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Visual Orthophoto Classification Application

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Abstract. Data acquisition using remote sensing has opened up new possibilities of their analysis and application. For the ecological stability calculations, it is needed to divide the observed area into subsections based on the land character. The selection may be done by various kinds of processing. For example, it may be done manually, but to increase the post-processing effectivity, it is necessary to find faster, automatic ways of the post-processing. Many software environments are able to solve this problematic by using spectral analyses and appropriate tools.

1. Introduction

In order to ensure the correct results of orthophoto analysis, by using the parametric methods, it is necessary to fulfil the pre-set conditions. The basic conditions present the normal Gaussian class distribution. The satellite images, such as orthophotos, are defined by the pixels with normal distributions. Various classification algorithms, such as maximum likelihood classifier, minimum distance K-means clustering classification methods, may post-process the files with normal distribution pixel definition. The selection of the correct parametric post-processing method is directly influenced by the properties of examined area and entities captured on orthophotos [1]. The choice of the post-processing method depends on the size, shape, parameters, properties and the precision of the basic dataset [2]. It is proved that parametric approaches are supposed to be much more useful and also they are easier to be implemented when talking about the non-complex terrains characterised by distinctly defined LULC (Land Used and Land Cover) categories. Functional visual orthophoto classification has many applications in engineering geology, forestry, agricultural sector, soil sciences and ecology, [3].

2. Manipulating raster data functions

The measured data may have qualitative (specific) or quantitative character. Due to the measured data character, the raster data may also be divided into these two groups. Quantitative raster dataset presents the amount of observed parameter in each and every raster cell (cells may obtain real-number values) and the variability of these values may obtain various ranges from interval domain. Qualitative raster dataset expresses the quality of the features (the cell values mostly obtain integer values) and in qualitative raster dataset cases, the variability of values is slight. This type of raster files may be divided into thematically data raster and image records (remote sensing, orthophotos, scanned analogue maps etc.). Qualitative raster files are used in GIS at the most as topographical bases or as a source of future data analysis. For these reasons, the editing and analytic functions must be considered, what is about to



be post-processed and how these functions may be performed. Some functions are suitable for every raster data types, some are suitable only for qualitative and some only for quantitative files [4, 5].

2.1. Colours and colour models

The colours represent the basic attribute raster data values. The vector data models also use the colours, but mostly they are used in the raster models. The visible light is the electromagnetic radiation, whose wavelength ranges from 380 nm – 780 nm. The sunlight represents the white colour consisting of all spectral colours. When the light interacts with the object, the colours arise. Some colour spectrum components are absorbed by the object surface and some are reflected from it. The mentioned reflected components create the colour of all the objects. Human eye is capable of differentiating up to 4×10^5 various colours. To catch and save the specific colour, colour models are employed. These models define the components of basic colour to make every colour complete, from which the colour is created (ratio of the basic colours). This idiom defines two basic colour models. *Additive models* are specific by counting of the basic colours, when every colour addition creates the light with higher intensity. The most intensive colour is white colour (count of three basic colours). They are used mostly in screens (monitors, televisions, etc.). However, the objects with additive environment radiate colour light, the outer lighting is not needed. The most famous additive model is RGB model, using the definition between red, green and blue colour ratio.

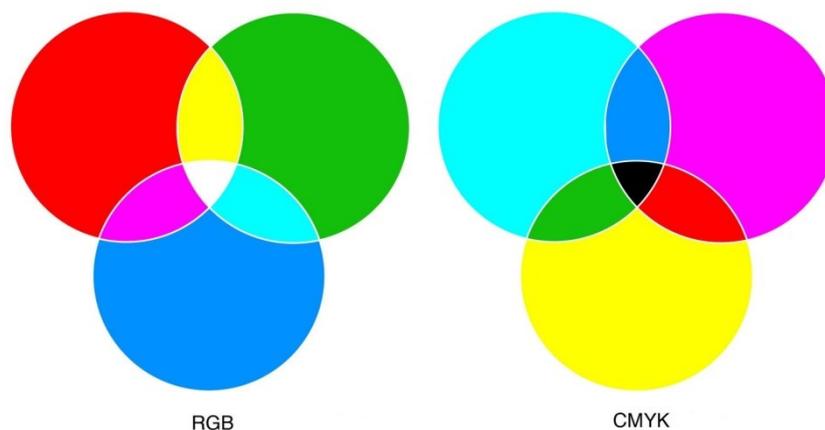


Figure 1. Principle of additive and subtractive models

Subtractive models are based on the colour subtraction. By mixing of three basic colours, the black colour origins (every colour subtraction creates darker colour). The basic model is CMY model (C-cyan, M-magenta, Y-yellow). The modification of CMY model is called CMYK (K-black colour) that is used during printing.

In order to preserve the saturation and brightness during the shade change, other models were created (HSV, HLS, CIE), which are closer to human understanding. From the point of displaying single colours on different output devices, the so called Gamut device is important. Gamut means reachable colour area of colour model in the visible colour environment. Gamut using devices describe the possibilities of these devices to display some colour (the part of colour model, which may be reproduced on device).



Figure 2. Gamut device [4]

3. Image edit

In case of raster images, it is necessary to realise that the most information are included in raw unprocessed images. Each and every image operation (pre-processing) decreases the value and image information quality. Raster image pre-processing is performed due to registering device imperfections and due to genesis of systematic and accidental error. The pre-processing goal is to edit the image look to facilitate its visual interpretation. The pre-processing raster image base means the correctness of its interpretation, parameters and figures. The interpretation signs are divided into real ones (shape, colour, size), unreal (tone, brightness) and indirect (position, neighbourhood). In the case of unreal raster image signs, three basic parameters are known. *Brightness* is defined as lightning energy received from the captured environment. The brightness dimension depends on lightning source, position of lightning source in relation to captured area and on the surface and displayed object reflectivity. In RGB colour model, it means the arithmetic mean of red, green and blue element. *Contrast* is characteristic property that defines the distance between two brightness levels of two neighbouring image point areas with the same brightness. *Colour saturation* is defined as lightning intensity combination and its distribution into various wavelength spectrums. During the intensity decrease, the colour saturation also decreases.

Other basic terms related to image processing include sampling and histograms. Within *the sampling*, the values (samples in regular grid) are obtained. The displayed area is divided into M-columns and N-rows. The column and row intersection creates the image point (the place of sample obtaining). The definition of interval is important due to sampling and sample grid regularity. The sampling interval must be selected more slight as the half of the smallest detail displayed in area. *Histogram* presents the brightness level in the image distribution. It means the amount of the pixels in the brightness level. In the case of Digital terrain model, the histogram is closer to hypsometry curve that is characterised by relation between the elevation and displayed locality areas. In normalized histogram shape, the single segments are divided by the total image pixel amount. In some cases, the processed image does not have a regular distribution of brightness segments and the image is non-contrasting and with bad resolution

of single details (histogram is precipitous and does not cover the whole brightness area). In some cases, it is better to use the histogram equalization method [5]. The histogram equalization means the transformation of brightness level into regular brightness distribution in the whole histogram area. Equalization may be processed separately for each colour channel. It is used mainly to highlight the details in highly-lightened images or images that are too dark (the contrast increases in the histogram maximum and decreases in histogram minimum). The histogram equalization is a process that uses final transformation globally for the whole image, whereas the retroactive equalization may return the image into its initial status. To increase the brightness value distribution only in local areas, the local upgrade technique is used. The technique is based on the piecemeal equalization of the image area window [6, 7].

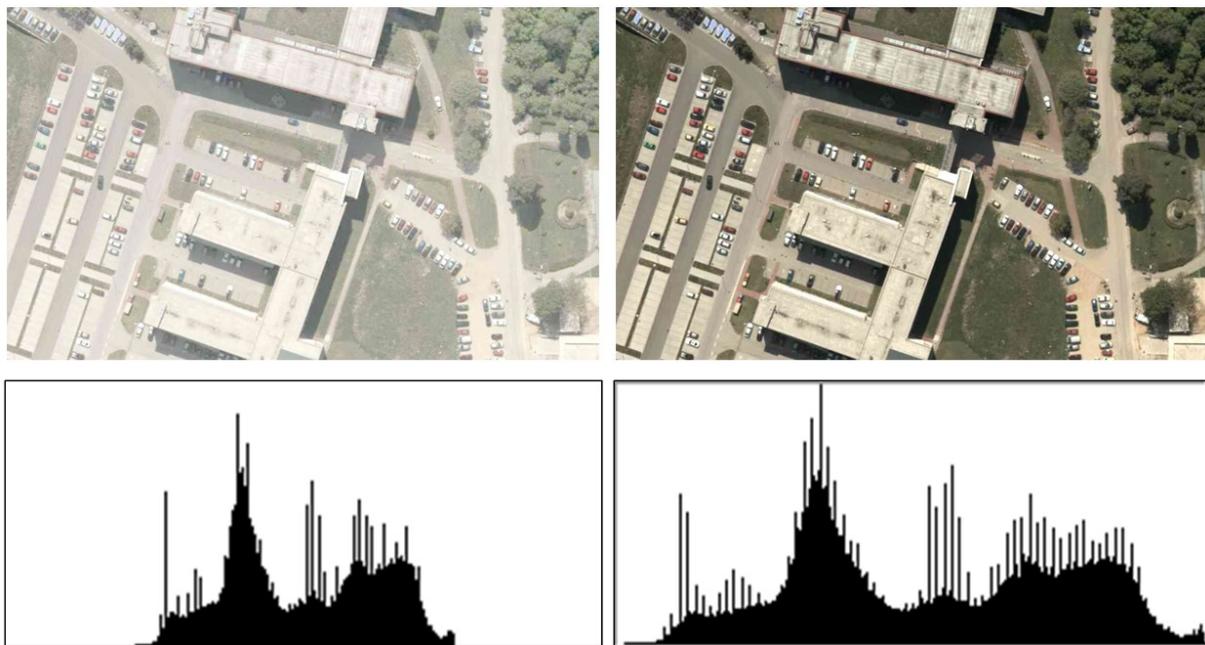


Figure 3. The raster image brightness edit by using the histogram equalization [4]

4. Conclusions

The technical improvement in the field of image processing increases the possibilities of image application (such as orthophotos, orthophotoimages, orthophotomosaic, etc.) for next analysis. For better processing, it is necessary to focus on the images precision (pixel resolution, size and other parameters such as colour brightness, saturation etc.). To increase the possibility, the post-processing methods have to be as precise as possible and have to reach the best possible results. For these purposes, methods of histogram equalization and sampling presented in the paper are used. The quality and correct presentation also depends on the used colour model such as RGB or CMYK.

References

- [1] Ch. Anusheema, S. Kamna, and K.J. Pawan. A Reflection on Image Classifications for Forest Ecology Management: Towards Landscape Mapping and Monitoring, Handbook of Neural Computation, Academic Press, 2017, ISBN 9780128113189.
- [2] E. Ivits, and B. Koch. Landscape connectivity studies based on segmentation based classification and manual interpretation of remote sensing data. eCognition User Meeting, October 2002, München, 2003.
- [3] J. Chromčák, D. Bačová, P. Pecho, and A. Seidlová. The possibilities of orthophotos application for calculation of ecological stability coefficient purposes, Sustainability (Switzerland), 13(6),

- 3017, 2021.
- [4] V. Koťka, M. Koreň, J. Izvoltová. Geoinformatics for Engineers I., EDIS Žilina, 2015, ISBN 978-80-554-1145-3 (in Slovak).
 - [5] N. Jiang, Z. Ji, J. Wang, X. Lu, and R. Zhou. Quantum Image Histogram Statistics. *International Journal of Theoretical Physics*. 59. 3533-3548, 2020. 10.1007/s10773-020-04614-x.
 - [6] B. Furht, E. Akar, and W. Andrews. *Creating Image Histograms*, 2018. 10.1007/978-3-319-96634-2_4.
 - [7] P. Mudjirahardjo. *Image Histogram Processing with C++*, 2015. 10.13140/RG.2.1.3155.0166.