

Report on the outcomes of “Spreading out the Knowledge from ISPRS Educational Events using a Dissemination Internet Platform (SKIEE-DIP)”

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1 Introduction

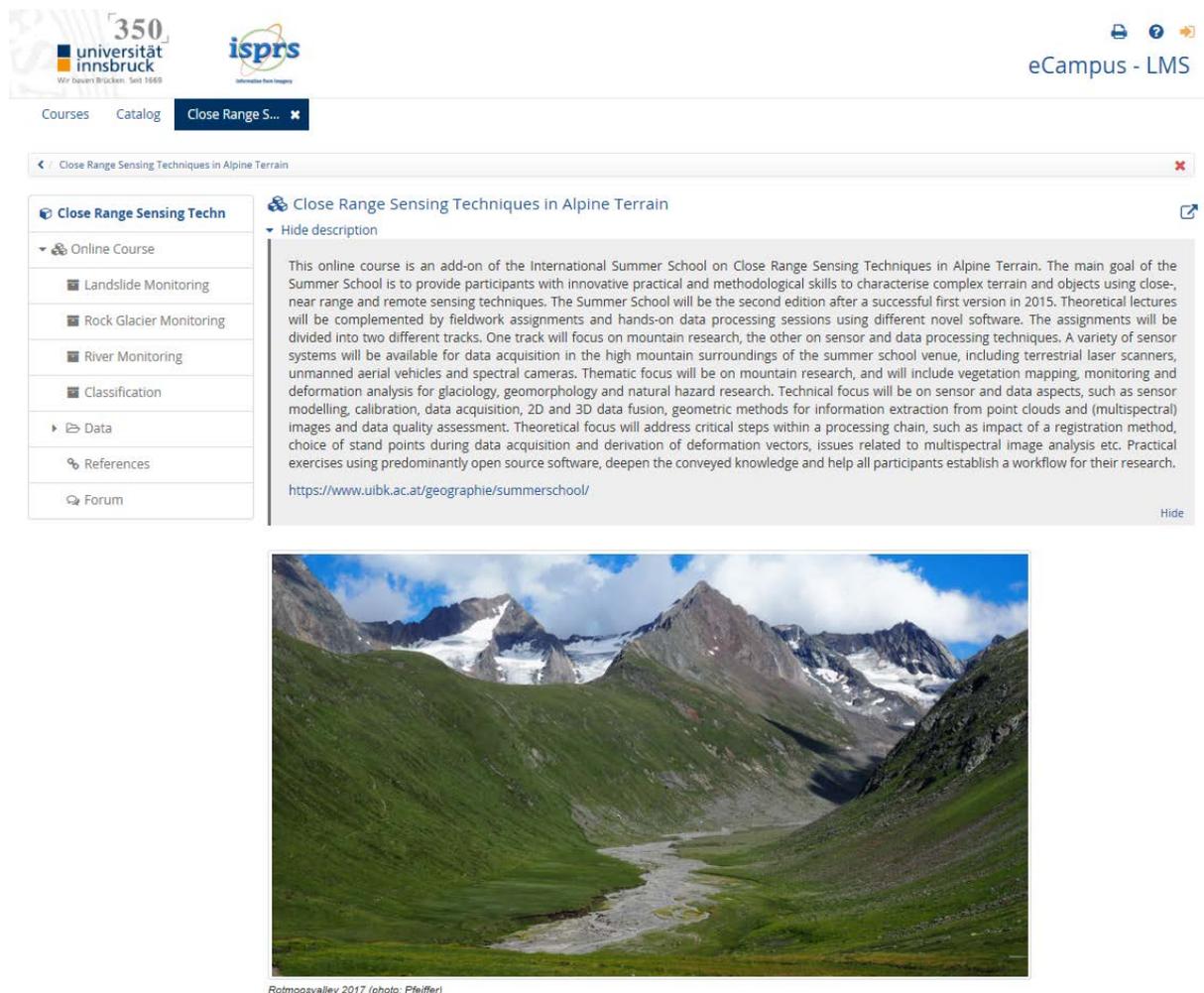
The project SKIEE-DIP (Spreading out the Knowledge from ISPRS Educational Events using a Dissemination Internet Platform) is an add-on of the International Summer School on Close Range Sensing Techniques in Alpine Terrain¹. The project outcome is an online course providing assignments where participants by themselves acquire innovative, practical and methodological skills to characterise complex terrain and objects using close-, near range and remote sensing techniques. Data acquired during the summer school of 2015 and 2017 with a variety of sensor systems such as terrestrial laser scanners, unmanned aerial vehicles and spectral cameras serve as a basis for assignments dealing with mountain research questions. Monitoring and mapping geomorphologic and vegetational processes (e.g., river erosion and sedimentation, rock glacier creeping, landslide deformation, landcover changes) are the superordinate topics of the assignments. Following elements are content of the online course: planning terrestrial laser scanning acquisitions, point cloud registration and georeferencing, deformation estimation, structure from motion and dense matching for image base point cloud derivation, data integration and classification of 3D and multispectral data. Established assignments should encourage participants to accomplish each exercise in an autonomous way. This should help them to establish a workflow relevant for their own research and should further inspire them to think of possible solutions for unsolved research questions.

¹ Rutzinger, M., Höfle, B., Lindenbergh, R., Oude Elberink, S., Pirotti, F., Sailer, R., Scaioni, M., Stötter, J., Wujanz, D., 2016. "Close-Range Sensing Techniques in Alpine Terrain." In: Proc. "ISPRS Congress," 12-19 July 2016, Prague (Czech Rep.), *ISPRS Ann. Photogramm. Remote Sens. Spatial Inf. Sci.*, Vol. III, Part 6, pp. 15-22.
Rutzinger, M., Bremer, M., Höfle, B., Hämmerle, M., Lindenbergh, R., Oude Elberink, S., Pirotti, F., Scaioni, M., Wujanz, D., Zieher, T., 2018. "Training in Innovative Technologies for Close-Range Sensing in Alpine Terrain." In: Proc. "ISPRS Technical Commission II Mid-term Symposium 2018 – Towards Photogrammetry 2020," Riva del Garda (Italy), 4-7 June 2018, *ISPRS Ann. Photogramm. Remote Sens. Spatial Inf. Sci.*, Vol. IV, Part 2, pp. 239-246.

2 Definition of guidelines for the implementation of DIP

With the project start in February 2018 guidelines for the implementation of a DIP (Dissemination Internet Platform) were discussed during an internet meeting between PI (Marco Scaioni), co-PI's (Roderik Lindenbergh, Francesco Pirotti, Martin Rutzinger, Bernhard Höfle) and a technician (Jan Pfeiffer). Outcomes of this meeting concretised the guidelines and structure of the implementation of the DIP. Following points were discussed and recorded:

- A welcome page should explain background and function of the course
- The DIP should offer a forum for discussion
- Accompanied data for practical assignments must be provided either within the DIP environment or linked to an open access data publication
- Content to be transmitted should build on the content of the summer school
- Content should be licenced using a version of CC to guarantee access and copyright for authors
- The course should be well structured by assignments and subtasks
- Each assignment should be accompanied with relevant literature and existing internet documentations
- A blank template of an assignment should be created to enable the implementation of further assignments in future



The screenshot shows the user interface of the eCampus LMS. At the top, there are logos for '350 universität innsbruck' and 'isprs'. The navigation bar includes 'Courses', 'Catalog', and a search bar with 'Close Range S...'. The main content area displays the course title 'Close Range Sensing Techniques in Alpine Terrain' with a 'Hide description' button. The description text reads: 'This online course is an add-on of the International Summer School on Close Range Sensing Techniques in Alpine Terrain. The main goal of the Summer School is to provide participants with innovative practical and methodological skills to characterise complex terrain and objects using close-, near range and remote sensing techniques. The Summer School will be the second edition after a successful first version in 2015. Theoretical lectures will be complemented by fieldwork assignments and hands-on data processing sessions using different novel software. The assignments will be divided into two different tracks. One track will focus on mountain research, the other on sensor and data processing techniques. A variety of sensor systems will be available for data acquisition in the high mountain surroundings of the summer school venue, including terrestrial laser scanners, unmanned aerial vehicles and spectral cameras. Thematic focus will be on mountain research, and will include vegetation mapping, monitoring and deformation analysis for glaciology, geomorphology and natural hazard research. Technical focus will be on sensor and data aspects, such as sensor modelling, calibration, data acquisition, 2D and 3D data fusion, geometric methods for information extraction from point clouds and (multispectral) images and data quality assessment. Theoretical focus will address critical steps within a processing chain, such as impact of a registration method, choice of stand points during data acquisition and derivation of deformation vectors, issues related to multispectral image analysis etc. Practical exercises using predominantly open source software, deepen the conveyed knowledge and help all participants establish a workflow for their research.' A URL 'https://www.uibk.ac.at/geographie/summerschool/' is provided at the bottom of the description. Below the text is a photograph of a mountain valley with green slopes and snow-capped peaks. The caption below the photo reads 'Rotmoosvalley 2017 (photo: Pfeiffer)'.

Fig. 1 - DIP welcome page

3 Implementation of a Prototype

Based on guidelines defined in the first step of the project a prototype assignment was developed using the Open OLAT web-based e-learning platform provided by the University of Innsbruck (Fig 1). This platform allows the creation of structured e-learning courses. Data provision option as well as the possibility for smaller design adaptations (e.g., placement of logos) enable a straight-forward implementation of e-learning assignments through different given course elements. For the DIP implementation a Content Packaging (CP) format embedded in the online course was used to create the assignments using an editor. Before implementing the prototype assignment, data required to perform the exercise had to be prepared and provided in a manageable size and in an open data format. Possible open source software that enable and facilitate the execution of the task had to be compiled. Based on this, a well suited open-source (or alternatively popular low-cost) software for efficient completion of the tasks is suggested within the assignment description.

The structure of the prototype assignment “Landslide Monitoring” was defined as follows:

- Introduction
- Data
- Subtask 1 “Registration”
- Subtask 2 “Deformation Calculation”
- References and Links

Every assignment should therefore contain a short introducing text where the content, objective and major challenges of the assignment are summarized (Fig 2). Additionally, a data description and explanation of where to find and download the data is given. This introducing sequence is followed by several subtasks inviting the participant to analyse and work with the data to fulfil the assignments objectives. At the end of each assignment a text giving an inspiring outlook to motivate participants to develop and implement own thoughts of how further research questions may be solved in future. References to relevant literature and links to useful software related internet documentations are stated below each assignment.

Close Range Sensing Techniques in Alpine Terrain

Close Range Sensing Techn

Online Course

Landslide Monitoring

Introduction

Data

Registration

Deformation Calculation

References and links

Rock Glacier Monitoring

River Monitoring

Classification

Data

References

Forum

Watching grass grow and hills slide: terrestrial laser scanning-based deformation monitoring

Hide description

Content

- get familiar with TLS acquired point clouds
- registration of multi epoch point clouds
- estimation of landslide induced deformation

Hide

ÖAW AMERICAN ACADEMY OF SCIENCES IGF TU Delft POLITECNICO DI MILANO UNIVERSITÄT HEIDELBERG

Introduction

Terrestrial laser scanning (TLS) allows one to acquire point clouds that represent the surface at a certain time. Acquiring at least two point clouds at two different points in time (epochs) enables the detection of surface changes (caused by vegetation or landslide deformation). Knowing stable parts within the point cloud is a crucial basic requirement because they are essential to derive transformation parameters (Wujanz et al. 2018).



Terrestrial Laserscanner in the field (photo: Seiffert 2017)

Fig. 2- Introduction section of the revised prototype assignment "Landslide Monitoring"

4 Feedback collection, prototype revision and implementation of further assignments

After Implementing the first prototype assignment in June 2018 students that are familiar with the field "close range sensing techniques" were asked to perform the assignment and return feedback to the project staff. Based on the received feedback the conceptual assignment formulation and data provision were adapted. Further data was collected and prepared to fit in further assignment which were subsequently prepared considering the suggestion for improvements. In addition to the revised prototype assignment "Landslide Monitoring" three more assignments were implemented. An overview of implemented assignments and their major contents are summarized below:

Landslide Monitoring:

- get familiar with TLS acquired point clouds
- registration of multi epoch point clouds
- estimation of landslide induced deformation

Rock Glacier Monitoring:

- TLS data acquisition planning
- point cloud georeferencing
- determination of surface changes caused by rock glacier flow

River Monitoring:

- Surface reconstruction from UAV and terrestrial images with Structure from Motion (SfM) and dense matching techniques
- Fusion of UAV and terrestrial photogrammetry data
- Comparing photogrammetric point clouds

Classification:

- Descriptor collection
- Classification with geometrical descriptors
- Classification with spectral descriptors

For each topic three major working steps were carried out to establish a respective online course assignment. Within a first step existing lectures, assignments, data and additionally available information was collected and compiled to derive an applicable workflow, specifying the structure of an online course assignment, in a second step. The third step of the assignment creation process is responsible to implement this workflow within the DIP using an illustrative way. Fig 3 summarizes the working steps that are needed to develop an online course assignment.

Lectures

Innsbruck Summer School of Alpine Research 2019
Close Range Sensing Techniques in Alpine Terrain
Obergurgl (Austria), 16.07. - 22.07.2019



First step

Collection of lectures, assignments data, and additional informations from previous summer schools

Classification with Machine Learners and validation of 3D point clouds with a data-rich set of descriptors

Authors: Francesco Pirotti
Affiliation: Università di Padova - Dep.t TESAF / Interdepartmental Research Center in Geomatics - CIRGEO

Objective of assignment

In this assignment we will use optical and 3D properties of an area to extract land cover classes using machine learning. We will also be testing the importance of chosen descriptors

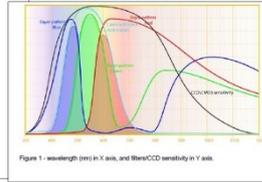


Figure 1 - wavelength (nm) in X axis, and filter/CCD sensitivity in Y axis

Material



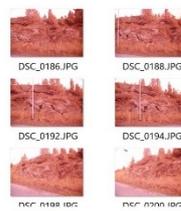
Study Area



Software



Data

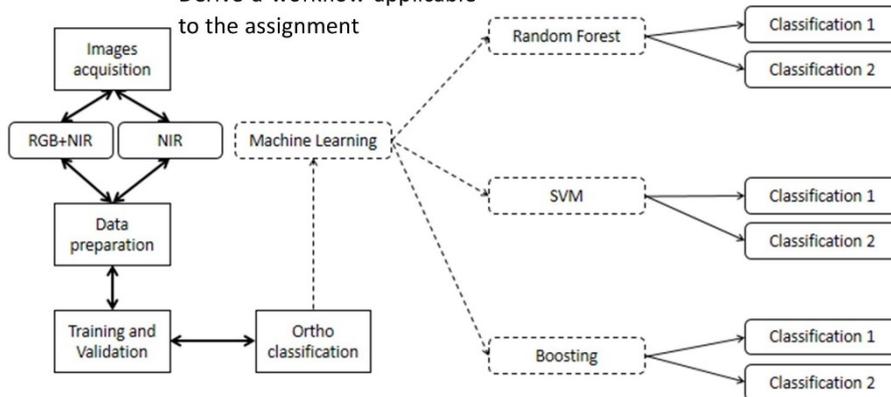


Data Acquisition



Second step

Derive a workflow applicable to the assignment



Third step

Implement the workflow



Fig. 3 - Working steps to develop an online course assignment

5 Summarized project outcome

The outcome of SKIEE-DIP is an online course dealing with close-range sensing data acquired during the ISPRS international summer school on close range sensing techniques in Alpine terrain which took place in Obergurgl, Austria in 2015 and 2017. The online course is embedded within an e-learning platform provided by the University of Innsbruck. So far, four assignments dealing with close range sensing data derived from cameras and laser scanning devices to monitor environmental process in Alpine environments are freely available and accomplishable for everyone interested in these topics.

The platform can be accessed online at (login with the guest access, last accessed: 29.05.2019):

<https://lms.uibk.ac.at/url/RepositoryEntry/4345856002>

6 Financial report

Description	Cost (CHF)
Prototype implementation: personnel cost	3,000
Cost of server maintenance, working facilities	1,000
Total cost	4,000

Project funding from ISPRS	3,000
Project co-funding from Austrian Academy of Sciences	1,000
Total project funding	4,000

The granted project budget was 3,000 CHF out of 10,000 CHF requested in the application. Such a cut-off resulted in a reduction of the activities that could be developed during the project, though the lower budget could be efficiently exploited to complete the planned activities. The main cost was the salary of a technician dedicated to the development and implementation (Jan Pfeiffer).

The Austrian Academy of Sciences contributed to the project development by granting services for a total cost estimable as 1,000 CHF.