

Geoinformatics and Remote Sensing

GIS-based Solar Radiation Modelling in Subcanopy Zone Using Remote Sensing Data

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study form: full time/external

Annotation: Solar radiation energy is one of the most important factors influencing bioclimatic conditions of the landscape biostructures from the global to the microlocal level. Knowing the amount of solar radiation falling on different surfaces of the landscape allows to evaluate the existing potential of solar radiation and to predict changes in the landscape caused by changing the amount of solar radiation, which is important e.g. in terms of climate change impact assessment. Modelling of solar radiation is well-researched topic within geoinformatics. At present, 3D models of the landscape produced based on remote sensing methods, which are able to record the landscape in ultra-high spatial resolution, are used to model solar radiation. With the geometric complexity of landscape object models, the demands on solar radiation modelling also increase, which also requires a change in approaches and optimization of data structures that enter to the process of solar radiation modelling. The current scientific research challenge is to calculate the amount of solar radiation energy on the terrain under the canopy, e.g. in forest stands. The aim of the presented dissertation is to model the distribution of solar radiation on the terrain under the canopy using detailed 3D landscape models and to propose a concept for optimizing the input 3D data. A prerequisite for the successful solution of the dissertation is, on a theoretical and methodological level, a comparison of various concepts for modelling solar radiation. Also, knowledge of remote sensing methods and skills in working with point clouds are essential for a successful implementation of the research. The research of the dissertation can also be enriched with an application part connected e.g. with bioecological research on soil invertebrate populations.

Accuracy analysis of multivariate 3D data collection in an urban environment

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study form: full time/external

Annotation: At present, there are several key geodetic technologies guaranteeing high efficiency and high accuracy of the collection, processing, and modelling of many multi-source heterogeneous geographic information in a complex urban environment. Traditional optical measurement and mapping methods are unable to capture all geometric aspects of a complicated spatial composition of the urban elements. GNSS technologies make it possible to create a large application space in terms of positional accuracy for the LiDAR (TLS and ALS) and digital photogrammetry. Efficient processes of collecting and processing 3D spatial data in urban environments with an integrated high-precision positioning platform with the multi-frequency and multi-modal GNSS and LiDAR techniques with the support of geodetic applications result in their qualitatively and quantitatively more perfect multivariate digital visualizations in GIS. The aim of the dissertation is to design and test methodologies of combined multivariate spatial data collection in a selected urban environment using GNSS, LiDAR techniques in conjunction with classical geodetic optical technologies with the support of a robotic total station and analyze the accuracy of individual measurement techniques data collection and processing for digital visualization in GIS.

Use of geomorphometry and 3D modelling to interpretation of heavy-mineral surface microtexture features from selected localities in the Western Carpathians

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study form: full time/external

Annotation: The aim of dissertation thesis is the analysis and evaluation of microtexture features which occur on heavy-mineral surfaces and result from the mechanical weathering processes during the transport. For this purpose, the geomorphometry methods and 3D models from specialised 3D software (e.g., Blender) will be used. These methods will test the possibility of identification, quantification and visualization of specific features of microrelief on the mineral grain surfaces using general geomorphometry techniques (system of morphometric variables). The relation of the formation of individual microtextural features on the surface of transported grains depending on the length of transport of detrital material will also be monitored (relief and watercourses modelling in GIS). The work will be focused on creation of methodology for analysis of microtexture features on heavy-mineral surfaces including the sampling in the field, the sample processing in the laboratory, the creation of DMR and 3D modelling of the mineral grain surfaces, geomorphometric analysis, interpretation of microtextures in relation to their genesis. The results of the research could be applicable in the identification of fluvial sedimentary palaeoenvironments and in the palaeogeographic reconstructions.

Spatial methods for analyzing work commuting in Slovakia

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study form: full time/external

Annotation: Attendance for employment is one of the most dynamically developing phenomena of the population's spatial mobility. At the same time, it indicates the transformation of spatial relations in each country's settlement and regional system. There are challenges to be addressed in terms of geospatial methods in the analysis of the complexity of commuting to work and associated phenomena. The project aims to identify, model, and visualize changing spatial and structural patterns of employment in Slovakia and their evaluation in the context of other geographical phenomena. The doctoral student will use or adapt existing geospatial methods and visualization and develop new procedures for analyzing and modeling commuting. It will primarily be based on extensive statistical databases from population censuses, transport networks and companies, bike-sharing companies, crowd-sourcing or real-time cameras on busy road crossings. The research results will present a proposal for new methodological procedures for geospatial analysis of population movement and its visualization. The added value of the work will interpret the finding of the phenomenon of attendance at work and its visualization, which can improve planning and decision-making in state administration and regions of Slovakia for planning sustainable transport with respect to social inclusion, accessibility, optimization, decreasing environmental and economic impact.