

## **AI4AGRI Summer School Braşov - Romania**

**David Hansen - 12315428 - June 10, 2024**

In the following I want to report on my experience at the AI4AGRI summer school that I attended together with my classmate Rohit Khati and with financial assistance from the University of Salzburg. At first, I will introduce myself and the reasons for my application together with what I expected before the stay. After that, I will present the stay from the journey to Romania to my personal learning outcomes during this week, including a day by day schedule and the possibilities for networking.

### **1 Who am I**

I am David (27); a master's student in the Erasmus Mundus Joint Master Degree Copernicus in Digital Earth which is hosted by the University of Salzburg, Université Bretagne Sud (in Vannes, France) and Palacký University Olomouc (in Olomouc, Czech Republic). After the first year at the University of Salzburg, which is focusing on Earth Observation (EO), students can choose between two specialization tracks that are hosted by the partner universities in France or the Czech Republic. Now, after almost two semesters in Salzburg, I will soon move to France for my internship and studies in the specialization track on data science for EO data.

Before starting my master's in October 2023, I studied Forestry and Environment at the University of Freiburg where I first got introduced to geoinformatics, earth observation and remote sensing. Through my work as a research assistant my bachelor's thesis emerged, where I trained a convolutional neural network for the estimation of individual tree parameters from LiDAR point clouds. This led to my decision to delve deeper into data science and earth observation. In the future I want to use my newly gained knowledge to enhance and digitize forest management.

### **2 Reasons for the application**

To promote the networking opportunities and diverse learning experiences during the program, participation in at least one summer school is mandatory. With my forestry background I already bring experience in a major applied field for remote sensing and EO. In the last two semesters I gained deeper knowledge in earth observation and machine learning through the diverse courses Z\_GIS and the Faculty of Digital and Analytical Sciences have to offer (e.g., Applied Machine Learning, Computer Vision, Advanced Remote Sensing). When I heard about the AI4AGRI summer school, I immediately knew that this summer school might fit perfectly to my academic path and interest. The opportunity to come back to an applied field of my interest after one year of more technical studies sounded very promising.

### 3 Journey to Braşov

I would describe myself as an ecological person. At least, I try to reduce my carbon impact in my everyday life. This is why I try to travel by public transport as much as possible even for long distance journeys. So, I was happy to see, even though Braşov is more than 1000km away from Salzburg, it is possible to reach the city by train. Because we booked our tickets from the Romanian railway company website the cost for tickets perfectly matched the funding for travel costs from the University Salzburg.

Our journey to Braşov began at the 6th May after the last class was over. We started with a 6 hours train ride to Budapest from where we took the night train to Braşov. We checked in and shared the cabin with two Germans, a Russian national volleyball player and a Romanian woman. In these old trains that come from a different decade, the journey to Braşov became more than just a normal ride from A to B. Of course, the beds are not the most comfortable ones, and the wagons are quite noisy. Thus, we did not get the best sleep. But the most special experience during the journey was the border control between Hungary and Romania. As a European citizen, I am not used to border controls anymore. In a year with difficult European elections, this again reminded me how important the European project is for all of us. After we made it through both checks everything went smoothly. Again, after a short sleep, we could enjoy the view on the Transylvanian countryside and arrived at Braşov around 10 a.m. at the 7th. In total we traveled around 20 hours. Since the summer school started at the 8th of May, we had a sunny day before us to explore Braşov before the lectures began.

After the summer school ended at the 14th of May, we took the same way back to Salzburg. Our way back started in the evening of the 14th in Braşov. This time we shared the cabin with 4 others and a cat but did not encounter anything special other than we already experienced a week before. We arrived back in Salzburg at the 15th of May in the afternoon; again after a 20 hours journey.

### 4 AI4AGRI

The AI4AGRI summer school is named after its host, the 'Romanian Excellence Center on Artificial Intelligence on earth observation data for AGRICulture'. AI4AGRI is a twinning project, funded by the European Union under the Horizon program. As a twinning project research partners from France and Italy (Paul Sabatier University and Jean Jaurès University - both Toulouse and Tor Vergata University of Rome), as well as the National Institute of Research and Development for Potato and Sugar Beet. As the name implies its main research target is the application of machine learning algorithms EO data to improve agricultural management.

## 4.1 Day by day schedule

In the following the daily contents of the summer school are displayed. Each day - except of the weekend - was structured the same way. The lectures started at 09:30 and ended between 5 to 6 p.m. With few exceptions, breaks were scheduled after two lectures. There was a coffee break every morning and afternoon; at noon the summer school provided lunch for all participants. Depending on presentation the lectures had more or less practical parts. Mostly, these came in the form of prepared notebooks that could be executed by the participants.

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**Day 1** At the first day we officially 'checked-in'. In return for our signature, we received a welcome bundle with material for notes and additional information on the summer school. With a short delay the official welcome of the summer school began with an introduction of Prof. Mihai Ivanovici. The subject of the first day was an introduction to machine and deep learning focusing on EO data. The theoretical part was presented by Prof. Josiane Mothe. In the afternoon a practical example was given by Dr. Nathalie Neptune who presented different strategies for applying pretrained neural networks for EO image classification.

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**Day 2** At the second day, Prof. Fabio Del Frate focused on a broader introduction to earth observation data from a strong physical perspective. Main content of his presentation were radiative transfer, optical and radar remote sensing. His presentations were followed by code snippets for band index calculations for Google Earth Engine. In the afternoon, Prof. Corneliu Florea presented semantic segmentation deep learning models with application in agriculture.

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**Day 3** In the morning Radu-Mihai Coliban presented manual and automatized visualization methods for hyperspectral images. Prof. Ivanovici held the first part on his presentation on digital transformation in agriculture. In the afternoon, Prof. Yajing Yan provided extensive knowledge on SAR processing and SAR time-series analysis.

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**Day 4** At the first day of the weekend we visited National Institute of Research and Development for Potato and Sugar Beet next which is closely located to the building we have been the days before. After a short presentation of the ongoing research at the institute we were shown different Romanian types of potatoes in addition to ground measurement systems for typical agricultural parameters (e.g. soil moisture, NDVI). After that we heard the second lecture on digital transformation in agriculture from Prof. Ivanovici that focused on a deep learning model for soil roughness estimation. Outside of the institute we were able to try out a handheld NDVI-meter and a device to measure the chlorophyll content of leaves. At around 12 a.m. the official part was over. We used the time after school to hike mount Tâmpa.

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**Day 5** On Sunday, we were lucky to be able to see one of Braşov’s most important events during the year. The Junii Braşovului, men (and one little girl) in the traditional clothing of Transylvania, descent with horses from the upper part of the city to the city center and back again, to bring back the crown that gave the city its German name ‘Kronstadt’.

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**Day 6** After the weekend the school started with the complex research field of hyperspectral unmixing for endmember recognition. Dr. Behnood Rasti presented multiple deep learning methods and his Python package for unmixing. After that Prof. Mihai Nita introduced us to the GEDI laser data that is captured from the ISS for global forest carbon stock estimations. Both lectures were supported by practical code examples for Google Colab and Google Earth Engine. In the afternoon Prof. Enrico Borgogno Mondino held an extensive presentation on aspects on UAV data for agricultural applications.

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**Day 7** At the last day Prof. Mihai Ivanovici presented his work on fractal analysis for EO data. After that the summer school officially ended after lunch.

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## 4.2 Networking and social events

In the sometimes lonely work in scientific institutes, it is a really good change to meet people who are interested in the same things. Even though lectures took a lot of time, the breaks and evenings made it possible to connect to new people; junior and senior researchers; from all kind of related fields. A lot of participants came from Eastern Europe two major groups from France and Italy and a few people from Central Europe. Much to our surprise, we were the only ones from Austria. An outstanding experience was that everyone was very happy to connect to people. No matter what academic position, all participants and lecturers very open to questions topic wise and in terms of questions on the academic career.

## 4.3 Personal learning outcomes

To a large part, the summer school focused on general information on machine learning and EO both topics I was intensively working on in my last months in Salzburg. I liked this repetition, because I could clearly see my learning outcomes in these fields. Different as expected, the summer school did not feel like it had a specific focus on the application of machine learning models for agriculture. Only a few operational examples were given. If applied models were shown they rather worked on EO data that was used to gain information for agricultural management. However, this is not at all a negative point for my learning outcomes. First, my expectations were just wrong. To have a focus on the application of machine learning models for earth observation data is what the research cluster is all about. In addition, it was like this a good first experience for me, to see the diverse possibilities for the deployment of machine learning models for information retrieval for agriculture.

The lectures on the application of unmanned aerial vehicles for ecological and agricultural research were really great, too. As this is a surveying technique, that I want work with, when I come back to research for forest inventories. It helped me a lot to understand the technical difficulties the method implies. In addition, I really liked to get introduced to fractal models for EO data. A technique that could have big impact on the modeling of tree structures - which is of high interest for me. The lecture on Synthetic Aperture

Radar processing was more challenging, but because I worked a lot on my understanding of this remote sensing technology, I was very excited to be able to delve deeper in to the topic of InSAR time-series analysis and more advanced radar processing.

## 5 Conclusion and Acknowledgements

All in all, the summer school was a great experience for me. It helped me a lot to see the progress I made in Salzburg and added a lot of things on my list of topics at are worth having a look into. It also gave me new energy for the upcoming time in France where I will deeply focus on machine learning for EO data. Connecting to so many open - and especially young - researchers was a pleasure. During these very important times for the European Union, it was great to see that, even though we are working at different universities in different countries, the European values are held high all over the continent.

First, I want to thank again the University of Salzburg for their funding. With their financial help it was possible to cover the whole traveling costs and support the costs of living during the week in Braşov. I also want to thank the European Union that funds the AI4AGRI project.

I would recommend this summer school for everyone interested in machine Learning and EO. Since the upcoming summer schools will try to shift to focus to more applied/operational topics there might be less of a repetition as this year. In addition to the academic experience, I would like to recommend the city Braşov and Romania itself. From what we have seen in this one week I can say that the Romanians were exceptional hosts that were very happy to have us there. Braşov and the forests next to city are beautiful and worth a hike.