Internship 1.

Title of internship: ***„Detecting anomalies in InSAR time series displacement using artificial intelligence"***

Contact person: Dr. Kamila Pawłuszek-Filipiak, e-mail: kamila.pawluszek-filipiak@upwr.edu.pl

Duration: three months

What is the research problem the intern will resolve:

The internship is related to a project concerning modeling displacements over time based on satellite interferometry data and building anomaly detection models for these displacements using Python software in the area affected by underground coal mining in the Upper Silesia region.

The task will be mainly conducted using predictive analytics methods encompassing various statistical techniques (including machine learning, predictive modeling, and data exploration). Historical information on displacements over time as well as field data on coal extraction in the Upper Silesia region, etc., will be utilized to "predict" future displacements. Predictive analytics helps us understand possible future events by analyzing the past. For this purpose, machine learning-based regression models can be applied, stemming from pattern recognition research, to learn from and predict data.

Based on the predicted displacements and actual displacements derived over time from interferometric observations, displacements significantly different from those predicted, representing a different displacement trend (anomaly detection), will be detected. The entire process will be visualized in the form of dynamic maps using Python environment (plotly, dashboard) for better representation of the spatiotemporal information characteristic of satellite interferometry data.

What is the expected outcome:

Internship has three main goals: predicting displacements based on InSAR data, detecting anomalies in time series, representing the results in the form of dynamic spatiotemporal maps.

Requirements:

Basic knowledge in the field of satellite interferometry and programming in the Python language.

Internship 2.

Title of internship: ***„Image-based indoor localization using AI methods and augmented reality"***

Contact person: Dr. Małgorzata Jarząbek-Rychard, e-mail: malgorzata.jarzabek-rychard@upwr.edu.pl

Duration: three months

What is the research problem the intern will resolve:

The problem of indoor localization and navigation is an interdisciplinary topic that connects fields such as robotics, 3D modeling, construction, and engineering. Unlike the widespread, well-developed GPS-based navigation for cars, we still face difficulties in locating destination points in various types of building complexes - such as offices, museums, or shopping centers. The ubiquity of smartphones with built-in cameras, combined with advancements in artificial intelligence, has sparked interest in innovative methods of visual localization based on images. Deep neural networks trained on real RGB images enable obtaining camera coordinates at the moment of taking a picture, and thus its localization. Although localization methods based on deep learning have made significant progress in terms of accuracy and efficiency, the requirement for a large amount of training data remains an open issue. A promising potential solution to this problem is to use synthetic images generated from existing 3D models of building interiors for network training, applying appropriate adaptation techniques.

What is the expected outcome:

Development of methods enabling visual localization in building interiors based on real and synthetic images, as well as the analysis of the obtained results.

Requirements:

Experience in programming in Python. Knowledge of English, adequate for understanding technical documentation and scientific publications.

Internship 3.

Title of internship: ***„Automatic identification of animals in thermal images obtained using unmanned aerial vehicles"***

Contact person: Dr. Grzegorz Jóźków, e-mail: grzegorz.jozkow@upwr.edu.pl

Duration: three months

What is the research problem the intern will resolve:

Unmanned aerial systems (UASs) can be equipped with various sensors, including: thermal cameras. UASs equipped with this type of cameras are used in many applications, e.g. to identify and locate objects that absorb thermal energy in a different way than objects surrounding them or emit such energy. Living animals are an example of objects that emit thermal energy. Therefore, it is possible to identify in thermal UAS images animals that live in an environment with a different temperature than their bodies, e.g. identify wild animals feeding on agricultural fields. The optimal solution to this task seems be an automatic determination of both the number of such animals and their type (species). Due to the specificity of the thermal cameras and the nature of data acquisition, this task is made difficulties due to several factors. The ground resolution of thermal images is low, so even relatively large animals (e.g. deer) will be visible on thermal images as a group of several dozen pixels. For this reason, distinguishing the type (species) of the depicted animal may be difficult or even impossible. The second factor is the fact that a single thermal image shows only a part of the area of interest and even the development of a 'thermal' orthomosaic using photogrammetric methods may make it difficult to both recognize and count moving animals. Moreover, in some weather conditions (strong sunlight), other objects (e.g. tree branches) heat up significantly and in thermal images may have a temperature close to the temperature emitted by animals' bodies. The aim of the internship will be to analyze various methods of classifying thermal images in terms of their suitability for identifying large wild animals (e.g. wild boars, deer), and, if possible (e.g. due to availability of test data), also to determine their type. In particular, it is necessary to perform a literature review, prepare test data (including manual identification of animals in thermal images), determine the pixel features of thermal images that can be used in machine learning, conduct experiments on animal identification using machine learning algorithms and assess their effectiveness. Test data in the form of a series of thermal images taken using UAS will be provided by IGiG.

What is the expected outcome:

Analysis of classification methods for thermal images collected with UAS in terms of their suitability for identifying large wild animals.

Requirements:

Python programming skills. Basics of aerial photogrammetry. Basics of passive remote sensing, in particular regarding image classification. Ability to plan machine learning experiments for classification. Previous experience using machine learning for image classification is welcome.

Internship 4.

Title of internship: ***„Noise type identification in HR-GNSS displacements' time-series"***

Contact person: Dr. Jan Kapłon, e-mail: jan.kaplon@upwr.edu.pl

Duration: three months

What is the research problem the intern will resolve:

Identification and classification of noise in displacement series determined from HR-GNSS data in seismological applications or structural monitoring are essential for their reduction, which can lead to improved detection of seismic wave arrival time or determination of vibration duration. Additionally, it can enhance the accuracy of acceleration determination using GNSS receivers.

During the internship, the following tasks will be required:
a) Conduct a literature review concerning noise identification in time-series,
b) Collect HR-GNSS data from publicly available data repositories (including EPOS-PL/EPOS-PL+),
c) Conduct HR-GNSS measurements using UPWr receivers of various types (including low-cost ones),
d) Calculate displacements from the acquired HR-GNSS data,
e) Identify noise dependent on: GNSS signal multipath error, receiver type, and registration frequency,
f) Prepare a report serving as the basis for writing a publication.

What is the expected outcome:

The aim of the internship is the identification and classification of types of noise occurring in displacement series determined from high-frequency GNSS data (HR-GNSS).

Requirements:

Knowledge of GNSS data types and processing, basic proficiency in Python or Matlab programming, Proficiency in English language.

Internship 5.

Title of internship: ***„Analysis of factors impacting human mobility"***

Contact person: Dr. Kamil Smolak, e-mail: kamil.smolak@upwr.edu.pl

Duration: three months

What is the research problem the intern will resolve:

The internship is part of an internal project carried out at the Wrocław University of Environmental and Life Sciences. The intern will carry out the task 'Analysis of external factors affecting mobility'. In the human mobility modelling task, the importance of external factors such as weather, spatial constraints, events and holidays are often overlooked despite the fact that they are of great importance and influence our mobility. The intern will combine human mobility data containing individual movement trajectories with data collected from open sources, related to external factors. She or he will then apply statistical and machine learning methods to identify relationships between mobility and these factors.

What is the expected outcome:

The aim of the internship is to apply statistical and machine learning methods to determine the impact of external factors on people's mobility.

Requirements:

Basic knowledge of the Python language, basic knowledge of statistics.

Internship 6.

Title of internship: ***„Software development for GNSS data analysis"***

Contact person: Dr. Kamil Kaźmierski, e-mail: kamil.kazmierski@upwr.edu.pl

Duration: three months

What is the research problem the intern will resolve:

The Institute of Geodesy and Geoinformatics is developing web services related to Global Navigation Satellite Systems (GNSS). The services in question allow, among other things, the analysis of data contained in RINEX files (https://doi.org/10.1016/j.softx.2023.101372), and the determination of the quality of real-time products delivered by various analysis centers. Information about RINEX files enables the selection of appropriate test periods and the assembly of a station set optimal for the user's research. The quality of real-time corrections can be used in choosing the correct stochastic modeling of computational processes related to precise positioning, for example, by using the Precise Point Positioning technique. The proposed internship assumes the organization of the source codes of the programs and the development of the tools' functionalities. Moreover, databases will be created to replace the current model of feeding the services with text files. The actions taken will streamline processes and optimize the source code, ensuring the possibility of further development.

What is the expected outcome:

Creating databases for both the RINEX file analysis service and the real-time correction quality analysis service, organizing and optimizing the source codes written in Python using the Streamlit framework. Expansion of the services' functionalities. The final outcome will be a report on the work carried out, modified source codes of the services, and the created and functioning databases. Additionally, a presentation on the operation and instruction for individuals responsible for building the services will be conducted.

Requirements:

Proficiency in the Python programming language, basic knowledge of GNSS systems, data analysis tools, and database management skills.

WROCŁAW UNIVERSITY OF ENVIRONMENTAL AND LIFE SCIENCES
DEPARTMENT OF GEODESY AND GEOINFORMATICS
ul. Grunwaldzka 53, 50-357 Wrocław, Poland
tel. +48 71 3205617
e-mail: igig@upwr.edu.pl | www.igig.up.wroc.pl | www.upwr.edu.pl

Internship 7.

Title of internship: *„Railway and tram tracks”*

Contact person: Dr. Izabela Wilczyńska, e-mail: izabela.wilczynska@upwr.edu.pl

Duration: three months

What is the research problem the intern will resolve:

Internship carried out at IGIG (two months) and at the GeoSter Aleksander Rau company (one month).

Subject:
- updating the database of Wrocław tram tracks,
- analysis of regulations and guidelines regarding the inventory of tracks and the assessment of their geometric condition,
- preparing maps for railway investments,
- inventory of tracks for axle adjustment,
- handling the construction of railway tracks.

What is the expected outcome:

Gaining experience in measurements for railway purposes. Possibility to publish the obtained results. Possibility of supplementing the professional practice diary with entries confirmed by an authorized surveyor (scope 1 and 4).

Requirements:

Basics of QGIS and C-geo.

Internship 8.

Title of internship: ***„The use of digital twins (3D models) of cities in issues of communication with the socio-economic environment"***

Contact person: Dr. Paweł Bogusławski, e-mail: pawel.boguslawski@upwr.edu.pl

Duration: three months

What is the research problem the intern will resolve:

Sustainable urban transformation supporting the transition to renewable energy is currently an important topic in European cities. Existing technological solutions enable simulations to support appropriate urban planning. One of the key elements necessary to conduct the analysis is to collect appropriate information. In the examined issues, the basic visualization platform is 3D geoportals. They allow for a transparent presentation of analyszes of both current situations and phenomena, as well as the impact of actions planned by the city in the future. In this context, an extremely important and even required element is communicating the changes planned by the city (e.g. in space), as well as collecting feedback from the entire socio-economic environment. Therefore, enriching 3D geoportals with functionality that implements the above communication goal will be a task to be implemented as part of the internship.

The project plans to use various geoinformatic tools and technologies, such as (FME, ESRI, Python, Java, etc.).

Internship carried out with the company.

What is the expected outcome:

The aim of the internship is to develop tools that expand the functionality of 3D urban geoportals as a practical channel of communication with the environment in the field of sustainable urban development issues.

Requirements:

- knowledge of issues related to spatial modelling;
- knowledge of selected technologies (FME, cesium.js, ESRI, Python, JavaScript or others);
- knowledge of English enabling understanding of technical documentation and scientific publications;
- CV

Internship 9.

Title of internship: ***„Comparison of energy models for selected European cities"***

Contact person: Dr. Paweł Bogusławski, e-mail: pawel.boguslawski@upwr.edu.pl

Duration: three months

What is the research problem the intern will resolve:

There are many initiatives supporting the clean energy transition driving a sustainable urban transformation. Many of them are based on simulations of electricity and heat consumption in connection with the analysis of the thermal efficiency of buildings. Accurate determination of building parameters is difficult and requires specialized knowledge. However, existing analysis results allow for the assignment of statistical values to individual buildings and energy analysis at the level of building groups. This makes it possible to estimate energy consumption for housing estates and entire cities.

It is planned to review existing commercial and open tools enabling energy analysis in cities. Selected tools will be used to perform analysis on the test model that will be developed as part of the internship. The necessary data will be obtained from open datasets and other sources. Data that is impossible to obtain will be simulated using a generator developed by the intern.

Next, the results will be compared with the results obtained in the SimStadt tool, which is OpenSource software used in the DigitalTwins4PEDs project (https://digitwins4peds.eu/). Additionally, analyses will be carried out using models of the cities of Wrocław, Stuttgart, Vienna and Rotterdam.

What is the expected outcome:

The aim of the internship is to perform a comparative analysis of the results of energy analyses obtained using selected tools for a part of the city.

Requirements:

- knowledge of issues related to spatial data processing;
- programming skills at least at a basic level (Python or other);
- English, at the level necessary to understand technical documentation and scientific publications;
- CV