

Internship at Spatial Services GmbH



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spatialservices

WHERE GEOINFORMATION MEETS TECHNOLOGY

Table of Contents

| | |
|--|---|
| Acknowledgement..... | 2 |
| Overview and a simple introduction to the company..... | 3 |
| Tasks Accomplished | 4 |
| Experience and Recommendation..... | 5 |

Figures

| | |
|---|---|
| Figure 1: Sample of density map | 6 |
| Figure 2: RefCamp App for dwelling extractions | 7 |
| Figure 3: Outcome of Deep learning in ArcGIS pro..... | 8 |
| Figure 4: Model for refining deep learning result | 9 |

Acknowledgement

My internship at Spatial Services was particularly valuable. I'd like to thank Hubert Schöndorfer for this opportunity, as well as Ahmad Alobaidi for his supervision and guidance across the whole of my internship period. Meanwhile, I'd like to express my appreciation to Kristyna MechurovaIt and Markus Kerschbaumer for supporting me in becoming acquainted with the office environment as well as for your guidance throughout my internship. It was a fantastic opportunity for me to learn a variety of skills from the professional team at Spatial Services GmbH.

Furthermore, I would like to express my heartfelt gratitude to the entire Copernicus Master in Digital Earth committee for guiding me to choose Spatial Service as my working place and allowing me to gain such valuable experience.

Overview

The addition of some professional experience is critical for maximizing the return on education. Internships are a great way to gain professional experience and can serve as a springboard for long-term professional success. Towards the end of my first semester of my master, I was looking for an internship opportunity to meet the requirements set forth by EM CDE for completion of the course and to expand my work experience. With the goal of finishing it by the end of the second semester and before moving on to my specialization track in France, I looked for several organizations that work in the geospatial domain.

During my search, I learned about many organizations working in the geospatial domain over Europe. However, because of the pandemic, I wanted to stay in Austria and thus I applied for an internship at Spatial Service, which was well-known in Europe for its contributions in the field of geoinformatics. When applying for the internship I knew Spatial Service as a spin-off from the University of Salzburg that develops and implements geoinformation products and services. I was encouraged to forward my request after attending a presentation from Peter Zeil, Gina Schwendemann and Ahmad Alobaidi about their contribution to humanitarian action during a conference session in the Geo-Humanitarian Action course.

A simple introduction to the company

Spatial Services GmbH is a service and consulting company located in the Science City in Salzburg, with a tagline of "Geoinformatics Meets Technology: We are spatial experts". They aim to develop and implement geoinformation products and services aiming at resource-efficient and sustainable development in support of climate change adaptation, stable livelihoods, secure energy supply as well as smart city and mobility planning. They focus on Earth Observation data exploitation, sensor system and integration of spatial indicators. As a spin-off from the university, the company represents a link to research results from the Interfaculty Department for Geoinformatics, Z_GIS and incorporated their developments for creating improved user-oriented products.

When interviewed by Hubert Schöndorfer and Ahmad Alobaidi, I was given an opportunity to express my field of interest and skills in GIS-related applications and programming language. Also, I expressed my willingness to work on any project that would help me improve my understanding of EO and GIS. From March 1, 2021, to July 24, 2021, I was hired as a paid part-time intern for Spatial Service GmbH for a humanitarian related project. As required, I completed the total working hours that correspond to the normal time equivalent to 8 weeks of full-time employment.

Tasks Accomplished

Spatial Services GmbH handled many projects for Médecins Sans Frontières (MSF) and other humanitarian organizations. Some of these projects involved extraction of dwellings in Refugee & Internally Displaced Persons (IDP) camps and updating of some of the previous projects due to abrupt changes in the size of the refugee or IDP camps. I was given the opportunity to participate in several tasks regarding these projects.

Image Tasking and Dwelling Extraction in refugee camps

When a service request is activated, it's critical to provide an up-to-date database of image availability. The creation of the dwelling maps necessitated the use of very high-resolution satellite imagery (Airbus, Pleiades, SPOT, etc.) and, depending on the map's purpose, satellite mission tasking. This involved a periodic data search, gaining access to data from various sources, and selecting the most appropriate images based on the area of interest. In Airbus, we were guided through the image tasking procedure for a specific area, followed by perusing the product. The step of image tasking was then followed by performing basic image pre-processing steps.

Once the data was ready, using a deep learning algorithm built on ArcGIS Pro, semi-automatic dwelling extraction was used to extract the dwellings from the imagery, though fine tuning and manual editing were done in ArcGIS Pro to fully

achieve the result. During this task, I worked on the dwelling extraction project for small parts of Sudan, Somalia and Democratic Republic of Congo.

Dwelling Density Maps

Following the task of dwellings extractions, ArcGIS pro was used to generate dwelling density maps for MSF tasks involving refugee camps. These maps can help decision-makers make more informed decisions based on the requirements uncovered by the analysis.

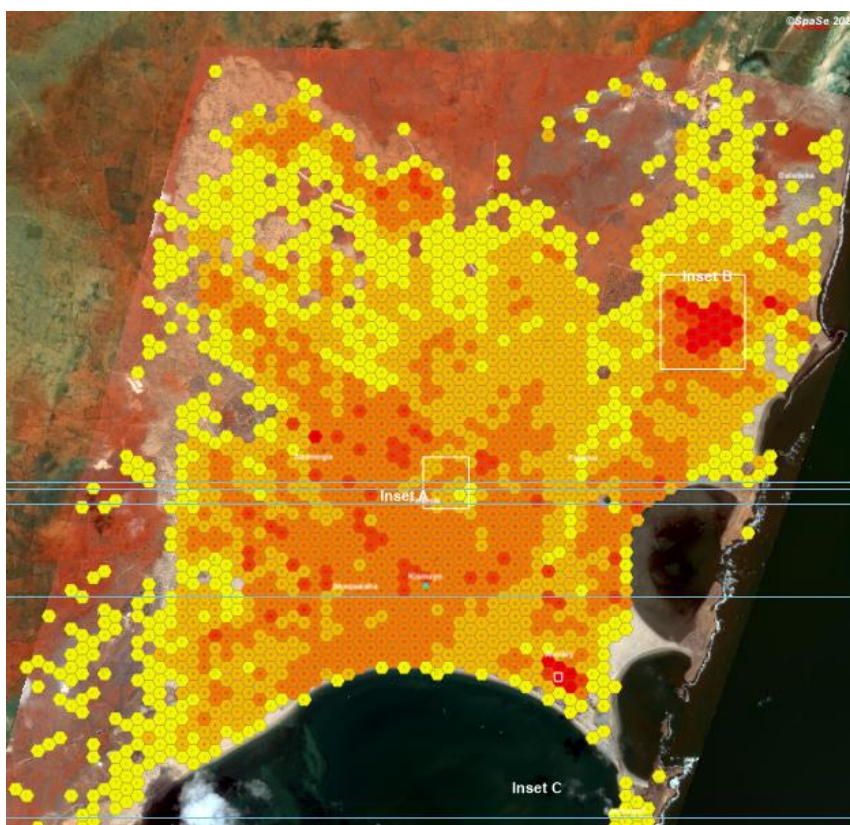


Figure 1: Sample of density map

Figure 1 is an example of the dwelling density layer generated during this task. The dark red tessellation represents the region with large number of dwellings whereas the yellow represents the comparatively lesser dwellings in those areas.

Implementing Machine Learning for Dwelling Extraction in eCognition

Despite the fact that the deep learning model was now implemented in the initial dwelling extract, I was also guided through the working procedures and dwelling extraction using machine learning algorithms-based application in ecognition developed by ZGIS called RefCamp App. We used this app library to perform an

experiment in ecognition developer for dwelling extraction for a small region of Mozambique. I was able to gain insight into the rules set used in this process while working on this task. Figure 2 shows the outcome that we achieved in this process along with the eCognition based GUI.

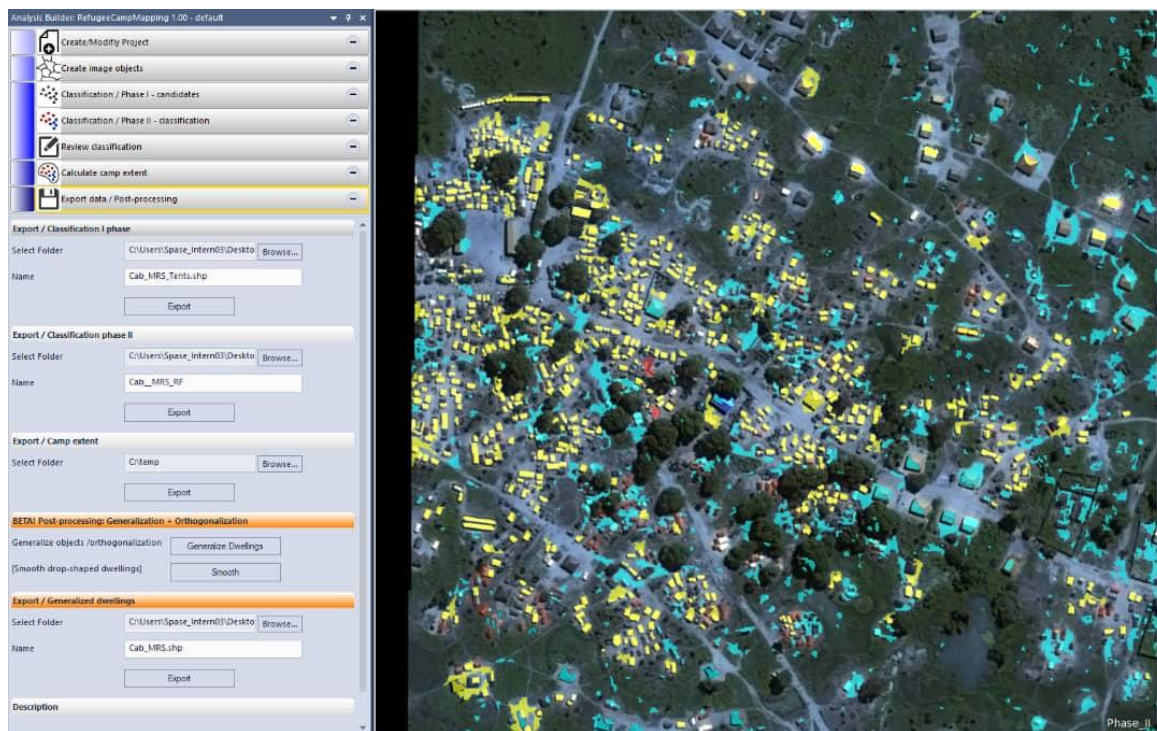


Figure 2: RefCamp App for dwelling extractions

Here, yellow polygons represent the well identified buildings of quad shape whereas blue are for building with different shape than quad. This task increased my knowledge on ruleset creation in ecognition and steps machine learning ability of the software.

Working with Deep Learning Model for Dwelling Extraction in python environment of ArcGIS pro.

Mask R-CNN Deep learning approach was used in the extraction of dwellings. The process involved general dwelling extraction without any classification. Here, we were provided with high resolution commercial data, and training samples was generated from few manually extracted dwelling. These samples were exported to a format compatible with a deep learning model for training. To get familiar with the task and methods involved this task was done with both ArcGIS pro toolset

for Deep learning and using ArcGIS pro notebook by setting up the environment as per required for the task. Figure 3 represents the final outcome achieved during this task.



Figure 3: Outcome of Deep learning in ArcGIS pro

Here, yellow polygons represent the samples fed to the model whereas the red polygons are the outcome of the process. Though the visually the result was not much appealing but I was satisfied with my work and the knowledge I gained regarding several parameters that are involved in affecting the results.

Finally, a model of sequential tool was created in ArcGIS pro using model builder for filtering and refining out the deep learning results as a part of post-processing step. One of the tools in the model was dedicated in dissolving the multipart to single part to avoid the duplicity of the dataset. The model looked like as shown in figure 4.

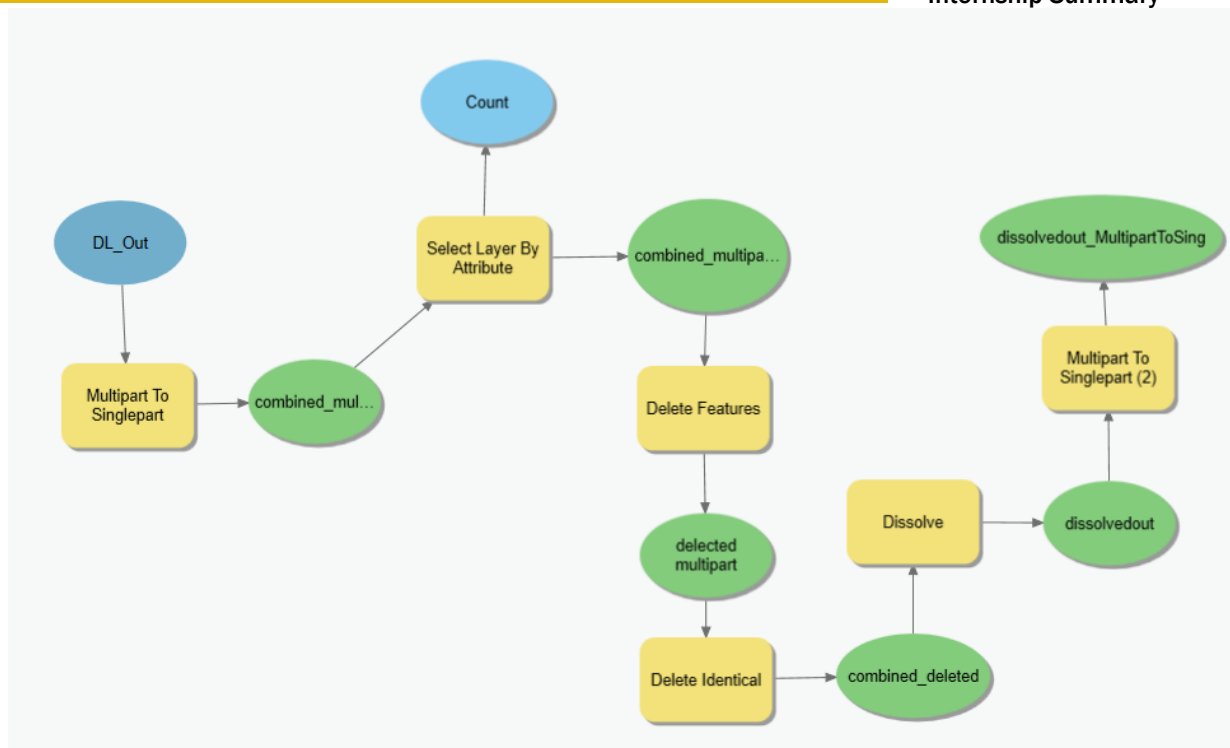


Figure 4: Model for refining deep learning result

Experience and Recommendation

Spatial Services have a good work atmosphere and encouraging team members. During my stay at the workplace, I was introduced to office activities and was able to complete the tasks that were allocated to me while doing my best to meet the expectations. Though initially, the task was more about GIS than EO and programming, it was enough to broaden my humanitarian knowledge base and lay a good learning foundation on which to build more humanitarian knowledge. Later, I was provided with the opportunity to improve my knowledge in Machine Learning for dwelling extraction that not just helped me to understand the terminologies involved in the process but also helped in gaining ability to solve the error that appeared during the process through research.

In addition to the office work, these tasks guided in performing research on dwelling extraction using deep learning algorithm built in eCognition environment. As a result, my teammate Tanya Singh and I came up with the idea of developing a GUI in ecognition using deep learning model in dwelling extraction as our integrated project, based on our knowledge of dwelling extraction through ecognition using machine learning and through ArcGIS pro using deep learning.

With the completion of my internship at Spatial Services, I am excited and confident in my ability to work in the field of Geo-Humanitarian utilizing my knowledge on spatial science. I was able to discover and learn more on spatial use for humanitarian. As I worked as a part-time intern while also attending classes, I developed a sense of time management by distributing my time in such a way that I could properly complete tasks assigned to me both in the office and in class. Also, I am delighted to congratulate Spatial Service on winning the "2021 EARSC EO Partnership Award for humanitarian downstream service." I'm happy to be a small part of this group.