Presentations “GNSS and SDI/Governance”

Assessment of ionospheric corrections for PPP-RTK using S-system theory

Name: **Dimitrios Psychas**[1,2], Sandra Verhagen[2], Xianglin Liu[1]
Affiliation: [1]Fugro, [2]Delft University of Technology
E-mail: d.psychas@fugro.com

The integer ambiguity resolution-enabled precise point positioning method, the so-called PPP-RTK, is a state-of-the-art Global Navigation Satellite Systems technique that allows to determine high-accuracy positions with short convergence time. The main idea behind PPP-RTK is to extend the PPP technique by providing single-receiver users, apart from precise orbits and clocks, with additional corrections (satellite phase biases, ionospheric and tropospheric corrections) so as to enable integer ambiguity resolution with fast or even instantaneous convergence to the centimetre level. This study presents an analysis of the ionospheric corrections required to get a significant improvement in PPP-RTK performance, in terms of position precision and convergence time.

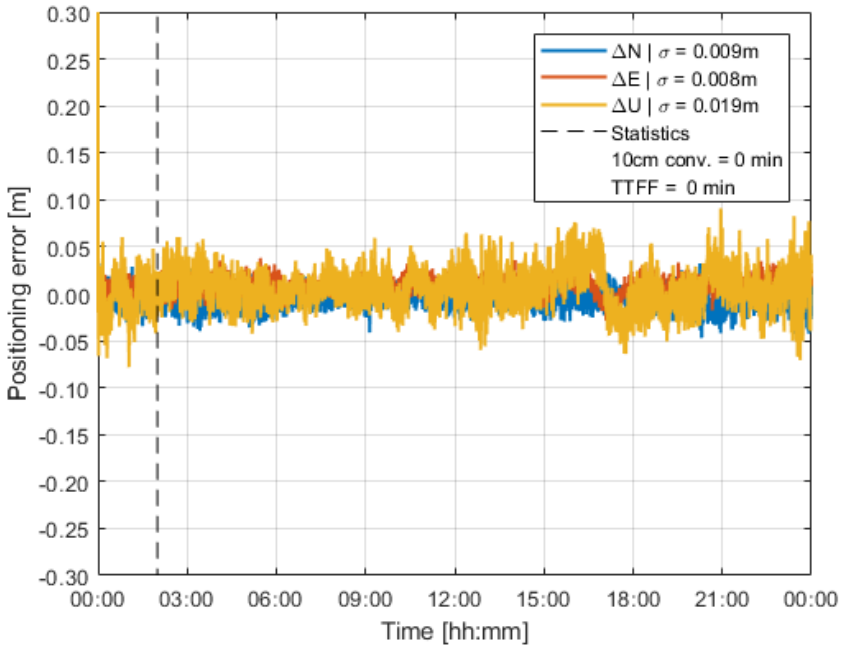


Figure: Positioning error (in meters) of GPS-only ambiguity-fixed PPP-RTK kinematic solution along the North, East and Up components, using ionospheric corrections of 5 cm precision. The horizontal position error converges instantaneously to the 10 cm level.

Presentation title: Glacial Isostatic Adjustment Models: Assessing Performance and Uncertainty

Name: **Karen M. Simon** (1,2), Riccardo E.M. Riva (2)
Affiliation: (1) Royal Netherlands Institute for Sea Research (NIOZ); (2) Delft University of Technology, Department of Geoscience and Remote Sensing
E-mail: k.m.simon@tudelft.nl

Glacial isostatic adjustment (GIA) describes the solid Earth response to surface loading and unloading during the last glacial cycles. Despite growing observational constraint from satellite geodesy missions, incomplete knowledge of both Earth structure and glacial history still make uncertainty in GIA models difficult to quantify. Thus far, the impact of using

different estimations of uncertainty in one dimensional GIA models has seldom been examined. Using pre-existing models and Global Positioning System (GPS) data, we compare four different methods for assessing the uncertainty and quality of GIA model predictions, including semi-empirical methods. Despite similarities between some of the uncertainty estimation methods, the interpretation of some GPS signals can still vary across methods for the same GIA model, as shown by examples from Scandinavia and North America.

GNSS observations in the Sulawesi region of SE Asia

Name: **Nicolai Nijholt**[1], Riccardo Riva[1], Wim Simons[2]

Affiliation: 1) TU Delft, CiTG; 2) TU Delft, LR

E-mail: n.nijholt-2@tudelft.nl

We reprocessed GNSS data in the SE Asia region recorded over the past two decades. We seek to place the final geodetic products, i.e. steady-state velocity vectors, in a tectonic context. Located in the plate boundary deformation zone of SE Asia, seismic hazard is high. Assessing whether faults in and around the island of Sulawesi accommodate large-scale deformation is key. Essentially, the interplay of active fault strands and the presence of transient velocities due to post-seismic relaxation produce a complex pattern of GNSS observations we seek to unravel.

Real-time GNSS Single-frequency PPP for moving platforms

E.M. Oudejans

1) E.M.Oudejans@student.tudelft.nl

The goal of this research is precise velocity estimation of a moving location-independent outdoor platform, for example a car on the road, a balloon in the atmosphere, or a buoy oating at sea. To this end we rely on GNSS in precise Point Positioning (PPP) mode. This allows for real-time position and velocity estimation from data obtained from a low-cost GNSS receiver at the moving platform, combined with corrective information (streamed over Internet) about satellite orbits and clocks, as well as atmospheric delays, produced by a global GNSS tracking network. In this presentation the data-processing procedure will be outlined, and results will be shown from an actual experiment with a buoy on the Noordzee, just outside Scheveningen Haven. The results will be validated against a high-precision ground-truth.

Figure 1: Two buoys equipped with single-frequency GNSS hardware.

Governance of Continuously Operating Reference Station, Global Navigation Satellite System (CORS GNSS)

Name: **Warakan Supinajaroen**
Affiliation: Knowledge Centre Open Data, Delft University of Technology
E-mail: w.supinajaroen@tudelft.nl

CORS GNSS is a positioning infrastructure to support many spatially related activities in many countries. Operating CORS GNSS is complicated. It relates to many aspects and conditions. Experiences in national CORS GNSS imply that governance of CORS GNSS is crucial. This research aims to define CORS GNSS governance. In the first step, cases of CORS GNSS in different countries are explored to identify elements of CORS GNSS governance. The findings will contribute to the creation of a generic CORS GNSS governance model and an assessment framework of CORS GNSS governance in the next steps.

In dialogue with the SDI stakeholders - Towards the final set of the STIG Principles and indicators to assess SDI

SD Name: **Bujar Nushi**
Affiliation: **TU Delft, Knowledge Center Open Data**
E-mail: **b.nushi@tudelft.nl**

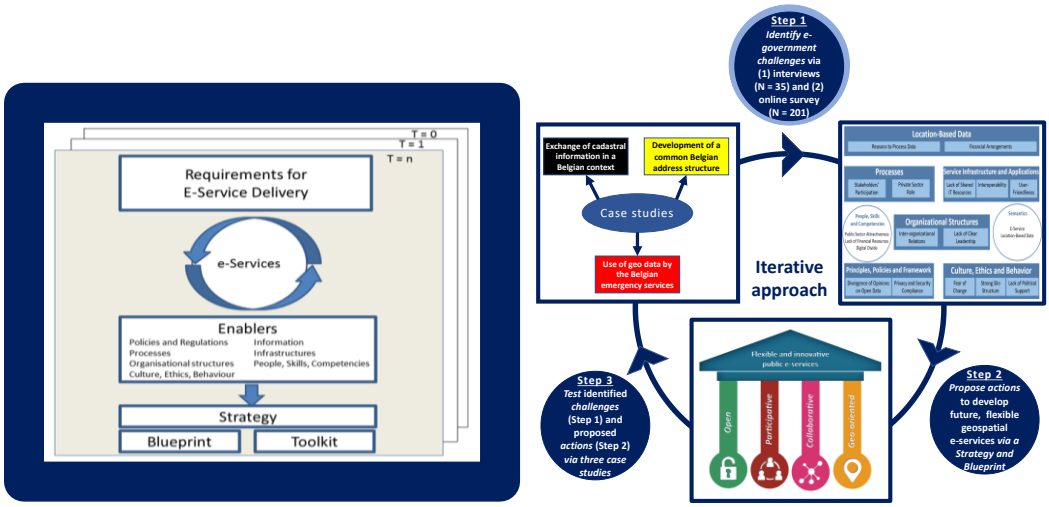
I experts all over the globe entail user friendly SDI assessment tools to evaluate the performance of their SDIs. As concluded by Nushi et al. (2015), the stress testing used in the financial infrastructures based on the Basel Core principles, can be a promising approach for assessing SDIs in a user friendly manner. In the previous research, authors have tested the applicability of the Basel Core principles with the SDI indicators. The main goal of this part of the STIG research was to start the dialogue with the strategic SDI users in the Netherlands on the STIG assessment method. We aimed to understand the applicability and user-friendliness of the STIG assessment framework in practice and to eventually add a new set of principles or indicators overlooked by STIG 1.0.

The key conclusions are that Dutch SDI practitioners are very positive about the STIG idea and framework. They are seeing interesting room for practical STIG implementation in assessment of the SDIs on different levels and are keen to promote the application of the STIG assessment methodology.

New Generation of flexible public services in Belgium – the geospatial case

Name: **Rink W. KRUK***, Maxim Chantillon[1], Anthony Simonofsk[1,2], Thomas Thombal[2], Joep Crompvoets[1]
Affiliation: National Geographic Institute (NGI)*, KULeuven[1], University of Namur[2], Belgium
E-mail: rink.kruk@ngi.be

In the context of technological, budgetary, legal and societal challenges cutting across policy levels and domains the four year FLEXPUB-project (2016-2020) develops a strategy for flexible, public, geo-enabled e-services serving a wide range of stakeholders in multiple policy domains for the Belgian Federal Government. Our mission is to propose a scientifically sound and comprehensive blueprint for adaptive and innovative government. After having identified the challenges and the enables for such e-services, we drafted the strategy that we currently are testing iteratively through its application to three use cases (emergency services, cadastral and address data). We present the geos-spatial specificities.



Spatial Data Infrastructures and Adaptive Governance

Name: Jaap-Willem Sjoukema

Affiliation: Wageningen University & Research, Laboratory of Geo-Information Science and Remote Sensing, Droevendaalsesteeg 3, 6708 PB Wageningen, the Netherlands.

E-mail: Jaap-willem.sjoukema@wur.nl

More and more Spatial Data Infrastructures (SDIs) are taking nowadays a critical position in society. This important role demands more from SDIs on both their stability as well as their ability to keep up with new techniques and user demands. Proper SDI governance is therefore needed, but this is not an easy task. This presentation will explain governance theories, provide insights in the evolution of SDI governance in practice and combines both into an SDI governance framework.

Common Operating Map from Open Spatial Information Infrastructure

Name: **Agung Indrajit**

Affiliation: TU Delft

e-mail:A.Indrajit@tudelft.nl

In Friday morning, Sept 28, 2018 there was a triplet disaster in Palu City, Indonesia. The earthquake was followed by tsunami and liquefaction responsible to more than 2000 human fatality, 5000 peoples was still missing and 63.000 refuge in shelter and temporary housing. Government entities and volunteers from many countries were coming to contribute in emergency response stage. These peoples were integrating many spatial information from SDI and various sources into a single view to assist their job in helping people. This so called 'view' was commonly used in military as "Common Operating Picture" or COP. In an ideal situation, a COP should improve communication and coordination of actions among troops and assets to have better understanding conditions and challenges, and build better collaborative actions. Government institutions and voluntary organizations often develop "Common Operating Map" or COM as guideline for all stakeholders. It is appropriate to present an idea how civilians can develop a reliable COM which is useful in disasters or specific events. A COM which is not about an interface serving all stakeholders from accessing spatial information from existing SDI and various sources of information and linking it with social media, but also a knowledge discovery for policy making and decision making.

Integrated Geodetic Reference Stations for INSAR and GNSS

Name: **Jurjen Kamphuis**, Karsh Patel, Hans van der Marel, Freek van Leijen and Ramon Hanssen
Affiliation: TU Delft
E-mail: J.C.Kamphuis@student.tudelft.nl

The integration of different geodetic observation techniques, to form a single combined deformation product, can be a challenge due to the lack of commonly observed objects. For INSAR and GNSS, an artificial point scatterer combined with a GNSS receiver, may be the answer. In this presentation we present the state of the art in passive reflectors and active transponders. In particular, we focus on the development of Integrated Geodetic Reference Stations (IGRS), which are currently being deployed in Groningen, and we give the results of testing a new generation of active transponders that is now coming to the market.

Troposphere augmentation for real-time precise point positioning

Name: **Hongyang Ma**
Affiliation: Delft University of Technology
E-mail: h.ma-3@tudelft.nl
Precise Point Positioning (PPP) is a well-known technique of positioning which provides accurate positioning solutions by Global Navigation Satellite System (GNSS) and tropospheric delay is one of the mainly error sources. Nowadays a long convergence time is still a challenging factor in the applications of PPP. One way to reduce the convergence time is to introduce the troposphere corrections to remove the troposphere effects on the coordinate solution. Concerning the tropospheric delays, the Zenith Hydrostatic Delay can be quite well corrected by the empirical models while the Zenith Wet Delay needs to be estimated in the data processing due to the highly variable spatial and temporal distribution of the water vapour. This contribution proposes the use of the local troposphere corrections to augment real-time PPP. Zenith Wet Delays at each station of Dutch GNSS network are estimated and then the corrections at any location within the network can be generated by the kriging interpolation. Meanwhile the random properties of these corrections are also considered in the stochastic model.

Positioning based on OFDM signals though phase measurements

Name: **Han Dun** [1], Christian Tiberius[1], Gerard Janssen[2]
Affiliation: Department of Geoscience and Remote Sensing, Civil Engineering and Geosciences (CEG), Delft University of Technology, the Netherlands
[2]Circuits and Systems Group, Electrical Engineering, Mathematics and Computer Science (EEMCS), Delft University of Technology, the Netherlands
E-mail: h.dun@tudelft.nl
Orthogonal Frequency Division Multiplexing (OFDM) signals, which can be found in various telecommunication systems, such as Wireless LAN (WLAN), long-term evolution (LTE) and the future 5G new radio (5G NR), have relatively wider signal bandwidths and larger signal power compared with GNSS signals. The received signal strength (RSS), cross-correlation based on time of arrival (ToA) estimation, and the subspace analysis based time delay estimation have been used for OFDM-based ranging and positioning, but there is limited research has been done on the positioning based on OFDM carrier phase measurements. As in GNSS, positioning by means of carrier phase measurements requires a change of geometry of the positioning scenario, and continuously transmitted signals, it can provide more accurate timing information and consequently achieve more accurate positioning results compared to other types of measurement. Although we obtain a 'float' solution from the observation model, the simulation result shows that the system based on pure carrier phase measurement can still achieve decimetre level accuracy.