and GIS By Dr. Clive Farquhar

Geospatial information is used by government agencies and commercial companies worldwide to gain insight about the Earth's surface and the natural and manmade phenomena that affect it. Remote sensing and Geographic Information Systems (GIS) are two closely aligned disciplines that involve collecting and analyzing useful geospatial information for the purpose of decision making in a wide variety of applications across industries. The primary difference between these techniques is their relative position on the imagery chain; remote sensing involves image acquisition, processing and analysis, while GIS examines relationships within the information. Fundamentally, remote sensing can be viewed as a key method for creating new geospatial information for input into a GIS for further, more relationship-focused analysis.

How useful a GIS becomes is highly dependent on its input geospatial layers. Traditionally, such data was derived from manual approaches such as field surveying, which can be costly and time consuming.

Today, as remotely sensed data such as satellite and airborne imagery becomes more readily available, it is also increasingly becoming a key complementary tool for GIS. As a cost effective alternative to manual processes, the use of remote sensing provides the unique capability for GIS professionals to update existing vector layers with current, accurate information derived from imagery.

Remote Sensing Data as an Input to a GIS

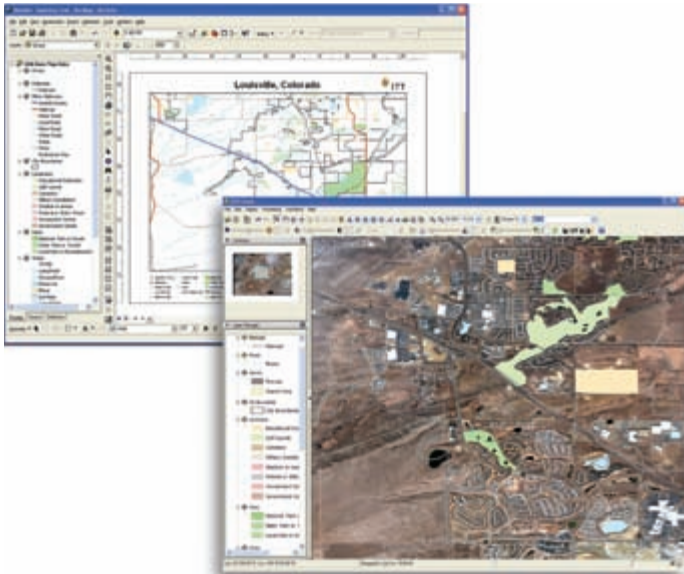
Historically, remotely sensed imagery has been used by GIS professionals as a backdrop either to give visual context to their GIS layers or as a source of data for manual digitization. Using imagery to derive additional information beyond what can be seen by the human eye was considered a task for image scientists with extensive knowledge of image processing techniques. However, recent advances – both in sensor technology and image processing and analysis software – have improved the suitability and value of using remotely sensed



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imagery as a source of data for GIS.

Advances in sensor technology have made it possible to obtain imagery with a spatial resolution below 50cm, enabling users to map individual buildings, vehicles and even road markings. Concurrent software advances have focused on removing the complexity of image processing and analysis techniques by creating user-friendly workflows that maintain scientific accuracy of the results, but are automated in their approach, saving the user time and effort. Software solutions, such as ENVI image processing and analysis software from ITT, contain a series of easy-to-use workflows built specifically for the types of analyses that are important to GIS applications, such as detecting



The integration between ENVI and ArcGIS allows data to be shared seamlessly between the two applications. In this image, layers displayed in ArcGIS have been dragged and dropped into ENVI, maintaining the same styling and symbology. Similarly, imagery analyzed in ENVI can be opened in ArcGIS for map creation or additional analysis.



You can now access ENVI image processing and analysis tools directly from ArcGIS.

change between images taken at different times and classifying land cover. For example, the feature extraction workflow in ENVI combines multiple image processing and analysis techniques in a wizard-like process, automatically digitizing features within an image by creating a land cover vector layer that can be directly ingested into an existing GIS.

The complete global coverage offered by many satellite sensors enables GIS professionals to use imagery to fill any gaps in geospatial layers due to particular regions' inaccessibility. In addition, a sensor's ability to record outside the visible spectra permits the gathering of unique geospatial information. For example, RADAR imagery can be used to map variations in soil moisture content at a scale that would be almost impossible to achieve using conventional methods. Finally, remote sensing is highly suited to collect elevation data, which can be used in a variety of industries such as environmental engineering, transportation planning and insurance studies.

Modern sensors' ability to revisit an area quickly also makes them ideal for regular updating of existing GIS layers with current information. The benefit of this is clearly evident in time-critical events such as natural or man-made crises. For example, GeoEye-1 imagery of the Haiti Earthquake was acquired less than 24 hours after the event and released free of charge to various agencies to aid in relief operations.

Future Convergence of Remote Sensing and GIS Technologies

Future advances in remote sensing technologies will continue to increase the ease of using imagery and adding its crucial information to a GIS as well as the quantity and quality of geospatial information derived from imagery. It has been forecast that in the next decade over 250 Earth observation satellites will be launched. Technological advances in these satellite platforms include improved spatial resolution with GeoEye-2, which has a planned launch of 2012 and is forecast to have a 25cm resolution, and improved quality image products such as the recently launched TanDEM-X, which will provide a global Digital Elevation Model (DEM) at unprecedented levels of accuracy.

Of potentially greater significance are future advances in image processing and analysis techniques and their integration with GIS software. Streamlined image processing techniques in the form of automated workflows allow the creation of valuable image products such as land-use maps, in a time saving, repeatable and standardized fashion. These workflows remove the steep learning curve that has previously been a barrier to many GIS professionals using imagery and image analysis tools to their full potential.

Integration of remote sensing and GIS technologies is already taking place by companies like ITT and Esri®, the developers of ArcGIS®, in a multi-year effort to effectively integrate image processing and analysis tools with the GIS platform. The ENVI line of software allows GIS professionals to access image analysis functionality directly from the toolbox in Esri's ArcGIS desktop and server environments. This tight integration of image processing and analysis tools with GIS tools has reduced the distinction between the technologies and has resulted in increased usage and applications of remotely sensed imagery.

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