Abstracts

Machine Learning and Stochastics:

Name: Bas van de Kerkhof

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Presentation title: **Information extraction from dynamic PS-InSAR time series using machine learning**

Using machine learning algorithms we extract relevant information from PS-InSAR time series. We cluster (group together) time series with similar behaviour, even though they may not be spatially close, such that the results can be used for further analysis. Our approach is to apply t-distributed Stochastic Neighbor Embedding (t-SNE), a machine learning algorithm for dimensionality reduction of high-dimensional data to a 2D or 3D map, and cluster this result using Density-Based Spatial Clustering of Applications with Noise (DBSCAN). The results show that we are able to detect and cluster time series with similar behaviour, which is the starting point for more extensive analysis into the underlying driving mechanisms.

Authors

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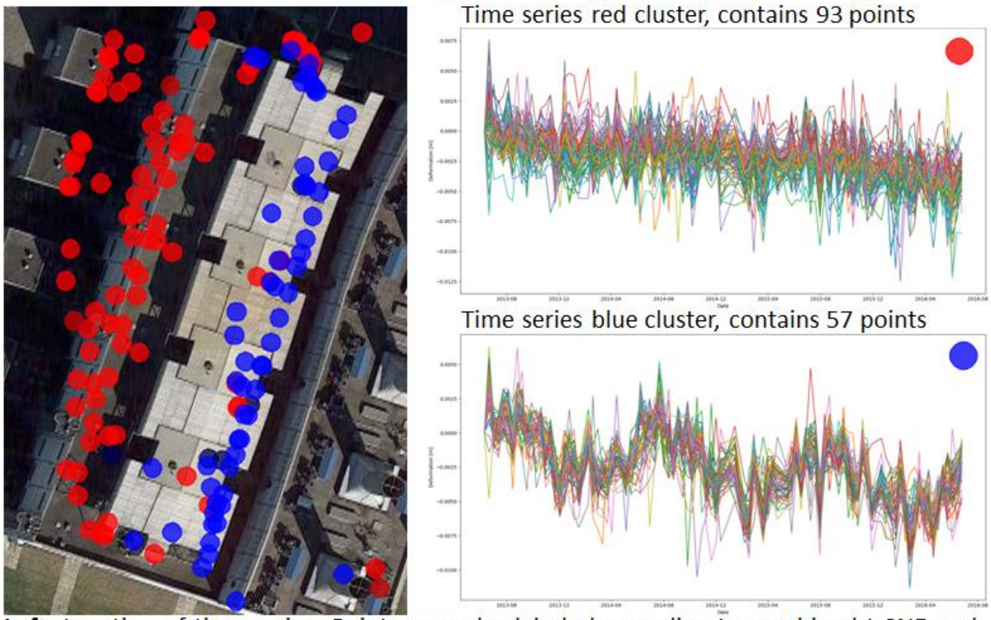
Results from information extraction from dynamic Persistent Scatterer InSAR time series using machine learning



Left: Location of time series. Points are color labeled according to combined t-SNE and DBSCAN output. **Right**: Time series corresponding to red and blue clusters on top and bottom respectively. **B. van de Kerkhof**

Acknowledgements:
NASA AIST-NNX15AG84G
(PI V. Pankratius)

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Presentation title: **Optimal stochastic merging of laser scanning and SAR interferometric data**

Laser scanning (either terrestrial or airborne), and SAR interferometric data both yield point clouds. Point positioning precision is expressed using the metric defined by the particular sensor. In order to optimally interpret the radar-derived deformation data, we provide a tailor made visualizationof both data sets in the same reference system.

Name: Kaixuan Zhou
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Presentation title: **Fusing BAG Building Boundaries to Enhance Edge of AHN2 by Using Continuous Markov Random Field**

The points around the edges of buildings in AHN2 are quite noisy due to the resolution of AHN or
viewing angle of airplane. On the edges, the points are distributed randomly on the roofs,walls or
grounds. If the points are used for generating 3D model or DSM with very high resolution, the accuracy
of the results on the edges will suffer from this effects. The idea is to use building polygons from BAG
with high accuracy to enhance points along the boundaries. These polygons from BAG give very precise
location of walls of buildings, which means (1) If the roofs are not overhanging the walls,the polygon
lines give very accurate edges for AHN. (2)If the roofs are overhanging the walls, the polygon lines give a
wrong indication. In order to best use the first feature and avoid the second feature to affect the result,
the assumption that roofs commonly have continuous planarity information is employed. Therefore, a
Markov random field can be applied to extend reliable planarity information inside of roofs to
reorganize the points on the edges, while the boundaries of BAG polygons are used to allow
discontinuity on the different sides. The point clouds are converted to DSM with a higher resolution. If
edge pixels of the high resolution DSM are enhanced, the points can be derived for enhancing the edges
in the point clouds as well. As the planarity and continuity information can be presented by normal and

position, these information can be parametrized to three continuous parameters instead of standard discrete problem in image domain: two normal parameters and the height parameters. Therefore, a particle simulation belief propagation approach is applied to solve the continuous MRF problem.

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Presentation title**: Point cloud classification by map guided interpretation**

Nowadays highly detailed images and point clouds are acquired to capture the shape and state of objects at the earth surface. The key challenge is to correctly classify the objects in the image and point clouds into meaningful classes. We present research plans how highly detailed map data can be used to automatically interpret point clouds. The map acts as an extremely detailed training dataset for classifying the point cloud data. By learning characteristics for all specific classes in the data at a national level, we build a classifier that can deal with an enormous amount of circumstances.

Name: Aji Putra Perdana

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Presentation title: **Crowd -based Place (names) information from (Big) Geosocial Data**

Nowadays, people become producer and consumer of crowd-based place names information in social media. Mobile and web-based platform provide social media “check-in” and significantly increased (big) geosocial data creation. Gamifying crowd-based place names information procedure developed by social media platform; such as Foursquare, Facebook Place Editor, Google Map Maker and Google Local Guide. We analyze the place information or description, contributor, and community involved in geosocial media. We argue that the richness, vandalism and potentially (big) geosocial data brings the new paradigm of place names information for Geographical Names Authority to deal with “unofficial” place names. In this paper, we present lesson-learned from geosocial media crowdsourcing place (names) information.

Name: Shayan Nikoohemat, Michael Peter, George Vosselman

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Presentation title: **Semantic labelling of Point Clouds in Indoor Environment**

We present a method for adding semantics to the point clouds of indoor environment. The point clouds may be acquired by Mobile Laser Scanners (MLS), Terrestrial Laser Scanners (TLS), Microsoft Kinect and Google Tango. We present methods for detecting openings, adding room segmentation and wall composition. In this research we address the problem of dealing with complex, non-Manhattan World structures that entail clutter. Our method restructures contextual information of indoor objects and their spatial relation in a hierarchy tree to learn semantic information.

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Presentation title: **Harnessing the power of deep learning for Digital Terrain Model extraction from challenging photogrammetric datasets**

Existing algorithms for Digital Terrain Model (DTM) extraction still face difficulties due to data outliers and geometric ambiguities in the scene. To address these challenging areas, we propose a method which harnesses the power of state-of-the-art deep learning methods, while showing how they can be adapted to the application of DTM extraction by (i) automatically selecting and labelling dataset-specific samples which can be used to train the network, and (ii) adapting the Fully Convolutional Network (FCN) to utilize both imagery and elevation information and to consider a larger surface area without unnecessarily increasing the computational burden. The method is successfully tested on three datasets, indicating that the automatic labelling strategy can achieve an accuracy which is comparable to the use of manually labelled training samples and outperforms two reference DTM extraction algorithms.


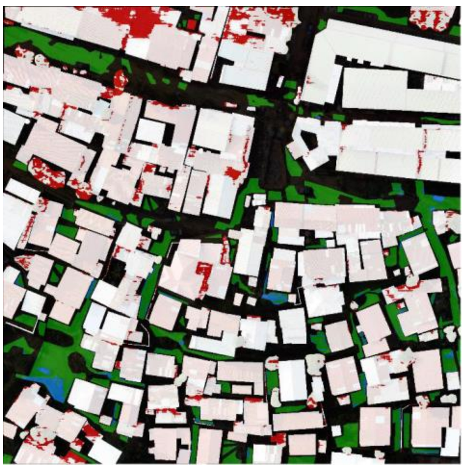

Figure 1. Classification maps showing the accuracy of: the first step to automatically select training labels (a), the final results of the proposed FCN method (b), and two reference DTM extraction methods: gLidar (c) and Lastools (d).

Authors: prof. Peter Teunissen and Christian Tiberius

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Presentation title: **Statistical testing is intended to remove unwanted biases, but ...**

In geodetic measurement processing, parameter estimation is usually accompanied by statistical hypothesis testing. The latter is exercised to be able to account for incidental model-misspecifications, typically outliers in measurements. A fault detection and exclusion (FDE) procedure, or detection, identification and adaptation (DIA) procedure is run in order to detect, identify for instance an outlier, and consequently adapt the working mathematical model to account for the outlier in the measurement.

We recently discovered that this is not the full story. In particular, as parameter estimation is conditioned on the testing outcome, the resulting estimator may have a statistical distribution, different from what we usually assumed so far, and more specifically, the estimator may be biased! Hence, detection, identification and adaptation is intended to remove unwanted biases from the solution, but at closer inspection, we find – initially counterintuitive – that it does not exactly do this. In this presentation we will outline and explain the phenomenon, show examples, and discuss consequences in practice.

Name: Marcel Kleinherenbrink, Riccardo Riva, Thomas Frederikse

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Presentation title: **Data weighting methods for estimate vertical land motion from GNSS and altimetry – tide gauge difference time series**

Vertical land motion (vlm) at tide gauges is estimated directly from GNSS or indirectly by differencing tide gauge and altimetry observations. We argue that the best method to obtain vlm from GNSS is by using the median of the trends within 50 km from the tide gauge. Ocean signals that remain in altimetry – tide gauge time series can be filtered by taking into account correlation threshold. The RMS of trend differences between the two methods are reduced from 1.47 – 1.21 mm/yr.

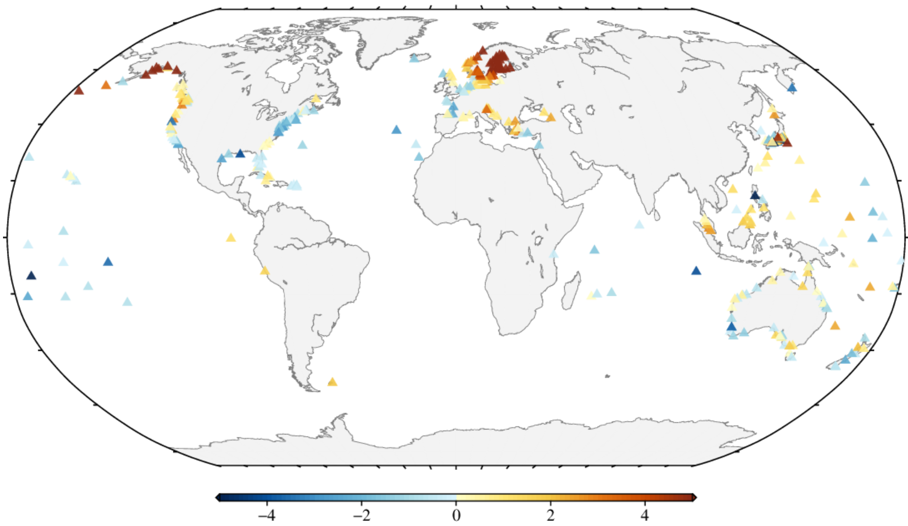

Fig: Vertical land motion (mm/yr) at 344 locations estimated from altimeter – tide gauge differences

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Name: Fashuai Li, Sander Oude Elberink, George Vosselman

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Presentation title: **Semantic labelling of pole-like street furniture in mobile laser scanning data**

Abstract:

Automatic semantic labelling of road furniture has been widely studied in recent years. Most of current research interpret road furniture as one single object. It is still not enough to depict different functionalities of road furniture in single object level. In this research, our contribution is to interpret road furniture based on functionalities (Figure 1 and Figure 2). 94.3% of street light heads are detected and 50 out of 65 detected street light heads are correct. Compared to other methods, our sematic labelling is more detailed (Figure 2). Our framework provides a promising solution to 3D precise mapping in urban environments.

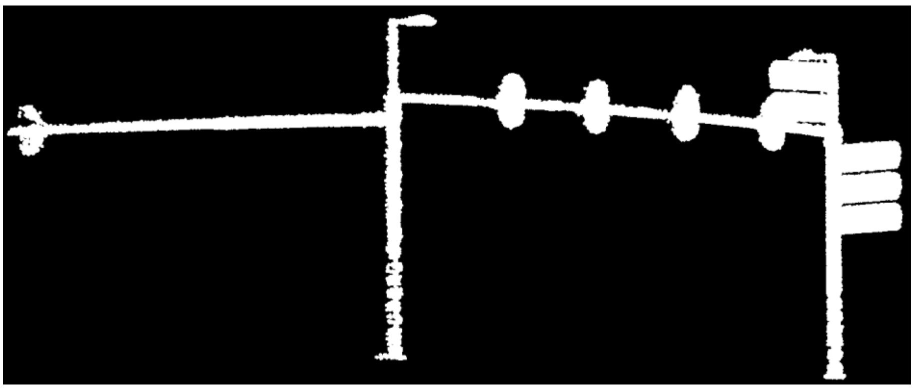

Figure 1. The original point cloud of a road furniture

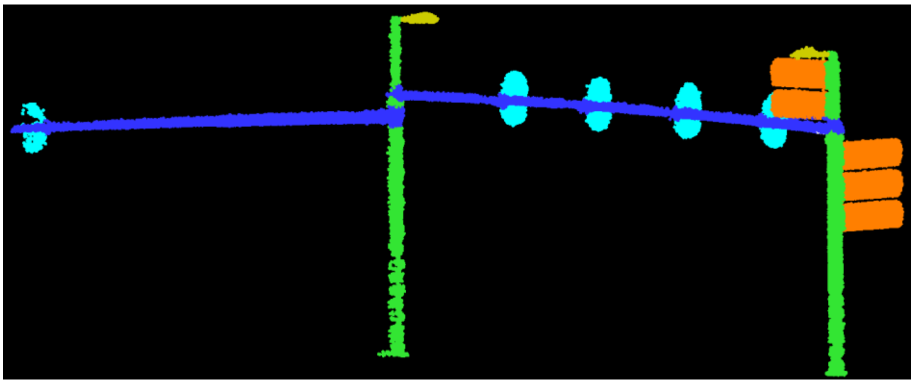

Figure 2. The interpreted road furniture (Orange: Street signs, Yellow: Street lights, Cyan: Traffic lights, Green: vertical poles, Blue: Horizontal poles)

Name: Jeroen van Heyningen

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Presentation title: **Google Earth Engine in Rapid Disaster Respons**

Recently, the Google Earth Engine (GEE) has been launched: an online, open-source processing tool that allows users to run algorithms on geo-referenced earth observation imagery and vectors stored on Google's infrastructure. The opportunities that the GEE provides are various. Keeping in mind that the GEE allows for the combination of multiple georeferenced datasets and processing on their infrastructure, the GEE possibly also has great impact for the field of rapid disaster response as the processing time is significantly decreased. In my master thesis, the GEE will be used for algorithm development to detect collapsed buildings after the 2016 L'Aquila earthquake.

Name: P. Ditmar, J.Ran, and R. Klees
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Presentation title: Statistically-optimal data weighting and regularization: assets and problems

Abstract

In is not uncommon in geoscience, when parameters of interest cannot be observed directly, but have to be extracted from data by means of an inversion procedure. According to statistical theory, optimal data weighting based on a stochastic model of data noise ensures the highest accuracy of data processing results. This accuracy can be further increased by an incorporation of a proper regularization. In real life, however, an attempt to implement a statistically-optimal data processing scheme may worsen the results instead of improving them. A few examples of that will be discussed in the course of the presentation.

To begin with, we will remind basic elements of statistically-optimal data inversion (optimal data weighting; Tikhonov and statistical regularization; optimal choice of the regularization parameter and estimation of data noise).

After that, we will address the issue of optimal data weighting in practice. An estimation of mass anomalies in Greenland from GRACE satellite gravity data will be considered as a typical example. We will demonstrate that an attempt to build up the optimal data weighting scheme using available error covariances matrices of GRACE data may both improve and worsen data processing results,

depending on the balance between the original errors in the data and the model errors associated with problem parameterization, which are inevitably introduced by the user.
Next, we will address the issue of the optimal regularization. We will show that the applied regularization must be tailored to the parameters of interest, including their temporal scale. For instance, an optimal regularization at the monthly time scale may introduce severe a bias when a long-term trend is estimated.
Finally, we will present a variant of Tikhonov regularization condition tailored for mass anomaly time-series. This variant is based on the assumption that the target signal is close to a combination of an arbitrary annual periodic function and a long-term linear trend. In the context of hydrological and ice sheet studies, it can be interpreted as an assumption that the behaviour of mass anomalies reflects stationary climatological conditions.

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Presentation title: **Multi-resolution image classification of building damages using deep convolutional neural networks**

Abstract (~100 words and optionally 1-2 figures):

The mapping of building damages following a disastrous event may be performed using sets of optical imagery at different spatial scales: satellite images at a regional level, airborne sets of images captured over a city and UAV imagery covering a building block. Damage mapping approaches often consider each of these resolutions independently. However, it is indicated in recent literature that multi-resolution approaches, up/down-sampling the original images, contributed for an increase in the classification accuracy when using convolutional neural networks (CNN). Our assumption is that the native multi-resolution present in remote sensing imagery collected with different sensors and from different platforms may also contribute to an increase in accuracy when performing image classification of building damages using CNN. Preliminary results and findings will be presented

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Presentation title: CLASSIFICATION OF MOBILE LASER SCANNING POINT CLOUDS FROM HEIGHT FEATURES

Abstract:
The demand for 3D maps of cities and road networks is steadily growing and mobile laser scanning (MLS) systems are often the preferred geo-data acquisition method for capturing such scenes. Because MLS systems are mounted on cars or vans they can acquire billions of points of road scenes within a few hours of survey. Manual processing of point clouds is labour intensive and thus time consuming and expensive. Hence, the need for rapid and automated methods for 3D mapping of dense point clouds is growing exponentially. The last five years the research on automated 3D mapping of MLS data has tremendously intensified. In this paper, we present our work on automated classification of MLS point clouds. In the present stage of the research we exploited three features – two height

components and one reflectance value, and achieved an overall accuracy of 73%, which is really encouraging for further refining our approach.

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Presentation title: **Automatic lamp pole identification from mobile laser scanning point clouds**.

Road environments contain a variety of objects including different types of lamp poles and traffic signs. Its monitoring is traditionally conducted by visual inspection, which is time consuming and expensive. Mobile laser scanning systems sample the road environment efficiently by acquiring large and accurate point clouds. We present an object-level shape descriptor to identify the lamp pole in point clouds automatically. To do so, the point clouds were first re-tiled and then were classified as ground and nonground
points. Next, an octree based clustering was performed on the non-ground points. Points of an interested lamp pole were manually segmented to construct the shape descriptor. Then, based on the similarity of the shape descriptors, the rest of the lamp poles are automatically identified in the rest of the data sets.

Name: Diogo Duarte, PhD Candidate

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