5th INTERNATIONAL DOCTORAL SEMINAR ON GEODESY GEOINFORMATICS AND GEOSPACE 2022.

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Determining the influence of flight height and unmanned aircraft sensors (CMOS, GNSS, IMU) on the achieved quality of the obtained digital orthophoto plan for cadastral survey purposes

Summary: Unmanned aircraft (UA) means any aircraft operating or designed to operate autonomously or to be piloted remotely without a pilot on board. Today, unmanned aircraft have wide application in many branches such as forestry, agronomy, geodesy, civil protection and many others and have surpassed their original military purpose. The main advantage of using an unmanned aircraft for geodetic surveying is the ability to collect a large amount of data in a short time compared to classical surveying methods. The possibility of using unmanned aircraft for the need of geodetic surveying was investigated in such a way that a test field was established, which consists of about 30 ground control points and checkpoints. The test field was first measured by the classical method of geodetic surveying, the polar method using a total station. After that, all points were again measured by GNSS RTK method. The GNSS RTK method was used to determine the coordinates of points in the official national coordinate system HTRS96/TM and the polar method to increase the positional "strength" of points in all directions, i.e., to increase the relative accuracy between all points. Using unmanned aircrafts with different image sensor characteristics, the test field was measured by an aerial photogrammetry method at different flight heights for the purpose of obtaining digital orthophoto. The absolute orientation of the model was performed using the external orientation data of each digital image based on GNSS and IMU unmanned aircraft sensors as well as using ground control points. Accuracy analysis of aerial photogrammetry was performed by considering the survey data collected by classical methods accurate and comparing them with the coordinates obtained by aerial photogrammetry method from digital orthophoto to establish horizontal precision and accuracy of the results and the dependence of precision and accuracy on image sensor characteristics, flight height and data obtained from unmanned aircrafts GNSS and IMU sensors.

Development of automated processes based on deep learning for collecting iRAP attributes

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iRAP (the International Road Assessment Programme) is the main programme of Road Assessment Programmes (RAPs) worldwide that are working to save lives. Halving road deaths and injuries is a United Nations Sustainable Development Goal along with other great social justice and health issues.

UN Member States have agreed on 12 Global Road Safety Performance Targets to drive action across the world. Some targets include ensuring all new roads are built to a 3-star or better standard for all road users, and more than 75% of travel is on the equivalent of 3-star or better roads for all road users by 2030. Achieving >75% of travel on 3-star or better roads by 2030 will save an estimated 467,000 lives every year and 100 million lives and serious injuries over the 20-year life of the treatments. Road attribute coding is the heart of an iRAP project. For every 100m long segment of road it is necessary to collect 64 attribute items separated into seven sections.

Considering that 64 attribute items is large amount of data to automatize process of collection and demand multiple solving approaches, in this phd research traffic flow and roadside severity sections are in focus. That are 2 sections with the biggest impact on final number of stars for observed road.

In this research so far, a method of determining macroscopic and microscopic parameters of traffic flow based on UAV orthogonal videos was developed. Full framework contains of 4 segments: terrain survey, image processing, vehicle detection and parameters determination. For that purpose, Faster RCNN object detection method was used as well as image registration for video stabilization. There are three macros (traffic flow rate, speed, and density) and four microparameters (gross and net time headways and gross and net distance headways).

Next steps in research is roadside severity classification based on LIDAR data. It is planned to generate 2D images of road cross intersections from point clouds. Based on generated images, deep learning techniques such as image classification and object detection will be used to recognize roadside objects and distsnce from road.

Keywords: iRAP, traffic flow, roadside severity, image classification, object detection.

The topic of the doctoral thesis:

Geodetic Approach in Arranging State Borders and Resolving Border Disputes

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Abstract:

One of the basic preconditions for good neighbourly relations between neighbouring states is a well regulated state border. In the last decade, geospatial technologies have played an increasing role in the regulation of state borders, such as the use of satellite images, global navigation technology and the use of GIS system tools. Based on the analysis of defining the border line between the Republic of Croatia and the Republic of Slovenia (using cartographic maps, border agreements and agreements with neighbouring countries, resolving disputes by analyzing cartographic maps and applying the provisions of international law, arbitration, and examples from the rest of the world), the aim is to provide guidelines for use of relevent documents and models for resolving open border issues.

Key words: state borders, satellite images, global navigation technology, cartographic maps, GIS.

Differences in the evolution of farmland fragmentation in China versus Germany

Abstract

Farmland Fragmentation (FF) is one of the main obstacles hindering the development of agricultural modernization and mechanization. Systematically exploring the general distribution characteristics, influential factors and classification of FF are of great significance for improving regional agricultural production capacity, promoting resource conservation and intensive use, and ensuring national food security, especially at the regional scale. Some scholars have investigated FF in European and Asian countries. However, the analysis of FF in Europe and Asia has not been done systematically from a comparative perspective. This paper aims to offer a broader view of the development of FF in China and Germany and identify points for improvement based on the current Chinese situation and European experience. In this study, we established a new conceptual index system using multivariable linear regression,geographical detectors, and magic cube model for FF assessment as well as an analysis of the spatial differentiation characteristics, evolution and driving mechanism of FF in Beijing-Tianjin-Hebei region in China and Bavaria region in Germany based on multi-source data characterizing geographic, land-use and socio-economic information.The findings of this study will assist the government in developing appropriate regional context and land consolidation policies and coping strategies to FF and food insecurity issues, and achieve sustainable development goals in China.

Keywords:
Farmland Fragmentation;
Evolution;
Driving mechanism;
Beijing-Tianjin-Hebei region;
Bavaria region

Automatization of procedural modeling and visualization of 3D buildings

Abstract:

The basic idea of procedural modeling is that one rule applies to a large number of buildings, ie entire cities, it cannot give a satisfactory and completely accurate representation of buildings. 3D models of buildings and cities are becoming ubiquitous for decision-making and interventions in space, as well as for improving the efficiency of spatial management. City and local authorities use 3D models of cities for urban planning and environmental simulations such as estimating shadows cast by buildings, exploring how traffic noise spreads through neighborhoods, and predicting how much solar radiation the roof of a building receives to assess whether it is cost-effective to install solar plate. Like traditional 2D geodata sets, 3D models of cities approximate the real world: features are modeled to a certain degree and certain elements are simplified or omitted. The amount and mixture of content was guided by the usual use of 3D models of the city, the origin of basic data, acquisition techniques, invested funds and spatial relationships. Manually creating many detailed models is very tedious. Procedural modeling methods help reduce the manual effort required to define a model, while at the same time providing an effective way to describe and store models. Moreover, once a procedural description (i.e., a set of rules or grammars) of a model is obtained, variations of the model can easily be generated just by manipulating a few rule parameters. The challenge in the reconstruction of 3D models of cities is a particularly large number of different and complex forms of construction. Therefore, in the last two decades, numerous approaches to building reconstruction have been proposed, but this topic remains a very active area of research in various scientific disciplines. In addition, recent developments in street data collection systems, such as mobile mapping systems, opens new perspectives for improvements in building modeling in the sense that field data (very dense and accurate) can be used with more performance compared to data obtained by remote sensing) to enrich building models at the façade level (e.g., geometry and texture).

Future research will examine:

-the amount of interaction of the operator that forms the 3D model (manual, semi-automatic, fully automatic)

- problems that arise during model making model (geometric, topological, and semantic), Pure geometry (and radiometry), Geometry can be unstructured or structured according to visualization purposes it can be incomplete, Topological errors (permeations, overshoots, undershoots).

Two new methods will be proposed that solve the problems of form grammar, with geometry, with the basic idea that existing algorithms for merging CGA rules can provide breadth for shape variations and can be used to create sequences between different procedural rules.

Contributions would relate to the visualization, adaptation, and transformation of grammars and CGA rules that make procedural modeling methodology more accessible to non-developers. At least two new tools in algorithmic terms would be obtained that address certain limitations of procedural modeling of buildings.

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