**4-year PhD Position in Geoinformatics: Detection of small-scale landscape elements located on agricultural fields with deep learning**

The European Union created the Common Agricultural Policy (CAP) in 1962, which aims to provide European farmers with a sustainable environment, enhance agricultural productivity and to supply with numerous other goals beneficial for everyone. There are various measures in CAP to achieve these goals - one of them is greening. The presence of landscape features, such as linear vegetation patches, ditches, or small forest islands on agricultural fields, is an important part of greening. It has a positive effect on landscape diversity, animals' biodiversity and habitats connectivity. Mapping such landscape elements manually is very time-consuming work and not very practical for large scale mapping.

The aim of this PhD project is to develop deep learning (DL) based methodology, which would allow to provide reliable detection of landscape elements (stone walls, hedgerows, small forest patches) on agricultural fields in Estonia on a national scale.

The project will mostly use freely available remote sensing data and open-source software for building the DL workflows. Training data for the DL models will be generated by digitizing small landscape elements from orthophotos. Additionally, the LiDAR-derived digital elevation model will be used as a potential secondary input layer for the DL models, since taller features (e.g., trees, bushes) in small forest patches can be distinguished from surrounding fields. The DL models will be based on the convolutional neural network (CNN) architecture, such as the U-Net, which has successfully been used for segmenting landscape elements from remote sensing images in recent years. The PyTorch4 Python package will be used for developing the DL models. To apply the models effectively on a national scale, the TorchGeo5 Python library will be utilized.

DETECTING LANDSCAPE ELEMENTS WITH DEEP LEARNING
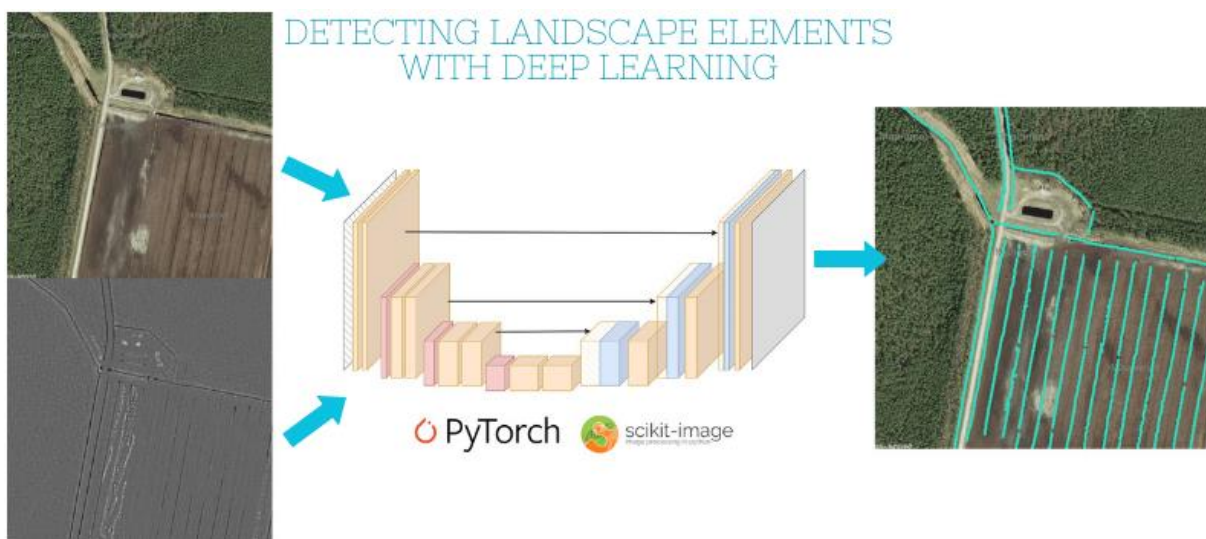
The resulting models can be used for detecting small-scale landscape elements (stone walls, hedgerows, forest islands and linear forest slivers) on a national scale, which enables governmental institutions like the Estonian Agricultural Registers and Information Board (PRIA) and the Estonian Land Board to automate some of their workflows. The models can also be used in other countries with similar landscape elements and landscapes.

The research is part of the "Creating Water-Smart Landscapes" project funded by European Research Council and Centre of Excellence for Sustainable Land Use. The PhD student will be working in the Landscape Geoinformatics Lab in the Department of Geography, University of Tartu.

Core tasks include:

- literature overview of the state-of-the-art DL methods for image segmentation and object detection from remote sensing data
- generating training data from orthophotos, model architecture selection and testing
- developing DL workflow and training the models (detection of stone walls, hedgerows, forest patches on agricultural fields)
- writing and publishing open-source scientific code

Requirements

Master's degree in geography, geoinformatics, quantitative ecology, physics or wider spatial and natural sciences.

The ideal candidate has proven experience in following essential skills:

- spatial analysis and GIS, comfortable with QGIS
- scripting of workflows and data analysis with Python or R
- experience in machine learning
- confident in English language spoken and written. See more info about language requirements https://ut.ee/en/sisu/phd-language-requirements English language test must be submitted by 15th of May
- good communication skills and willingness to work in a team

In addition, following skills would be beneficial:

- understanding of and experience in using deep learning or computer vision methods
- understanding of landscape processes (physical geography)
- experience with tracking code with version control systems (e.g., Git)
- experience using the PyTorch and scikit-image Python libraries

Desired knowledge

Priority will be given to candidates with experience in spatial data analysis, programming knowledge (especially in Python) and machine learning. For shortlisted candidates, we will also aim to assess technical and spoken communication skills in an online interview.

Funding and Health Insurance

The position is fully funded. Full-time PhD student will be on a junior researcher position with gross salary of 1830 EUR (net approx. 1450 EUR) as minimum with expected increase of 5-10% per year. Living costs in Estonia are very reasonable and the allowance can cover your living costs.

All PhD are provided with Estonian national health insurance. Health insurance coverage is available for the full nominal study period of PhD studies (4 years). University is also covering regular health checks and some health improvement (e.g. gym, swimming) costs for the staff members.

Living in Estonia

In Estonia you will be living in a highly connected society, with free wireless Wi-Fi almost everywhere. Many everyday activities are made easier with various IT solutions: register a company with as little as 18 minutes, park your car with phone, register courses online etc. Entrepreneurship and innovative solutions are highly welcomed in Estonia, which has a strong start-up community and has also become known as the Silicon Valley of Europe. Student life in Estonia is full of activities and events. There are many organizations and events that help foreign students to settle into Estonian life and create a social network in the country. For more information about Living in Estonia https://studyinestonia.ee/living

Start of the studies: 2nd of September 2024

To apply

Please submit the following materials via email to evelyn.uuemaa@ut.ee by **20th of March** :

- A one-page letter of motivation explaining how your prior research experience qualifies you for the position and why you would like to work on this topic.
- Copies of both bachelor's and master's diplomas, and diploma supplement (bachelor's and master's transcript/mark sheet, including the description of the grading scale). Applicants graduating in 2024 and having their diplomas issued later than the application deadline, should electronically submit their most recent official Transcript of Records by the required deadline along with the rest of the required documents. Please note that you must have graduated from your master´s studies by 1 August, 2024.
- A two-page CV (including publications if available).
- Names and contact details for one reference.
- Applicants selected for an interview will be contacted before the end of March 2024.