

AUTOMATED ANALYSIS OF ULTRA HIGH RESOLUTION REMOTE SENSING DATA: GIS TO THE RESCUE?

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EXTENDED ABSTRACT

Geographic Information Systems (GIS) are more and more seen as an integral part of the modern information and communication society. Improved methods for data access and integration have accelerated this process. Scientific advances have also paved the way for GIS as a catalyst for a new evolving discipline *Geoinformatics* thus changing the role of GIS from a tool to a scientific discipline.

One of the problems in applying GI (often now also referred to as geospatial) technology has been the currency, accuracy, accessibility and completeness of geodata. Although we have seen a shift from analogue to digital geospatial information storage in almost all industrialized nations, much of the available information is still based on old and sometimes outdated maps.

Remotely sensed image data, on the other hand, can be used to generate current, accurate and synoptic information about all parts of the earth as a basis for geoscientific analyses in GIS. Consequently, almost all major GIS software packages offer now at least the possibility to display and query digital images as part of their GIS database. With the advent of the new (civilian) satellites with a resolution of better than 1m and airborne scanner sensors with a high geometric fidelity and spatial resolutions in the cm range we see another push for the integration of remotely sensed images into GIS.

With these ultra high resolution sensors, however, the user community faces a new problem in the analysis of this type of image data. Standard classification techniques have to be augmented for an appropriate analysis because the necessary homogeneity of landuse/landcover classes can no longer be achieved by the integration effect of large pixel sizes (e.g. 20 – 80 m). New intelligent techniques will have to be developed that use multisensor approaches, GIS integration and context based interpretation schemes.

This paper presents the development of an automated procedure for mapping biotop changes near the river Elbe that are caused by the fairway expansion of the river. We used ultra-high resolution multispectral scanner data from the *High Resolution Stereo Camera - Airborne* (HRSC-A) of the German Space Research Center (DLR). The following HRSC-A datasets were provided for three selected study areas along the river:

- panchromatic imagery (585-765 nm, 8bit),
multispectral imagery (blue / green / near infrared / infrared, 8bit),
digital surface model (DSM, 16bit).

The data were delivered with 15 cm ground pixel resolution. Accuracies were given as ± 20 cm in x,y-direction and ± 30 cm in z-direction. For true color visualization a synthetic red band was derived using arithmetic

operations involving the near infrared and panchromatic bands. In a further step this artificial red band was used for vegetation masking.

The Geoinformatics Center developed a procedure for a context based hierarchical image analysis and classification scheme which incorporates a priori (GIS) information, digital surface model (DSM) and multispectral image data. This image analysis process operates with advanced masking techniques, dividing the images into several semantically meaningful layers (non-vegetation / tree-vegetation / herbaceous vegetation) by using indices and threshold values derived from the original image data. Especially, the use of the DSM plays a decisive role for distinguishing vegetation types in the flat regions along the shore.

The resulting layers can each be treated with the appropriate classification algorithms. The further classification of the non-vegetation can easily be performed by isodata clustering whereas for classification of herbaceous vegetation the inclusion of textural features proved to be necessary. The individual layer classifications are combined in a hierarchical process considering a predefined priority order to obtain the final result. A flowchart based modeler tool was used to formalize and automate this hierarchical analysis process.

Using this method for example, biotope types of a small river island could be distinguished into five types of non-vegetation, twelve types of herbaceous vegetation and four to five types of tree-vegetation. Comparisons of the actual results with older maps of the same area that were produced in a conventional manner show the tremendous advantages of the new method such as richness of details and geometric accuracy. The hierarchical technique facilitates the documentation of dynamic processes in long term environmental monitoring projects can be estimated as very advantageous. The original image as well as the classification result can easily be integrated in a GIS environment. Time series at pixel level of the original imagery or the classification result can easily be performed.

This process required the analysis to be performed in an integrated GIS/remote sensing environment. However, the current processing status can still be described primarily as data exchange between a GIS and an image analysis system. An Integration of functionality, especially for user specific high-level commands is lacking far behind. Consequently, we will address a concept for remote sensing as an integral part of a modern GIS. Object and analysis models that are typically associated with GIS technology can be used to automate the extraction of geospatial information from remote sensing data. This information will in return be used to update the GIS. First steps for the design of a truly integrated geoprocessing system will be presented and discussed.