This article is published in ‘Questions of Cybersecurity, Modeling and Information. Processing in the Modern Socio-Technical Systems’. Proceedings of the Int’l Sci. and Technol. Conf. Kursk State University (KSU), May 26–27, 2015. Ed. by V. M. Dovgal, Y. N. Bykov, and L. S. Kryzhevich. Kursk, Russia: KSU Press, pp. 109–111.

УДК 550.8

P.Lemenkova,
pauline.lemenkova@gmail.com
Univerzita Karlova v Praze, Přírodovědecká fakulta

GEO-INFORMATION TECHNOLOGIES OF OBJECT BASED IMAGE ANALYSIS (OBIA) FOR URBAN MAPPING

Current work is aimed at the deriving of information from the remote sensed VHR data using a priori knowledge in the Object Based Image Analysis (OBIA) approach. OBIA technology is new and effective tool for urban mapping, as it enables dealing with raster images for detailed and precise cartography. Specific focus of this study is selected urban areas of the city of Brussels, Belgium. The study is performed using panchromatic very high resolution (VHR) image processed in the eCognition software.

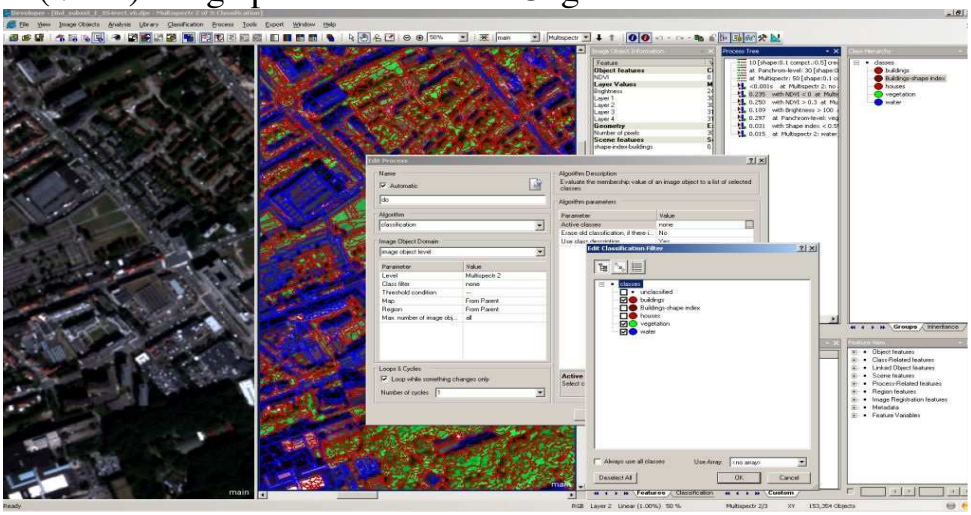

Fig.1. Image classification and objects recognition in eCognition software

Application of the a priori knowledge in the OBIA approach towards classification of the satellite imagery for solving problem of the land cover studies is the target aim of this research. Some attempts of utilizing knowledge in the classifying map objects are performed [1] describing techniques of the labelling objects in urban environment. The authors developed an open source framework to study urban evolutions using vector based topographic databases as a part of the open GeOpenSim project. Using visualization of the geospatial objects from the database and expert knowledge labelling of the objects and generated the data set has been performed. It included continuous and discontinuous urban fabric, individual houses, high and low density mixed housing surface, hydrographical and communication network (canals, rivers), as well as specific urban surface (industrial wasteland and buildings), etc.

Among earlier works, a review of the existing knowledge based approaches and examples in geospatial modelling is presented [2], where current development of this research branch is demonstrated. As it is noticed, the

external knowledge that can be used for image interpretation may exist in a the form of models of the imaging process knowledge and models of the types of structure that can be on the image, as well as in view of other data sets, e.g., previous interpretations or map data by the user, and the user's own expertise and experience. Example of application of knowledge based expert image processing is given [3], where meaningful area-wide spatial information for city planning and management from IKONOS imagery is derived. The authors applied expert knowledge for image classification and mapping homogeneous zones of urban environment for detection of spatial distribution of the built-up densities within the city. The classification based on shape and neighbourhood enabled image to be segmented by object extraction using region-growing rule.

The methodology of current work considered existing works and includes processing and classification of the remote sensing data (satellite very high

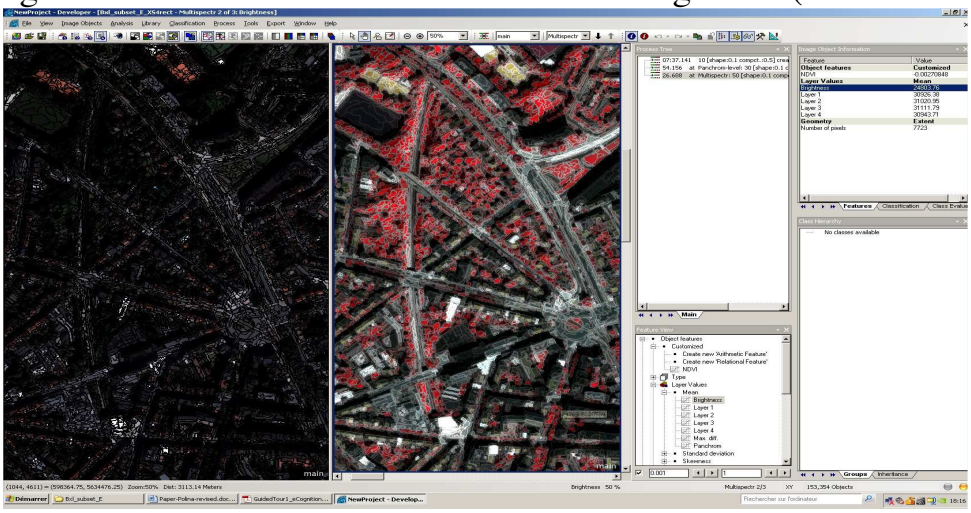

Fig.2. Fragment of classification: objects classified as 'vegetation' class (red coloured). Initial image: left.

resolution images) using eCognition software. The operation "Multi-resolution Segmentation" was chosen for image processing, as this is one of the most important image processing tools. During segmentation the image was divided up into large homogeneous regions and isolated shapes into the separate polygons within the study area. This procedure was performed at a different scale factors to adjust local conditions, such as urban structures, contrast factors, topology, etc. The four first layers in the layers legend represent multispectral image, while the fifth layer belongs to the panchromatic image. These two images were processed, in order to benefit from the high spatial and spectral resolution of the images which have different properties. Besides, processing of both of them gave various results: the panchromatic VHR image enabled to achieve very detailed segmentation of the image. However, for the current research aim (mapping urban environment and detecting separate buildings), the level of such scale was too detailed. The nearest neighbour classifies subdivide image into objects based on the image sample using mean spectral signature values of the objects [4].

The results are presented by accurate geographic classification of the raster image. The objects are grouped into the separated classes connected with each other according to the hierarchical values of their features. The target objects are detected using existing knowledge which helped to find out what information exists in the objects based on training test areas (TTA). The classification is done using nearest neighbour principle after the manual defining of the number of sample objects [4]. Alike to the standard pixel-based classification, all spectral bands are also used as input channels in OBIA approach, so that the difference consists not in the data but rather in their methodological processing [5]: while pixel-based classification is based on the classification of each pixel separately, the object-based classification treats together all pixels that belong to one object, which is embedded in eCognition. The method of the multiresolution segmentation procedure using OBIA approach was applied to the image in eCognition software and the image was processed (Fig.2). The classification is based on the segmentation of the whole image into meaningful polygons, according to the fuzzy logic approach and nearest neighbour classifier which is similar to the supervised classification in usual image analysis software. The work proved effectiveness of the object based image analysis approach for satellite data processing in urban mapping.

Acknowledgment
The financial support of this research has been provided by the Wallonie-Bruxelles-International (WBI) Scholarship Committee of Belgium.

LITERATURE

[1] Lesbegueries J., Lachiche N., Braud A., Skupinski G., Puissant A., Perret J. 2012. A Platform for Spatial Data Labeling in an Urban Context. Chapter 4 In: E. Bocher and M. Neteler (eds.), Geospatial Free & Open Source Software in the 21st Century, Lecture Notes in Geoinformation and Cartography, DOI 10.1007/978-3-642-10595-1_4, Springer-Verlag Berlin Heidelberg.
[2] Tailor A., Cross A., Hogg D.C., Mason D.C. 1986. Knowledge-based interpretation of remotely sensed images. Image and Vision Computing, 4 (2).
Taubenböck H., Esch T., Roth A. 2006. An urban classification approach based on an object-oriented analysis of high resolution satellite imagery for a spatial structuring within urban areas. 1st EARSeL Workshop of the SIG Urban Remote Sensing Humboldt-Universität zu Berlin, 2-3 March 2006.
[3] Baatz M., Benz U., Dehghani S., Heynen M., Holtje A., Hoffman P., Lingenfelder I., Mimler M., Sohlbach M., Weber M., Willhauck G. 2005. eCognition User Guide. Definiers Imaging GmbH. Munich, Germany.
[4] Walter V. 2004. Object-based classification of remote sensing data for change detection. ISPRS Journal of Photogrammetry & Remote Sensing 58, 225– 238.