THOMAS BLASCHKE

The Significance of Objects

A sub-discipline of geoinformation science is devoted to partitioning remote-sensing imagery into meaningful image-objects and assessing their characteristics through spatial, spectral and temporal scale. One expert at the forefront of developments in this field is Professor Thomas Blaschke of the Department of Geography and Geology and the Centre for Geoinformatics at the University of Salzburg in Austria.

What does your work entail?
I have been involved in the development of analysis strategies for nature conservation areas, and my PhD included a nature conservation evaluation procedure for riparian forests in the subalpine fluvial regime and temperate climatic zone. But I have taken on more and more responsibilities in all kinds of GIS and remote-sensing related activities. Today I am more of a research manager. I'm a full professor of Geoinformatics at the University of Salzburg; co-director of the Centre for Geoinformatics, a centre of excellence built with external funds which employs some 38 staff members; and head of the research studio iSPACE, which is best described as a ‘pipeline between universities and the market'.

What are the highlights of your career thus far?
I am proud of several scientific awards I have received. In addition, my PhD-related work on habitat modelling and integration of ecological gradient models was implemented as cartographic models in a GIS to create fine-scale digital biodiversity maps. I was also very pleased to receive a Marie Curie post-doctoral fellowship from the European Commission in 1998, and a Fulbright Professorship in California in 2006.

How do you define object-based image analysis?
OBIA mimics a very human part of any recognition process: it spatially groups and subsequently analyses and classifies areas in imagery or any raster data. This gives the resulting objects more internal similarity with regard to a chosen attribute as compared to the outside of the resulting object. Obviously, this works well if the spatial resolution of the data is finer than the objects of interest. That's when a grouping of pixels or raster cells is advantageous; however, we still need sub-pixel analysis methods to achieve the desired information from data of coarser resolution.
This is a very broad explanation, and describes the use of the methodology as a research and management tool to examine spatiotemporal processes such as land-use conversion, natural disturbances, resource management, and the extraction of buildings or landforms from a DEM. Increasingly, we are questioning the limitations of the word ‘image' in OBIA, as more applications emerge which can use any kind of raster data or point-clouds, including original Lidar point data.
As a result, ‘image' may be too narrow a term going forward.

What are the practical applications of OBIA?
The fascinating aspect is that the applications are so broad. They span everything from land-use and land-cover classifications, automatic counting of refugee tents, automated workflows, map damage from earthquake, flood or landslide; also automatic detection of cars, people and infrastructure. We are also seeing OBIA concepts used in medical imaging and industrial imaging, in the material sciences, for example. My colleagues at the GIScience Institute of the Austrian Academy of Sciences in Salzburg have, for instance, applied OBIA principles to the patterns of lesions in multiple sclerosis taken from MRI images, and worked on 4D-concepts exploiting 3D-objects in time series.

These are just a few examples of how widely applicable the general principle is: to group what is similar, regardless of scale, from the nano world to cosmology. Dirk Tiede, a colleague of mine, and an ex-PhD student, helped a group studying nano-particle behaviour in environmental samples using hydrodynamic chromatography. Focusing on the ‘geo' world, Geoffrey Hay from the University of Calgary, a sharp thinker and important author in this field, suggests the term ‘GEO-object-based image analysis' or GEOBIA. Scientific literature and discussion on this subject may be found on 1.

How is OBIA advancing knowledge in the geospatial sector?
In the geo-domain it is only through the advent of high-resolution digital imagery - airborne digital cameras and the ‘1-m generation' of earth-observation satellites - that OBIA has been able to develop so successfully. Together with many other methodologies, it may help us to have a better grasp of objects. I strongly believe that the notion of objects is more natural to humans than that of pixels.

What benefits does it offer compared to other technologies in the field?
I mentioned the ability to derive image objects at several scales simultaneously, which are then analysed in context; the resulting parameters can be mapped, quantified and classified. This is increasingly combined with other techniques, from the GIS domain as well as from image analysis. A particular trend is the use of decision trees and statistical methods for defining appropriate scales and finding the most relevant parameters. It's important to stress that
the data itself must be accurate. Detail is often necessary, but in very high-resolution imagery we may also need to generalise and

iteratively change the level of consideration. Herein lies the strength of OBIA: in the multi-scale approach and all the inheritance of rules between ‘super objects' such as forest stands, buildings or orchards, and ‘sub-objects' such as single trees, chimneys, rooftops or pavements.

What particular impact does it have on the monitoring of climate change and extreme weather conditions?
There are two important aspects. In monitoring climate change OBIA is already being used to integrate GIS remote-sensing applications. Similarly, it is used extensively to analyse the impact of flood, forest fire, tsunami and other natural disasters. In trying to understand 4D processes in the atmosphere with reference to extreme weather situations, as with the March 2010 volcanic ash event, most approaches are in their infancy and not yet able to fully deliver the information required.

The development of OBIA software is a booming business; to what do you attribute this?
The idea of incorporating contextual information in the classification of remote-sensing images can be traced back to the 1970s, although appreciation of the importance of incorporating texture has grown along with improving resolution. The first period of OBIA at the start of this decade coincided with the mass availability of high-resolution imagery. This period was characterised by the commercial success of new software and an increase in the number of scientific publications. The majority of these papers were, however, proprietary in nature, and they were neither immediately transparent nor open to scrutiny through the peer-reviewed system of academic literature. Today the level of sophistication is higher, and academic research into algorithms, methods and methodologies is acknowledged by the industry.

The first OBIA software packages introduced some new ways to handle information in a market which has been dominated by the ‘per pixel' concept. From the start of Landsat 1 in 1976, geoinformation has been bound to extract as much information as possible from a pixel: an approach which will not work well in a high-resolution image with a hundred million pixels. Thus far, the bottleneck in large-volume, high-throughput geospatial imagery environments, such as industrial image processing under standardised conditions, was a sound methodology in the world of conditioned information: that's how my colleague Stefan Lang defines context-dependent recognition and classification of objects and scenes.

What impact is this likely to have on the geomatics sector?
It won't have too much of an impact on geomatics in its entirety; at least, not when expressed in financial figures and market share. In the future, ‘information on demand', ‘context-aware applications' and ‘geo-intelligence' may play an important role in bridging GIS concepts and the GIS industry and the imaging industry, which it already does anyway.

The most significant future potential arises from the terabytes of data acquired daily from space- and airborne platforms, resulting in massive archives with huge information potential. Recently we have begun to mine the spatial wealth of these archives. In essence, we are data rich and we need to turn this wealth of data into tangible geospatial information. Data/image access was and remains constrained by technological, national and security barriers.OBIA is one tool for analysing, visualising, comparing and sharing these data and their extracted information within complex workflows and spatial data infrastructures. Furthermore, policy, legal and remuneration issues relating to who owns value-added products resulting from the original data sources, or from products that represent the culmination of input from many different users (i.e. citizen sensors) need to be better understood. In summary, I see opportunities for improved geospatial information generation and exploitation on demand.

How do you think object-based image analysis will affect the use of images and Lidar data?
OBIA has already influenced the remote-sensing community. Several international journals have devoted special issues to this topic, and a number of books have been written about it. This does not imply that OBIA is the best solution for every application. I mentioned the issue of relative resolution between objects of interest and the spatial footprint of the data. There are also already many impressive examples for deriving objects from Lidar point-clouds, but specialised software in this field plays a more important role at the moment.

Is there an OBIA community emerging and, if so, where?
OBIA has strong roots in Germany and Austria. In a recent overview article I studied some 1,600 publications and came to the conclusion that OBIA evolved in Europe and North America almost simultaneously. This is also reflected in the location of dedicated scientific conferences. The organising committee will have a tough time deciding on the GEOBIA 2012 conference, since Brazil and Australia are both eager to organise this growing event, and both are attractive destinations.

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