EduServ 16th
Distance e-Learning Courses
Spring 2018

Automatic Topographic Mapping through Description and Classification of Remotely Sensed Imagery and Cartographic Enhancement

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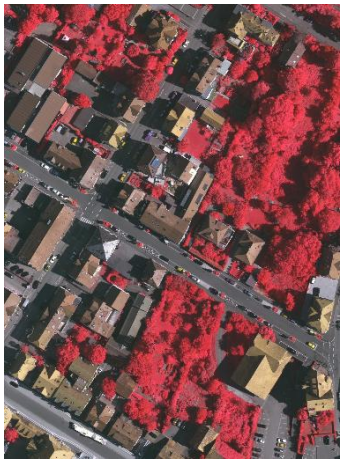
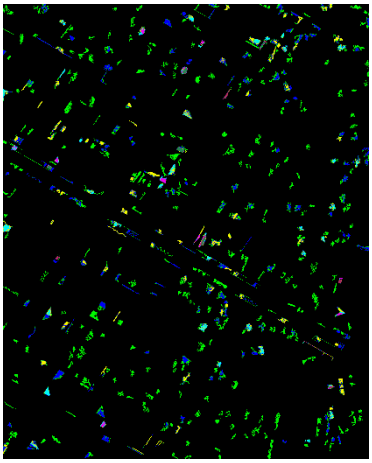
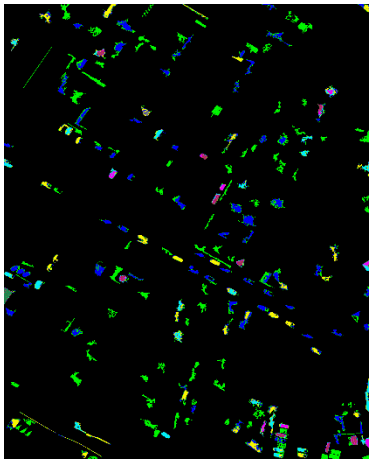
Target audience: University and PhD students in fields related to remote sensing and image analysis; staff from National Mapping Agencies, public authorities and interested third parties involved in mapping and geoinformation

Introduction: Topographic mapping may automatically be achieved from high-resolution multi-spectral orthoimages and dense digital elevation models by means of appropriate image features and classification methods. The results of the classification can further be enhanced and refined, both for the raster- and vector format. An alternative map production will then be possible when one-meter accuracy and cartographic quality are required. This course will introduce an efficient strategy through the use of novel image features called “Attribute Profiles” and recent machine learning techniques to generate such maps from orthoimage and derived features of remotely sensed images. The image processing techniques for map enhancement and the methods of assessment are also part of the learning. The results of recent research work using this approach are presented which may stimulate interest to use the provided processing tools for updating topographic databases.

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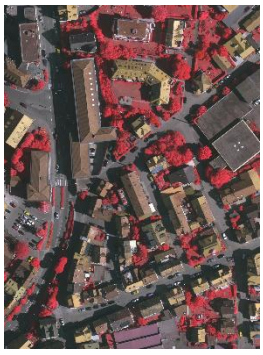
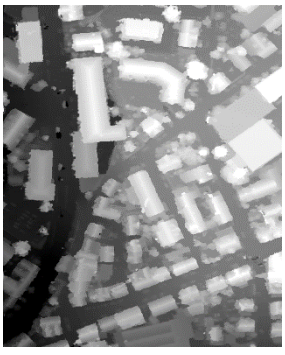
Course objective: The course introduces recent classification schemes with the goal to produce and update 2D topographic databases. The inclusion of the spatial descriptors such as geometry and shape are important to characterize topographic objects in orthoimages. This course will present some of the challenges in mapping from high- resolution orthoimages and highlights the necessity of characterizing the orthoimages in the spatial domain. The solution to the above challenges will be provided by the efficient tool called morphological attribute profiles. They are multi-scale attributes and are constructed by a hierarchical representation of the images, thus enabling object-based image analysis. These characterizations are classified using well-established machine learning methods and different data sources (either raw or derived features). Different approaches to assess the thematic and geometric accuracy of map data will be discussed, and lastly the cartographic enhancement of the classification maps at different levels of quality will be presented. Solutions to the tasks are given by means of detailed course material including open source programs.

Course outline: The pre-course seminar will provide an overview of the applied methods to produce automatically topographic map data. Examples carried out by the teachers of the course and by other research groups will be presented in lectures. The course material will be explained. The e-learning on the Internet is divided into four modules (see below). The teachers will answer questions of the students regarding the course material through e-communication. Assignments will be given for each module and answers of the students will be commented by the teachers of the course.

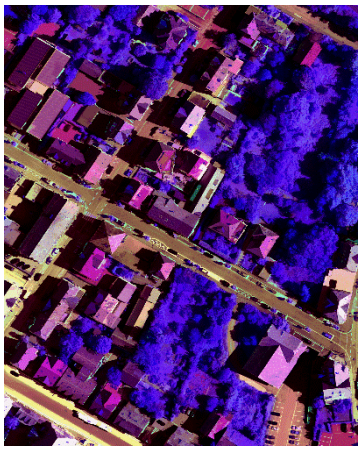
Module 1: Principles of Image Analysis for Topographic mapping
This module introduces the basic concepts of image analysis and the challenges involved in automatic mapping of high-resolution aerial images. Furthermore, the importance of different types of data sources (aerial nadir images, orthoimages, DSM, DTM, nDSM, GIS-data, etc.) and complimentary information (spectral signature, vegetation index, etc.) that can successfully be applied in mapping of topographic objects will also be covered.

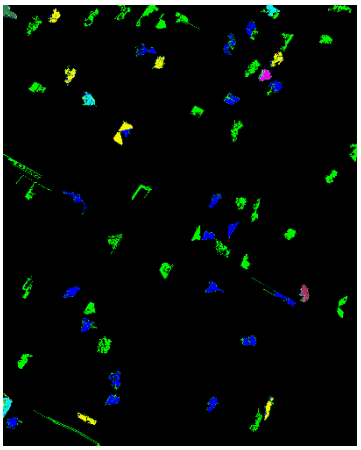




Module 2: Spatial-Spectral Feature Extraction and Classification Techniques
This module consists of two parts: the first part focuses on how to extract the informative features which include the geometrical, shape and texture features. We introduce the effective technique called *Attribute Profiles* to derive such informative features from very high spatial resolution images. We also cover the potential of attribute profiles on different spectral

derived features. In the second part of this module, machine learning techniques (including feature selection techniques) are taught to obtain the classification maps from the features derived in the first part of this module. Case studies will present the obtainable thematic accuracies.





Module 3: Assessment and Enhancement of Classification Maps

This module covers the techniques aiming to assess the quality of the extracted topographic data. As the urban landscapes consist of objects with different shapes, we cover methods not only related to thematic accuracy but also to geometric accuracy of the extracted and enhanced topographic map data. Depending on the results and the demands, it might require some additional processing techniques to enhance the quality of the classification maps. The enhancement techniques, both for the raster and vector format will be taught. The techniques comprise algorithms like Hough transform and least-squares adjustment for lines and rectangles.

Module 4: Applications

In the last module of this course, we cover some important applications. They will reach from mapping of topographic elements (buildings, roads, trees, bushes, hedges) to non-topographic elements (cars, roof material). Real applications will be addressed with existing software suites.