Module description

Methods & Applications

General information

GIT_MethApp

Methods & Applications (GEO_MethApp)

Module category

Geomatics specialization

Lessons

3 lessons of lectures and exercises per week

ECTS

3

Language of instruction

English (Documentation English / German)

Brief description

In the Methods and Applications module, current topics and trends in geoinformation technology are addressed and dealt with in depth: Computer Graphics, Mobile Mapping, and Deep Learning.

3D computer graphics are a powerful tool for creating realistic and interactive virtual environments. Real-time rendering is a technique used in video games and other interactive applications to create images in real-time, enabling smooth and responsive user experiences. Ray tracing is another technique used in 3D graphics that simulates the behavior of light to create highly realistic images. In this course, students will learn the fundamentals of 3D graphics, including real-time rendering and ray tracing, and their application to create visually stunning and interactive virtual environments. They will also learn about the challenges and techniques for optimizing performance and achieving realistic results.

Mobile mapping is synonymous with concepts, methods, and systems for the kinematic acquisition of 3D geodata and their subsequent use in different application areas. After an overview of possible use cases and scenarios, the aspects of positioning or navigation sensors, in particular, GNSS and INS based systems, as well as different approaches to process these data to solve the georeferencing problem are covered. Furthermore, an overview of the widely used sensor platforms and the spectrum of measurement or environmental sensor technology is given. In the second part, approaches to system calibration, data processing, and distributed data usage are discussed using the example of the IVGI's stereovision-based mobile mapping solution.

Machine learning and deep learning are powerful techniques for natural language processing (NLP) and image recognition. These methods enable computers to learn and improve their performance based on data without being explicitly programmed. NLP and image recognition are two of the most common applications of machine learning and deep learning, with vast potential to automate tasks and provide insights into large datasets. In this course, students will learn the fundamentals of these techniques and their application to solve practical problems in NLP and image classification.

Goals, content and methods

Learning objectives, competencies to be acquired

- Students will learn the methods and technologies for 3D visualization and the processes required on the computer side for this and explain the possibilities, limitations, and challenges.
- They explain the concepts and methods of "Spatialization" and discuss areas of application.
- Students will explain the main methods and procedures for kinematic acquisition of 3D geodata and the calibration, georeferencing and evaluation procedures required for this purpose.
- They analyze the possible applications of the methods covered and identify suitable approaches to solving and answering specific problems and questions.

Module content

Computer Graphics

- Basics Graphics APIs (Low-Level and High-Level)
- Rendering pipeline
- 3D objects: Modeling, Visualization, Optimization
- Rendering Techniques

Spatialization

- Introduction
- Self-organising Maps (SOM)

Mobile mapping

- Introduction, overview, applications
- Positioning / Georeferencing
- Measurement sensors
- Stereovision Mobile Mapping (incl. calibration)
- (Automated) evaluation methods using the example of extraction / mapping of traffic signs

Deep Learning

- Introduction
- Using PyTorch for NLP
- Using PyTorch for Image Classification
- Practical Examples

Module plan with weighting of the course contents

- 3D Visualization and Virtual Globes (approx. 5 weeks)
- Spatialization (approx. 2 weeks)
- Mobile Mapping (approx. 2 weeks)
- Deep Learning (approx. 3 weeks

Module organization (e.g. division into courses)

Course Geovisualization (3D and Spatialization)
Mobile Mapping Course

Teaching and learning methods

- Lectures (approx. 2 lessons per week)
- Exercises (approx. 1 lesson per week)
- Self-study and brief presentation of selected supplemental content.

Prerequisites, previous knowledge, entry skills

XML, HTML, JavaScript, Python-Programming

Bibliography / Bibliography

Performance Evaluation

Admission requirements for the module final examination (testate requirements)

Written module final examination

Exam duration	90 minutes
Permitted aids	Written summaries (max. 5 pages A4, single-sided, handwritten)

Comments
