Forest Information Technology
Student Research Colloquium

Spring 2021 - Program

This document contains the detailed program of the Student Research Colloquium to be held online on Spring 2021 at the Master Forest Information Technology. At the end is a list of abstracts for all programmed talks.

1 General Schedule

The Student Research Colloquium takes place on two days: May 27 and 28, 2021. It will consist on talks by master students, following this overall schedule:

	Thursday 27	Friday 28
10:00 - 10:30	Welcoming words	Talks
10:30 - 12:00	Talks	
12:00 - 13:00	Lunch break	Lunch break
13:00 - 15:00	Talks	Talks
15:00 - 15:30	-	Closing

Note that all times are given as Central European Time (CET).

The Colloquium will take place exclusively online, on the following videoconference room: `https://bbb.hnee.de/b/lui-2ki-sny-1n4`

2 Detailed Schedule and abstracts

- First session on Thursday 28: Talks on ecology, agriculture and database systems.
- Second session on Friday 29: Talks on remote sensing.

Thursday 27	Talk title and presenter
10:00 - 10:30	Welcoming words
10:30 - 11:00	Development, Testing and Implementing of Insect Catching Drones. **Shahrukh Kamran**.
11:00 - 11:30	Modelling Seasonal Variation of Occupancy Probability for a Large Herbivore in an Alpine Study Area. **Anshika Kulshrestha**
11:30 - 12:00	Selection of the best formula for the volume of wood for three samples of trees from western Poland. **Emilia Kamola**.
12:00 - 13:00	Lunch break
13:00 - 13:30	The Impact of Agroforestry on Farmland and Crop Production in Löwenberger Land, Brandenburg, Germany. **Muhammed Sinan**.
13:30 - 14:00	Development of a geodata management structure for patch crop experiment conducted by Leibniz-Zentrum für Agrarlandschaftsforschung (ZALF) e.V. **Akhil Chandran**.
14:00 - 14:30	Analysis & development of a web-based payroll management system. **Md Mahmudur Rahman**.
14:30 - 15:00	Database of Forestry Students' Scientific Association WULS. **Jakub Smyk**.

Friday 28	Talk title and presenter
10:00 - 10:30	Detection of windthrown tree stems on UAV-based orthophotos using a U-Net convolutional neural network and generic training data. **Stefan Reder**.
10:30 - 11:00	Pre-processing of Full-Waveform LiDAR Data - Research Project in Cooperation with Helmholtz-Centre Potsdam. **Marlene Degner**
11:00 - 11:30	How to get rid of man-made structures in ALS data for forest analysis: A comparison of external data clipping and shape detection. **Hauke Gronenberg**
11:30 - 12:00	Investigating the effect of seasonality and flight line overlap on modelling forest stand characteristics from large-area LiDAR acquisitions. **Jonathan Wolf**.
12:00 - 13:00	Lunch break
13:00 - 13:30	A Machine Learning approach to predict Wildfire Burn Severity using Landsat-8 and LiDAR data. **Mir Mazedur Rahaman**.
13:30 - 14:00	Global Mapping of Forest Fires. **Reinhard Kückes**.
14:00 - 14:30	Statistical relation between Vegetation cover and Land Surface Temperature (LST) in Phnom Penh City. **Gulam Mohiuddin**.
14:30 - 15:00	Tree height estimation in the Amazon with GEDI and machine learning **Michael Gleißner**.
15:00 - 15:30	Closing.

Development of a geodata management structure for patch crop experiment conducted by Leibniz-Zentrum für Agrarlandschaftsforschung (ZALF) e.V

Chandran, Akhil

Geodata organization is the set of technological processes for reducing heterogeneous data and models to a single consistent information model that can be efficiently reused in various analysis and management techniques. Also, geospatial data management plays a connecting role between data acquisition, data modeling, data visualization, and data analysis. In land-use planning, land evaluation is an important factor when resources are insufficient. Land evaluation is used to analyze the requirements of land properties. The research topic illustrates the management of the collected data especially making a geodata management plan including file structure design, nomenclature, and unification of data. This reserach aims to provide a useful geodata management structure for patch crop experiment conducted by Leibniz-Zentrum für Agrarlandschaftsforschung (ZALF) e.V. The patch crop experiment is an experimental approach to design multifunctional and sustainable cropping systems of the future. The objectives of this research were derived from the overall objectives of the patch crop experiment. The result of this work is a folder structure created for adequate storage of geodata and unification of collected geodata. Geospatial data science is expected to become a central research field for the next decade to integrate unstructured and structured data and extract geospatial knowledge, i.e., data and patterns, in interdisciplinary applications. Also, geospatial data science will link the gap between modern information technology concepts and geo-related science. Using this geodata management structure will continuously allow having a powerful management tool that will facilitate the evaluation for a better assessment of land management.

Presentation on Thursday 27 of May of 2021 at 13:30.

Pre-processing of Full-Waveform LiDAR Data - Research Project in Cooperation with Helmholtz-Centre Potsdam

Degner, Marlene

Aerial photogrammetry and Laser Imaging, Detection, and Ranging (LiDAR) techniques are the most commonly used methods for the digital acquisition of height structures and allowing 3D vegetation mapping of landscapes. Unlike the mostly used discrete return LiDAR sensing that is characterized by the recording of first and last returns, full-waveform LiDAR is (theoretically) able to record an infinite number of returns sampled in fixed time intervals. The large number of measurements give insights into a full height profile of the sensed object. Especially for vegetation analyses under a closed forest canopy this method can provide new opportunities, which are not yet fully exploited by reason of limited capabilities of processing and analysis software for full-waveform data (FW). In order to contribute to that issue, the process of FW LiDAR data pre-processing was integrated as part of the NaTec-KRH project (Helmholtz-Centre Potsdam) and drafted exclusively based on open source software, which should hand over measures to anyone interested in working with this type of data.

Keywords: full-waveform lidar, lidar pre-processing, waveform lidar

Presentation on Friday 28 of May of 2021 at 10:30.

Tree height estimation in the Amazon with GEDI and machine learning

Gleißner, Michael

Understanding carbon storage on earth is still a goal of the research community in 2021. Several studies have attempted to use carbon maps to determine the storage of carbon on land on a global scale. These earlier studies still have room for improvement in terms of accuracy. With the help of the Global Ecosystem Dynamics Investigation Mission (GEDI) a new spaceborne LiDAR sensor is available to explore vegetation structure over huge areas. This data set delivers 109.457 shots over the area of interest which describe the relative height above ground. In This analysis the relative height at 95% (RH95) is used. The investigation area lies in the middle of the amazon rain forest and has an extend of 1 x 1 degree (111 x 111 km). The used GEDI data cover only about 0.7% of the area therefor the machine learning algorithm random forest is applied to estimate heights over the entire area. This report focus on understanding, rebuilding, and refining an approach to estimate vegetation heights. Together with GEDI and Landsat data and random forest a vegetation height map will be produced. All in all, it was possible to map heights over a large area. With $R^2 = 0.401$ and an RMSE of 6.90 m, the model produced does not forecast perfectly, but it is somewhat better than recently published results. These results give hope that in the future it will be possible to map the height of vegetation over the entire planet more precisely.

Presentation on Friday 28 of May of 2021 at 14:30.

How to get rid of man-made structures in ALS data for forest analysis: A comparison of external data clipping and shape detection

Gronenberg, Hauke

In recent years, the number of available free Airborne Laser Scanning (ALS) data and processing tools is increasing. Since ALS data is well known for its applicability in forest inventories, methods for the identification of man-made structures need to be found. Therefore, two approaches were im- plemented and tested. First, the external data approach. The idea is to find points by cadastre data (Authoritative Real Estate Cadastre Information System - ALKIS) and a digital landscape model (Authorative Topographic- Cartographic Information System - ATKIS). Since this approach does not consider the three-dimensional structure of ALS data and relies on the qual- ity of external data, a shape detection approach developed by Limberger et al. (2015) was additionally applied. Basic assumption for this approach is that the majority of man-made structures is linear or planar and can be de- tected by these attributes. It was found that the shape detection approach is more adequate to identify man-made structures. This approach is able to process large-scale ALS data (here tested on the area of Thuringia in Germany) although it needs more computation time.

Presentation on Friday 28 of May of 2021 at 11:00.

Selection of the best formula for the volume of wood for three samples of trees from western Poland

Kamola, Emilia

In my research project, in cooperation with Karol Bronisz from Warsaw University of Life Sciences, I decided to investigate three samples of trees. The first attempt is black locust, the second and third attempts are Scots pine, but from different areas. The empirical data were collected from 1 black locust and 2 scots pine stands located in west Poland, In the R environment I created a script where I used models to calculate the thickness of the wood for all samples. The models were selected on the basis of the article "Biomass and stem volume equations in Europe". The following were also calculated: coeficient of determination, root- mean-square error and residual standard error. In the next step a residual analysis was computed to see how the residuals are distributed. Then, after comparing the given sample of indicators, I choose the most optimal formula for calculating the volume for a given sample. The aim of the test is to select the best model for calculating the timber thickness. The end result of my research project is a summary based on all indices and the distribution of the residuals of the best volume formula for a given sample. In addition to tables, there will also be graphical elements such as residual analysis.

Presentation on Thursday 27 of May of 2021 at 11:30.

Development, Testing and Implementing of Insect Catching Drones

Kamran, Shahrukh

The decline of insect populations observed around the world entails far-reaching ecological consequences. One of the first actions to be taken to better understand the impact of insect decline on ecosystems is to improve insect monitoring systems. However, considering the importance of flying insects as pollinators or feed for higher trophic levels, insect populations must be monitored at different heights.

This pilot study aims at developing an innovative method, using sweep-nets carrying drones to observe easily the abundance and diversity of insect populations at different heights, and different times in the day, in various sample sites, with limited or difficult access. This pilot study paves the way to future improved predator-prey and movement ecology studies in the coming years, combined with advanced tagging of swallows and chiropterans revealing exact foraging altitudes based on their movements.

Altogether 2,204 insects were caught via three different treatments. When comparing drones' catches, it was observed that insect numbers decreased with altitude. Among the habitats, the more diverse was the hedges, followed by rapeseed, wheat and grassland. Twice as many insects were caught during the second half (afternoon until evening) of the day. Out of two flight schemes (with wind and perpendicular to wind), the most efficient was perpendicular to wind. Between two net carrying drones (hanging net and fixed net structure), the most efficient was with fixed net. Despite major discrepancies among wind and temperature parameters, drone velocity, maintaining altitude manually, etc., the dataset is very informative and useful. The study also showed that drones can offer a worthy alternative to conventional sweep nets and suction traps provided that they become affordable for farmers, hunters, ecologist and entomologists.

Keywords: Agroforestry, Ecology, Entomology, Drones, Traps

Presentation on Thursday 27 of May of 2021 at 10:30.

Global Mapping of Forest Fires

Kückes, Reinhard

Fire is a natural part of many forest ecosystems, but human activity as well as climatic changes have increased fire risks in new regions of the world (Scott et al., 2013). During this research project we used remotely-sensed MODIS and VIIRS fire data to create global maps of annual burned forest area for the period 2002-2019, and to identify hotspot areas with increasing fire activity. These maps were published in an interactive web GIS portal to allow users to do their own analysis in regions they are interested in.

Presentation on Friday 28 of May of 2021 at 13:30.

Modelling Seasonal Variation of Occupancy Probability for a Large Herbivore in an Alpine Study Area

Kulshrestha, Anshika

Habitat is defined as the resources and conditions present in an area producing occupancy and determining the survival and reproduction of an organism (Morrison, M. L., & Hall, L. S. (2002)). Factors such as diet, behaviour, inter- or intraspecific competition, and the possibility of predation or hunting by humans can all affect where these habitats are chosen (Manly et al. 2002, Hirzel & Le Lay 2008). To assess the anthropogenic impact, a broadscale camera-study was conducted in study area Karwendel located in Bavaria. To test both static and dynamic variables responsible for ungulate habitat choice, an occupancy model was created to estimate the probabilities of detection and habitat use in red deer (Cervus elaphus). The aim of this internship project was to interpret how seasonality affects populations and as a result, the interpretation of surveys conducted during different seasons. The seasonal changes in the probability of occupancy for red deer in this study may have resulted from temporal changes in the study area such as the distributions of resources or the climate (Hebblewhite et al. 2008). Most top ranked models in all seasons included landcover variables like "canopy cover" and "forest cover"and had a positive influence on the probability of occupancy shown in the estimates of study. Methodologically, we demonstrated how projecting time-calibrated occupancy models may help to identify the effects of seasonal and climatic variations in the occupancy of red deer. We corrected for times when cameras had a propabilty of detection = 0 by filtering photographs that were covered with snow. Such a spatially- specific approach can be used to predict changes in occupancy and aid management decisions, such as wildlife zonation, co-occurrence relationships, human impact on wildlife distribution (e.g. Reimoser et al. 2009).

Presentation on Thursday 27 of May of 2021 at 11:00.

Statistical relation between Vegetation cover and Land Surface Temperature (LST) in Phnom Penh City

Mohiuddin, Gulam

This study assessed the correlation between Normalized Difference Vegetation Index (NDVI) and Land Surface Temperature (LST) in Phnom Penh City (Cambodia) within 2016-2020. Understanding the LST and NDVI can be helpful to understand the Urban Heat Island (UHI) scenario, and it can contribute to planning urban greening and combating the effects of UHI. The relation between NDVI and LST is a well-studied topic, and some studies focused on statistical analysis. Even though previous studies found a negative correlation between NDVI and LST, they could not agree on the magnitude of this relationship. The existing relevant studies produced a wide range of correlation coefficients (ranged from -0.18 to -0.78) depending on the sampling and analysis techniques. This study has implemented an approach that provides an alternative to the sampling-based statistical analysis and hence, a fresh look at the subject matter. The study used Landsat-8 images as the data for analysis. They have 100m spatial resolution (per pixel) in the thermal band. The current study is unique as it used an approach for the statistical analysis that considers every pixel from the study area instead of taking few sample points or analyzing descriptive statistics. Also, this is the first study on this study area (Phnom Penh) examining the correlation between NDVI and LST with a spatially explicit approach. The study found a strong negative correlation between NDVI and LST (coefficient range -0.56 to -0.59). This relation between NDVI and LST is possible to express by a simple linear regression model. This study showed a way to avoid the probable error from the sample-based approach in examining two spatial variables. The method is reproducible for a similar type of analysis on the correlation between spatial phenomena.

Presentation on Friday 28 of May of 2021 at 14:00.

A Machine Learning approach to predict Wildfire Burn Severity using Landsat-8 and LiDAR dat

Rahaman, Mir Mazedur

Wildfires, which caused by natural event or humans, are considered among the most dangerous and devastating disasters around the world. The availability of detailed, reliable mapping and periodic and immediate updates makes wildfire prevention and extinction work more effective. Their complexity comes from the fact that wildfires are hard to predict, hard to exterminate and cause enormous financial losses. To address this issue, many research efforts have been conducted to monitor, predict and prevent wildfires using several Artificial Intelligence techniques and strategies Machine Learning, and Remote Sensing. Remotely sensed imagery such as Landsat is well suited for capturing horizontally distributed forest conditions, structure, and change, while Light Detection and Ranging (LiDAR) data are more appropriate for capturing vertically distributed elements of forest structure.

The objectives of this study are successfully generated a burn severity map from Landsat images, processing the LiDAR data to obtained necessary matrices to build a dataset from the burn severity map and LiDAR metrics, find a correlation between the LiDAR metrics and burn severity and developed a Random Forest model to predict burn severity from LiDAR metrics. The research focused on a mountainous area of Oregon where recently a devastating wildfire occurred in August 2020. The Normalized Burn Ratio (NBR) and the differenced NBR (dNBR) were calculated from two dates of Landsat data (September 2020 and October 2020). While 36 LiDAR-derived metrics were calculated and together with the three-class burn severity from dNBR a dataset was prepared. The LiDAR-derived metrics and the burn severity classes were mostly correlated. In addition, the random forest model classification model gave a mean accuracy of 57%. The results were assessed using different validation approaches such as k-fold cross-validation, and classification metrics. The generated model will be a helpful tool to be used to predict burn severity in advance using the previously recorded LiDAR data. Furthermore, this roughly predicted result may help to identify fire zones where the authority can send supports to reduce the damages.

Presentation on Friday 28 of May of 2021 at 13:00.

Analysis & development of a web-based payroll management system

Rahman, Md Mahmudur

Payroll application has developed for the purpose of managing, organizing and automating the employee payment and allowances that need to be given to the employees of the institution. It also acts as a reporting tool for the employees salaries and helps the accounts department in many ways. The main advantages of such a system is that it reduces a lot of administrative tasks related to employees salary calculation which is time consuming and error-prone.

A small to medium sized garment factory in Dhaka needs to automated their salary calculation and it's reporting. Currently they are doing it manually by using excel sheet. But doing it manually for 600 hundred employees with their different role and contract is time consuming and higher probability to have mistakes in calculation. Sometimes accountant personnel send salary sheets to different employees than they are supposed to send. By considering the above mentioned problem, they are looking for the following solutions:

a. A solution that will manage the salary and employee information under the organization where Manager users can import, export employees salary data, allowance benefit, compare and synchronize with multiple employees information and calculate employees salaries. By using this system individual Staff users are able to claim their salary information and communicate with corresponding Managers under the organization.

b. Develop a mobile application whose development cost will be lower and at the same time it will run independent of the mobile platform.

Presentation on Thursday 27 of May of 2021 at 14:00.

Detection of windthrown tree stems on UAV-based orthophotos using a U-Net convolutional neural network and generic training data

Reder, Stefan

The ongoing climate change and especially, the associated increasing number of severe storm events are threatening the European forests (Forzieri et al. 2021). Besides the primary damages directly caused by storms, there are secondary damages like bark beetle outbreaks, soil compression and vulnerability to further storm damages. Moreover, there are tertiary damages as monetary drawbacks due to productivity loss and falling market prices (Gardiner et al. 2010). These secondary and tertiary damages can be minimized and partially avoided if a detailed overview of the affected area and the amount of damaged wood can be obtained as quickly as possible and included in the planning of the clearance measures.

The presented project aims on these challenges by analyzing UAV-born orthophotos with Convolutional Neural Networks to detect and quantify the thrown stems. Therefore, the U-Net architecture (Ronneberger et al. 2015) was adapted based on current developments in the field of environmental and biomedical image segmentation. For the training of the network, a 2-staged training strategy was implemented, using a huge generic training dataset created with a sophisticated data augmentations strategy and a smaller real-word trainings dataset. The influence of size of the generic trainings dataset, resulting from the numbers of augmentations per stem, was investigated.

In the first training stage, the three generic datasets with 10, 50 and 100 augmentations per annotated windthrown stem reached a validation F1-score of 97.1% (Aug10), 98.0% (Aug50) and 98.3% (Aug100). In the second stage trained with real-world data, they achieved validation F1-scores of 63.0%, 70.2% and 73.9%, respectively. Predicting independent test data, the Aug100 model reached 65.6%, slightly outperformed the Aug50 model (F1-score 64.4) and the Aug10 model (F1 score 61.3%).

These results emphasis the applicability of the proposed architecture and training strategy suggest further generalization by collecting training data from other windthrown areas.

Presentation on Friday 28 of May of 2021 at 10:00.

The Impact of Agroforestry on Farmland and Crop Production in Löwenberger Land, Brandenburg, Germany

Sinan, Muhammed

The importance of forest and agriculture in the environment has a crucial relationship that is essential for all living things. Hence, the protection of these two should be prioritized and one of the best practices is agroforestry, which is a collective term for land-use systems and technologies where woody perennials are intentionally used on the same land-management components as crops or animals. Farmers can also get both direct and indirect benefits through agroforestry practices. In this circumstance, the Department for Forests and Environment of the University for Sustainable Development at Eberswalde, Germany (Hochschule für nachhaltige Entwicklung) had developed an agroforestry plot with alley cropping agroforestry system in a small village named Großmutz, Löwenberger land, in the federal state of Brandenburg, Germany in 2017. The reason for this project is that there are only a few practical examples of agroforestry in Germany compared to other European countries and the world. The project is designed as a long-term study and addresses central issues of conservationists and land users. Hence, the main objective of this study is to recognize how the land is changed after the project implemented with remote sensing and geographic information system (GIS) techniques through vegetative and water indices like Normalized Difference Vegetation Index (NDVI), and Normalized Difference Water Index (NDWI). Sentinel 2 data were used in this study assessment. This study discovered that the vegetation and water content have increased these years of examination. This study also analyzed how agroforestry affects the productivity of crops and found that the yield of crop production between 2016 and 2020 are varying. To validate the relation of trees in the agroforestry plot and the changes in the crops should be done with more precise study in the future with better methodology.

Presentation on Thursday 27 of May of 2021 at 13:00.

Database of Forestry Students' Scientific Association WULS

Smyk, Jakub

The student scientific movement is a special educational phenomenon. There are several scientific associations at the Warsaw University of Life Sciences with various fields of activity. Of these, the Foresters' Scientific Association (KNL) is the largest student scientific organization and has the most diverse spectrum of research interests. The complex and multifaceted nature of the KNL makes it possible to show on its example what improvements should be implemented in the management of a student research organization. A problematic issue in the management of the KNL is the recording of events and achievements occurring within its activities. Meticulous recording and storage of KNL data in an orderly manner seems to be important both for streamlining current factual reporting and providing complete information for historical studies. In view of the above conditions, the aim of the study was to design an electronic database for storing and processing historical data of KNL, as well as to fit their structure. The improvement of KNL factual reporting by means of a database was realized on a trial basis on the example of the Section of Forest Botany, as this section was the first to have its history comprehensively compiled. The database was designed in MS Access, placed on a university network drive, made available to authorized users and then filled with Section history data. An application with a user-friendly interface was programmed in VBA language to operate the database. The database contains 22 tables that store data on the overall activities of the Forest Botany Section. It allows, among others, to create lists of scientific papers, research camps, tutors or members of the Section as well as to generate reports summarizing the activity of the Section of a given year or the achievements of a selected student. The KNL database, properly exploited, may significantly improve the reporting and the creation of studies on the KNL activities.

Keywords: research association, database, history, MS Access

Presentation on Thursday 27 of May of 2021 at 14:30.

Investigating the effect of seasonality and flight line overlap on modelling forest stand characteristics from large-area LiDAR acquisitions

Wolf, Jonathan

The aim of the research is to present the difficulties that may arise when using large-area LiDAR acquisitions for the modelling of forest stand characteristics. This is the first step in a larger project, where LiDAR data is used as auxiliary data for model-assisted estimation of population parameters describing the state and change of the forests in Thuringia. During this pilot study, efforts were limited to tree trunk volume as a proxy for other target variables. Tree trunk volume was modelled using the area-based method for three beech (*Fagus sylvatica*) stands using a two-parameter, multiplicative model. Mean height of LiDAR returns and the percentage of returns 2 m above ground were chosen as the predictor variables.

The research questions are: (1) How do differences in acquisition time (leaf-on/leaf-off) affect the modelled tree trunk volume?; (2) How strong is the effect of varying point cloud densities due to overlapping flight lines?; and (3) Is there any benefit by applying species-specific models.

Seasonal leaf conditions show significant differences, which are characterized by decreasing values of tree trunk volume for leaf-off conditions. The application of species-specific models also leads to obvious differences and therefore illustrates the need for models that are adopted to leaf conditions and particular species. Thinning out the point cloud to the minimum point cloud density, which in this case was around 4.5 points per m^2, resulted in a slight decrease compared to leaving the point cloud in its original varying density. However, the clear pattern shown in the results of this research suggests that efforts to achieve even point density to ensure comparability are reasonable.

Presentation on Friday 28 of May of 2021 at 11:30.