

A multipurpose patch creation tool for efficient exploration of digital cartographic products

Anastasios L. Kesidis ^{a,*}, Vassilios Krassanakis ^a, Nikolaos Merlemis ^a, Loukas-Moysis Misthos ^a

^a Department of Surveying and Geoinformatics Engineering, University of West Attica, Athens, Greece, Anastasios L. Kesidis – akesidis@uniwa.gr, Vassilios Krassanakis – krasvas@uniwa.gr, Nikolaos Merlemis – merlemis@uniwa.gr, Loukas-Moysis Misthos – lmisthos@uniwa.gr

* Corresponding author

Keywords: patch creation tool, multi-scale dataset, digital cartographic products exploration

Abstract:

An image patch is a part of a digital image that is characterized by its shape, dimensions and orientation and is expressed in image coordinate system (pixels). Patch creation constitutes a vital pre-processing step in several image processing or analysis tasks (Karimi & Ward, 2016), including applications related to geosciences (Liu et al., 2020). In cartographic research, patch construction process is incorporated in various operations related to the exploration of digital cartographic products, including scanned maps generated by analog products, e.g., historical maps. Potential cartographic applications involve any operation related to color and textual analysis and/or modelling, such as color quality assessment, visual complexity quantification, image saliency identification and many others.

In this work, a patch creation software tool that allows the systematic extraction of patches from images based on various criteria and conditions is presented. Since a patch is characterized by several properties related to its position on the image, as well as to its content, the proposed tool provides an extended set of functions enabling the extraction of a set of patches from one or more images that fulfil conditions summarized in the following main categories: (i) Geometrical criteria, like shape, size and orientation etc., specifying the appearance of the created patches. (ii) Spatial criteria: these criteria refer to the methodology followed in the creation of the patches, e.g. if their position is selected randomly or sequentially in a sliding window manner. Overlapping criteria that define the maximum allowed (or minimum required) percentage of overlapping between patches can also be included. Moreover, the user may apply spatial distribution criteria that define the manner in which the image is covered by the extracted patches. For instance, uniform coverage may be required for a user-defined number of patches. On the other hand, user-defined areas that should be considered (or ignored) during the patch creation process can be also interactively defined. (iii) Content-based criteria: Patches created according to the abovementioned criteria may be further filtered out by rules and conditions that refer to the visual content of the image under each patch. For this purpose, statistical and/or feature-based or even user-defined functions can be applied to the extracted patches, providing a higher level of patch characterization allowing further filtering or sorting of the patches according to these function's output. For instance, the patches may be sorted according to their homogeneity and only the top-N (a user-defined parameter) patches are finally selected.

In order to highlight the functionality of the proposed tool, a new multi-scale cartographic dataset is also introduced and utilized. Multi-scale maps involve information (content) at several zoom levels, providing improved usability experience and having recently attracted significant attention in the cartographic research (Dumont et al., 2020). The dataset has been produced based on the utilization of the color Web Map Service (WMS) of OpenStreetMap as it is provided by terrestris GmbH & Co. KG and includes different rectangle regions of Greece in the Greek Geodetic Reference System (GGRS) 1987 (EPSG:2100), at sixteen different zoom levels that range from 500m×500m up to 60km×60km. The resolution of images at all zoom levels is 2000px×2000px. Towards achieving high color heterogeneity among images in the dataset, the selected regions involve all the municipalities across Greece. The proposed overall dataset collection consists of 5200 color image maps. Using this multi-scale cartographic dataset, several use-case scenarios are applied that highlight the various aspects of the proposed patch extraction tool and demonstrate its applicability in the domain of map exploration. The utilization of the proposed patch creation tool provides the means for adequately exploring the whole dataset, supporting tasks such as color quality assessment and visual complexity.

References

Dumont, M., Touya, G., & Duchêne, C., 2020. Designing multi-scale maps: lessons learned from existing practices. *International Journal of Cartography*, 6(1), 121–151.

- Karimi, D., & Ward, R. K., 2016. Patch-based models and algorithms for image processing: a review of the basic principles and methods, and their application in computed tomography. *International Journal of Computer Assisted Radiology and Surgery*, 11(10), 1765–1777.
- Liu, B., Du, S., Du, S., & Zhang, X., 2020. Incorporating Deep Features into GEOBIA Paradigm for Remote Sensing Imagery Classification: A Patch-Based Approach. *Remote Sensing*, 12(18).