RNI: DELENG/2005/15153
Publication: 15th of every month
Posting: 19th/20th of every month at NDPSO

No: DL(E)-01/5079/20-22
Licensed to post without pre-payment U(E) 28/2020-22
Rs.150

ISSN 0973-2136

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Volume XVI, Issue 7, July 2020

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COVID-19 and the Surveying Profession

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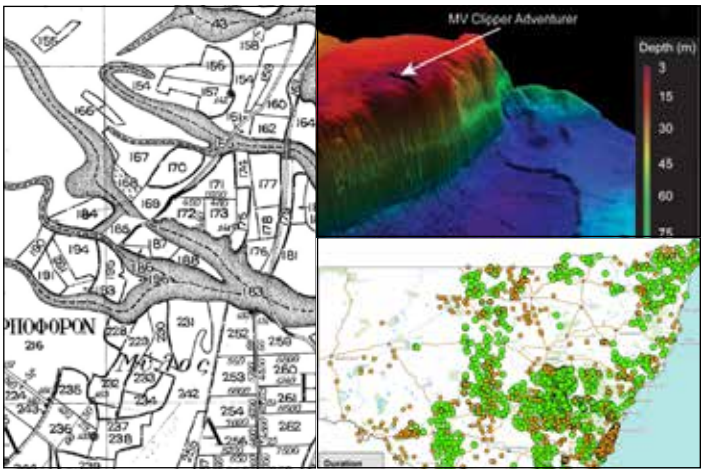

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This issue has been made possible by the support and good wishes of the following individuals and companies
Antonios Mouratidis, Bruce Calderbank, Dimitrios Ampatzidis, Dionysia-Georgia Perperidou, Georgios Moschopoulos, John Hannah, Nikolaos Demirtzoglou, Simon McElroy and Volker Janssen; CHC, Javad, Labsat, MicroSurvey, SBG System and many others.

Mailing Address
A 002, Mansara Apartments
C 9, Vasundhara Enclave
Delhi 110 096, India.
Phones +91 11 42153861, 98102 33422, 98107 24567

Email
[information] talktous@mycoordinates.org
[editorial] bal@mycoordinates.org
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Web www.mycoordinates.org

Annual subscription (12 issues)
[India] Rs.1,800 [Overseas] US$100

Printed and published by Sanjay Malaviya on behalf of Coordinates Media Pvt Ltd
Published at A 002 Mansara Apartments, Vasundhara Enclave, Delhi 110096, India.

Editor Bal Krishna
Owner Coordinates Media Pvt Ltd (CMPL)

In the pre-Covid-19 era,

Already there were concerns

Regarding too much of exposures to screens

TV, Computers, iPads, mobile,…

And their likely consequences.

Out of many, one of the repercussions of the Covid-19

Has been the many fold increase in 'screen time'

Work from home, communications, webinars, even entertainment…

With many of our activities going online,

This new way of life,

Unfortunately being misconstrued as a new normal,

Might actually be abnormal.

Our challenge is going to be

How to time ourselves out.

Away from the screens!

Bal Krishna, Editor
bal@mycoordinates.org

Transforming the old map series to the modern geodetic reference system

In the present paper we present a methodology, which is based on the verification of the common points of the two different geodetic systems and the implementation of the well-known 2D similarity transformation. The numerical application took part for the Northern part of Greece (Central and Eastern Macedonia)

Georgios Moschopoulos
Freelance Surveyor Engineer and member of the Commission of the Northern Greece Surveyor Engineers' Association, Greece

Nikolaos Demirtzoglou
Freelance Surveyor Engineer, Drama, Greece

Dr Antonios Mouratidis
Assistant Professor, Department of Physical and Environmental Geography of the Aristotle University of Thessaloniki, Greece

Dr Surv Ing Dionysia-Georgia Perperidou
Adjunct Lecturer, Department of Surveying and Geoinformatics Enineering, University of West Attica, Greece

Dr Ing Dimitrios Ampatzidis
Research Associate, German Federal Agency for Cartography and Geodesy, Frankfurt a.M., Germany

The transformation of the old map sheets series of the Greek State remains a recurring issue. The main problem lies in the transformation of the old Greek Datum (GR-Datum), which is mainly used for the mapping of the Greek rural areas. Up to date, there is no official transition procedure connecting the old version of the GR-Datum to the new official Hellenic Geodetic Reference System of 1987 (HGRS1987). As a result, geodesists, surveyors and cartographers are obliged to develop ad hoc techniques.

In the present paper we present a methodology, which is based on the verification of the common points of the two different geodetic systems and the implementation of the well-known 2D similarity transformation. The numerical application took part for the Northern part of Greece (Central and Eastern Macedonia). The consistency of the old version of the GR-Datum and the HGRS1987 is at the level of 1 meter.

Introduction

After 1917 and especially following the arrival of the Greek refugees from Pontus and Asia Minor (1922), there was a great need for the settlement of the rural population. In this direction, the Surveying Agency of the Ministry of Agriculture (which was established in 1917, from now on SAMA) created numerous Map Distributions (MDs), in order to facilitate the whole procedure (Fotiou and Livieratos 2000). The initial work included classical triangulations and mapping and finally the creation of map sheets mostly in 1:5000 scale (or in 1:1000). The coordinates referred to the old Greek Datum (GR-Datum) and particularly its pre-1940 version (Fotiou and Livieratos 2000). The so-called old version of the GR-Datum consists of measurements and computations held before the Second World War. It is referenced to the Bessel 1841 ellipsoid and uses the Hatt projection system (Mugnier 2002). Hatt is an equidistance map projection, which has practical no deformation for limited areas (e.g. not larger than 30-40 km)[1]. Consequently, its accuracy corresponded to the needs of this particular era and of course to the necessity for the prompt settlement of the population. There are cases where the accuracy is particularly low (e.g. lower than 5 meters), while in some areas the results reach a 15-20 cm accuracy. Figures 1 and 2 depict part of SAMA's MD for a village near Thessaloniki and Drama regions, respectively.

Unfortunately, to date, there is no officially accepted methodology for the transformation of SAMA's old map series to the official Hellenic Geodetic Reference System of 1987[2] (HGRS1987, HEMCO 1987, Takos 1989, Kalamakis et al. 2017).

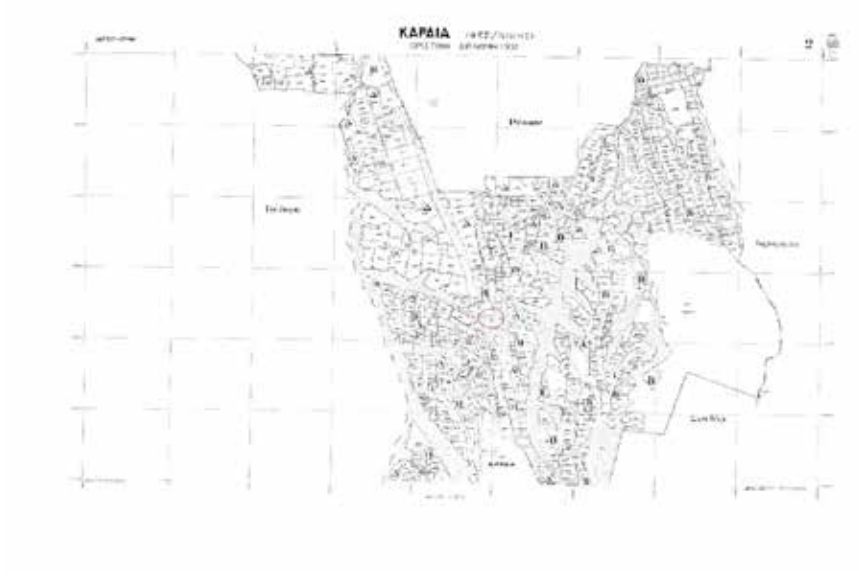

Figure 1: A part of SAMA's MD in Kardia village (near Thessaloniki). Year of release: 1932.

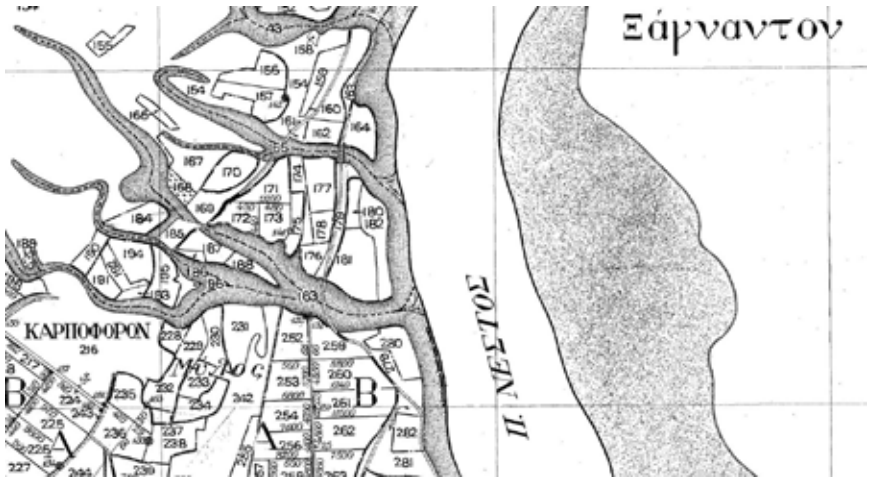

Figure 2: A part of SAMA's MD near Paranesti village (Drama region). Year of release: 1932.

Figure 3: A common benchmark of the State's network between the two versions of the old datum.

As a consequence, geodesists, surveyors and cartographers are applying ad-hoc techniques, in order to align the old MP information to their surveying layout[3]. In this context, we describe a methodology based on the 2D transformation of the coordinates of the State's benchmarks[4] from the old version of GR-Datum to the new one, using common points. We test the methodology to 11 Map Sheets in the Central and East Macedonia regions.

Methodology

As previously stated, there is no officially released procedure to transform the old version of the GR-Datum to any newer version/datum. On the other hand, for the new version of the GR-Datum, which is practically realised in mid-80s with new measurements and new adjustments (Takos 1989, Fotiou and Livieratos 2000), there is an explicitly defined and publicly released transformation procedure for the transition to the HGRS1987, using second degree polynomials (HEMCO 1995). Figure 3 presents an old benchmark of the State's network, which is a common point between the two versions of the GR-Datum.

The second degree polynomials refer to map sheets of 1:100000 scale (or for some rare cases to 1:50000)[5]. Thus, if a connection between the two versions of the GR-Datum can be made, then the old map series can refer to the HGRS1987. This point-wise connection is realized by the implementation of the so-called 2-D similarity transformation[6], according to the following equation (Dermanis and Fotiou 1992):

$$X_i = cx_i + dy_i + t_x \quad (1a)$$

$$Y_i = -dy_i + cx_i + t_y \quad (1b)$$

where X_i, Y_i are the point's coordinates with respect to the new version of GR-Datum, x_i, y_i are the point's coordinates with respect to the old version of GR-Datum and c, d, t_x, t_y are the four unknown parameters of the 2D similarity transformation (uniform scale, rotation and two translations of the axes), which will be estimated through a least squares adjustment (e.g. Dermanis and Fotiou 1992). The methodology can be visualized through Figure 4. Furthermore, it should also be pointed out that for the cases of the -relatively- large 1:1000 scale, one can graphically trace some points in SAMA's map, which remain till today (e.g. fences of buildings) serving also as common points (measured as well with respect to HGRS1987). This can be sometimes dictated due to the lack of State's benchmarks, however it reduces the points' accuracy by at least 25-30 cm, due to human's eye resolution ability and the map scale used

(Davidson 1993). Hence, this approach should be adopted with extra caution.

The aforementioned procedure allows the transformation of the old map series (referring to the old version of the GR-Datum) to the HGRS1987. For each examined area the procedure provides the ability to transform any type of information (map sheets, benchmarks, points, layouts) to the HGRS1987 and at the same time, delivers the accuracy of the transformation. This plays an important role to several scientific groups, such as: (a) Surveyors who are occupied with the Cadastral mapping, (b) State's Agencies, which are looking for reliable transformation for many applications and (c) Cartographers.

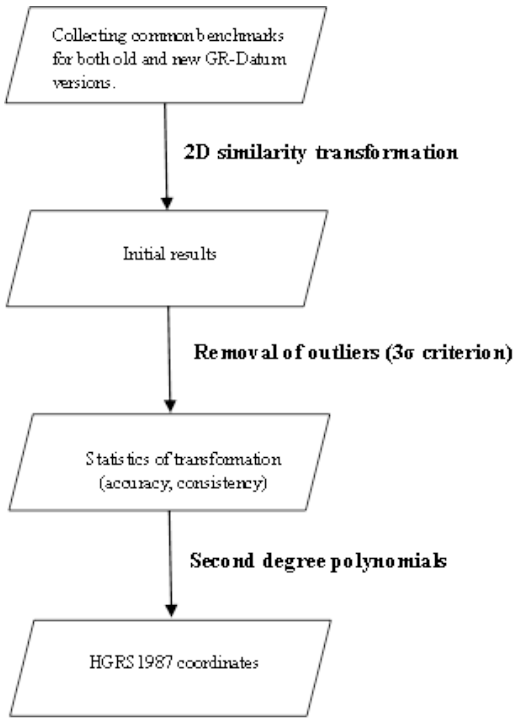

Figure 4: The methodology of transforming the old map series.

Table 1: The statistics of the 2D similarity transformation between the two GR-Datum versions, after the removal of outliers. Values are in meters.

Name of the map sheet (MP 1:50000)	residual errors standard deviation	residual errors minimum value	residual errors maximum value
Rodolivos	1.495	-2.964	2.965
Serres	0.625	-1.477	1.469
Prosotsani	0.854	-1.528	1.446
Sidirokastron	1.000	-1.680	2.353
Achladochorion	0.448	-0.356	0.977
Kastanousa	0.239	-0.306	0.460
Kerkini	0.649	-0.926	1.229
Neon Petritsion	0.711	-1.488	1.500
Nikisiani	0.909	-0.962	1.566
Sitochorion	0.949	-1.556	2.307
Sochos	0.863	-1.245	1.520

Finally, it should also be underlined that the MD of the new version of the GR-Datum consists of map sheets at the scale 1:50000 (387 for the whole country, according to the distribution of the Hellenic Geographic Military Service-HGMS-, HEMCO 1995, Fotiou and Livieratos 2000). This practically means that the second degree polynomials previously described is rather possible to be identical for maximum four map sheets of the new version's MD. Thus we should initially refer the old version's coordinates with respect to the associated 1:100000 sheet[7].

Numerical application

We collected common points between the old and the new version of the GR-Datum for 11 map sheets located in the Northern part of Greece (Central and Eastern Macedonia). The relevant map sheets are depicted in Figure 5.

At this point is ought to be stressed out that the most difficult issue is the verification of the common points. During the past decades (in some cases up to 90 years) the common benchmarks are either destroyed or severely inclined. On the top of that, the associated documentation is also difficult to be found and to be validated.

Following the flowchart presented in Figure 3, we have the residuals' statistics quantifying the consistency of the two versions (Table 1, after the removal of the outliers). For each map sheet, we found at least 10 common points between the two versions. In some map sheets we excluded 1-2 points (as outliers).

The results imply that there is no uniform consistency between the old and the new version of the GR-Datum, respectively. The standard deviation ranges from 23.9 cm to 149.5 cm. The mean standard deviation is at the level of 80 cm. It should also be mentioned that the accuracy of the transition between the new version of the GR-Datum to the HGRS1987 (using the second degree polynomials) is at the level of 10-15 cm (HEMCO 1995)[8]. Roughly, the total transformation accuracy from the old version of the GR-Datum to the official HGRS1987 for the examined areas is in the order of 80-100 cm (mean value). Taking into account the oldness of the observations and the problematic old version of the GR-Datum, we can consider this accuracy as normal. It practically means that the scale, which can be used for the reliable cartographic map series transformation is between 1:4000 and 1:5000.

One can directly apply the 2D similarity transformation between the old version of the GR-Datum to the HGRS1987. This perhaps mitigates the transformation error, since there is an exclusion of the final transition step (from the new version of the GR-Datum to the HGRS1987)[9]. However, this procedure avoids the officially accepted use of the polynomials and thus may give rise to many questions regarding its consistency with respect to the regulations of the Greek state. In addition, we do not expect considerably better results, due to the aforementioned problem of the old version of the GR-Datum. For more consistent results between the old version of GR-Datum and the HGRS1987, one can follow the procedure described in Ampatzidis and Melachroinos (2017).

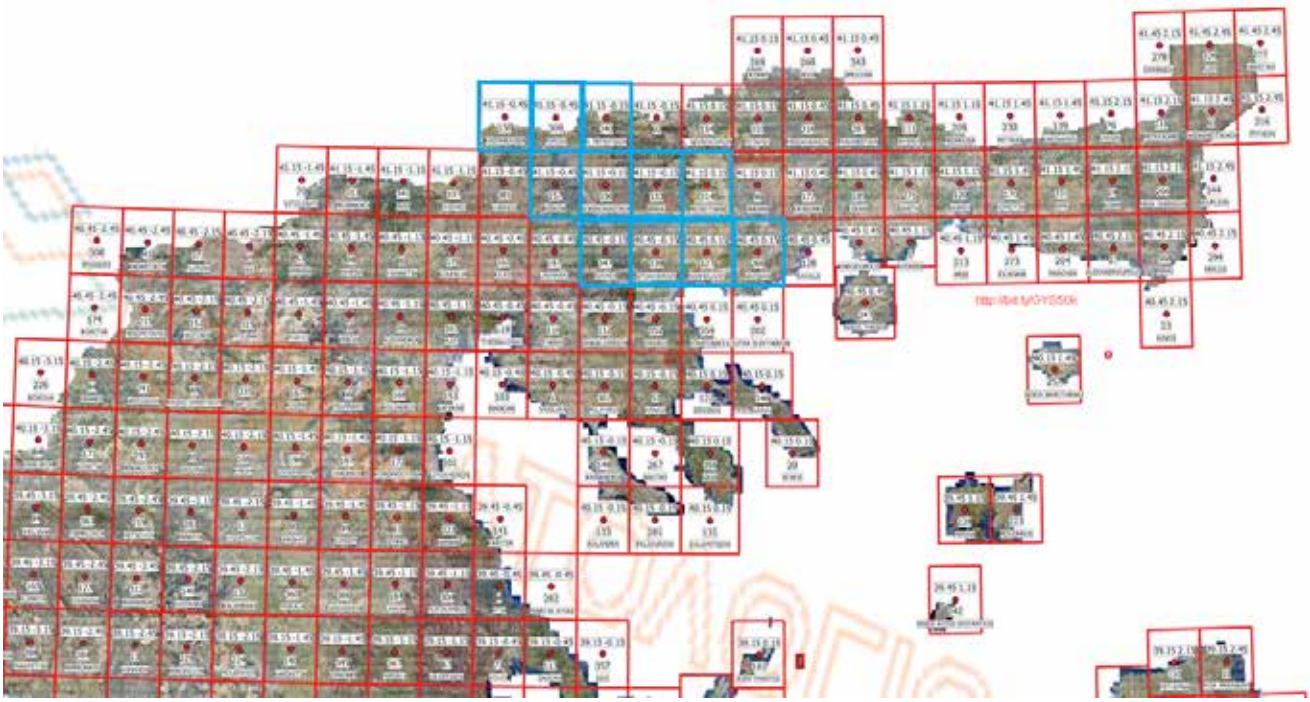

Figure 5: Part of the 1:50000 MP for Northern Greece. The cyan boxes correspond to the 11 map sheets applied for the present study (the initial map was derived from the site of Hellenic Cadastre S.A.). The MP was applied from HGMS.

We strongly suggest to the Greek State the creation of a group of specialists (e.g. geodesists, surveyors and cartographers) in order to establish a reliable methodology for the transformation of the old map series, containing useful information, to the official HGRS1987

Conclusions

We presented a methodology for converting the old map series of SAMA's MDs to the HGRS1987. The core of the methodology lies in finding of the common points between the old and the new version of the GR-Datum. Initially, a 2D similarity transformation provides the necessary transition to the new version of the GR-Datum and as a final step we proceed with the implementation of the second degree polynomials which connect the new version of the GR-Datum to the official HGRS1987. We tested the procedure for 11 map sheets of 1:50000 located in the Northern part of Greece (Central and Eastern Macedonia) and we found a mean consistency between the old and the new version at the level of 80 cm, which is at level of our expectations according to our field experience.

We strongly suggest to the Greek State the creation of a group of specialists (e.g. geodesists, surveyors and cartographers) in order to establish a reliable methodology for the transformation of the old map series, containing useful information, to the official HGRS1987.

Endnotes

[1] the Hatt projection was developed by the French cartographer Philippe Hatt. It was mainly used for the mapping of the on-shore regions in the Pacific Ocean (Mugnier 2002). Greece is the only European country, which adopted this kind of projection.

[2] HGRS1987 is the official geodetic reference system of Greece (from the early 1990s) and the Greek Cadastre is based only on this system.

[3] Practically speaking, the alignment of SAMA's old mapping infrastructure to the HGRS1987 is a major problem for the Surveyor Engineers, especially in Northern Greece (Macedonia and Thrace regions). The major difficulty is the lack of benchmarks/points. This absence is causing significant pitfalls during their daily professional practice.

[4] As State's benchmarks we define here those of the State's triangulation network. Unfortunately, there is no remaining information for the benchmarks located in the land parcels. The latter ones were called 'orosima' -Greek jargon- and they were used for the property identification, having estimated projection coordinates.

[5] The second degree polynomials do not show uniform accuracy throughout the country. In some cases the transformation (between the two versions) accuracy remains low (Fotiou and Livieratos 2000, HEMCO 1995). The scale of 1:100000 corresponds to dimensions of 30' X 30' of a map sheet.

[6] We applied only the 2D similarity transformation, since this type of transformation does not cause significant deformations (e.g. a square remains a square –though scaled and rotated- after the implementation of the 2D similarity transformation).

[7] The MD of the SAMA initially refers to dimensions of 6'X6' map sheet. Thus, we should convert the coordinates to the associated 30'X30' map sheet of the new version. This procedure is called 'change of the map's center of Hatt's projection' and it is described in detail by Fotiou and Livieratos (2000).

[8] Unfortunately, there is no accuracy information regarding the transformation of the GR-Datum's new version to HGRS1987 by the use of the second degree polynomials.

[9] The HGRS1987 also carries inconsistencies, which can reach several decimetres in an absolute sense (HEMCO 1987, Takos 1989). However, for local cartographic/surveying studies (e.g. for a map sheet of 1:50000) the consistency of the HGRS1987 is at the level of some centimetres (see e.g. Giannakidis 2009).

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NASA, partner space agencies amass global view of COVID-19 impacts

In response to the global coronavirus pandemic, NASA, ESA (European Space Agency), and JAXA (Japan Aerospace Exploration Agency) have joined forces to use the collective scientific power of their Earth-observing satellite data to document planet-wide changes in the environment and human society.

In an unprecedented collaboration, the three space agencies have created the joint COVID-19 Earth Observation Dashboard, which integrates multiple satellite data records with analytical tools to allow user-friendly tracking of changes in air and water quality, climate change, economic activity, and agriculture. This tri-agency data resource gives the public and policymakers a unique tool to probe the short-term and long-term impacts of pandemic-related restrictions implemented around the world.

In April, the three agencies formed a task force to take on the challenge. The group identified the most relevant satellite data streams and adapted existing computing infrastructure to share data from across the agencies and produce relevant indicators. The dashboard presents users with seamless access to data indicating changes in air and water quality, economic and agricultural activity on a global scale and in select areas of interest.

Air quality changes around the world were among the first noticeable impacts of pandemic-related stay-at-home orders and reductions in industrial activity that emerged from satellite observations. One air pollutant, nitrogen dioxide (NO2), which is primarily the result of burning fossil fuels for transportation and electricity generation, shows up clearly in satellite data. NO2 has a lifetime of a few hours and is a precursor of ground-level ozone, which makes it a useful indicator of short-term air quality changes. Changes in another critical component of our atmosphere, carbon dioxide (CO2), are highlighted in the dashboard to probe how global and local reactions to the pandemic have changed concentrations of this climate-warming greenhouse gas.

The dashboard will also present tri-agency satellite data looking for signs of changes in agricultural production around the world, such as harvesting and planting due to disruptions in the food supply chain or the availability of labor. *www.nasa.gov*

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Clipper Adventurer Grounding[1]

This paper reviews the background to the grounding of Clipper Adventure, and the geomatics issues related to the grounding

Bruce Calderbank
Retired Fellow of the Royal Institution of Chartered Surveyors (FRICS), a Canada Lands Surveyor (CLS), a Canadian Certified Hydrographer (CH) Level 1, a Certified Professional Hydrographic Surveyor Level 1 (CPHS 1), and an Albertan Professional Engineer (P. Eng.). He has carried out consulting assignments as the Client Navigation Representative for over 30 companies, while supervising a variety of contractors over a period of 38 years. Past legal consultancy assignments have included providing two Expert Opinion Reports, and delineating an international offshore boundary.

Abstract

There seems to be a general perception that the increasingly ice-free Arctic waterways are safe for passage, when significant areas have not been adequately surveyed. However, as of 2011, less than 10% of Arctic waters had been surveyed to modern standards[2]. On 27 August 2010, the expedition cruise ship **Clipper Adventurer** went aground at 13.9 knots on a rock shoal whilst travelling in a limited surveyed area of Coronation Gulf, Nunavut. This paper reviews the background to this grounding, and the geomatics issues related to the grounding.

Summary

With any vessel grounding or offshore incident, but especially where litigation could be involved, the survey, navigation and positioning issues should be considered along with any legal liability issues to ensure the best case is put forward.

Introduction

The expedition cruise ship **Clipper Adventurer**, length 100.6 metres, beam 16.3 metres and draft 4.7 metres[3] with 128 passengers and 69 maritime crew onboard, was at the end of a fourteen day cruise enroute from Port Epworth to Kugluktuk (the hamlet's name was changed from Coppermine on 01 January 1996), Nunavut[4]. The **Clipper Adventurer** ran aground on a shoal of solid rock with such force that more than half of the vessel's length was embedded on the rock shoal.[5]

The **Clipper Adventurer** grounding occurred in the western portion of Coronation Gulf which lies between Victoria Island and mainland Nunavut. To the northwest it connects with the Dolphin and Union Strait through to the Amundsen Gulf and thence to the Beaufort Sea and Arctic Ocean; to the northeast it connects with Dease Strait and thence to the Queen Maud Gulf.

Clipper adventurer grounding

On 27 August 2010 at approximately 1832 hours Mountain Daylight Time, whilst in transit from Port Epworth to Kugluktuk, and sailing in between the Lawford and Home Islands, the **Clipper Adventurer** was steaming at 13.9 knots through the area when it grounded on a rock shoal.[6] The seas were calm without any wind or swells, and sunny conditions and good visibility prevailed.[7] The tide was at its highest and the water was clear.[8] There was no appreciable water current.

The grounding led to 13 of the vessel's double-bottom tanks being breached, some holding fuel, freshwater and sludge.[9] The damage was below the waterline and, consequently, the fuel oil was forced to the top of the tank due to the ingress of sea water. As a result, there was no leakage of the oil. The Canadian Coast Guard (CCG) also verified that at the time of grounding there was no sign of oil pollution in the vicinity of the grounded ship. However, several days following the grounding, a light sheen was visible but it dissipated quickly.[10]

An overhead view of the grounded **Clipper Adventurer**, which clearly shows the rock shoal approximately 60 metres either side of the vessel is provided in the left Figure 1. A starboard side view of the vessel with a list of 5 degrees to port shown in the right Figure 1.[11]

Overhead View[12] Starboard Side View[13]

Figure 1: Clipper Adventurer Grounding

On 8 October 2010, CHS Chart 7777 was corrected by a permanent indication of the shoal and an updated Notices to Mariners (NOTMAR) was issued.[14] A revised CHS Chart 7777 was issued on 15 May 2015, which was 57 months after the grounding occurred and is shown in the left Figure 2. The 85 metre rise in the seabed at the face of the rock shoal is shown in the right Figure 2.

Starboard Side View[15]

Rock Shoal[16]

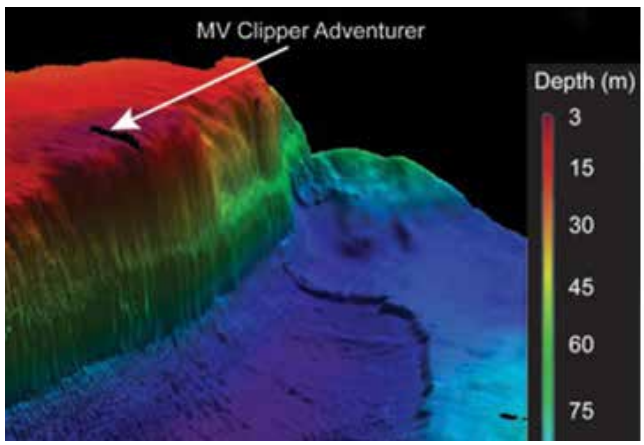

Figure 2: Revised Chart 7777 and Rock Shoal

Voyage planning

In the 2012 Canadian Transportation Safety Board (TSB) Report there were four (4) pages dedicated to Voyage Planning with the following Table and Figure provided to illustrate three (3) possible routes, which could have been considered by the deck officers on the **Clipper Adventurer**.[17]

Table – Voyage Planning[18]

Route	Approximate Distance	Required Speed	Time Required to Kugluktuk
A	90 nautical miles	6 knots	15 hours 07 minutes
B	85 nautical miles	6 knots	14 hours 10 minutes
C	200 nautical miles	13 knots	15 hours 23 minutes

Part of Route C had been taken on 26 August 2010 by the **Clipper Adventurer** to arrive at Port Epworth. The Master of the **Clipper Adventurer** had only planned to take Route A.[19] The TSB calculated the travel times for these routes to show there was no clear reason why the vessel needed to sail at 13.9 knots. For unexplained reason(s), the captain made the **Clipper Adventurer** speed to be 13.9 knots over the shorter route,[20] which was not required to meet the vessel's schedule.

1965 CSS richardson survey

In 1965, the track of soundings in question generally followed by the **Clipper Adventurer**, were acquired by the Canadian Survey Ship (CSS) **Richardson**. The vessel was commissioned by the CHS in 1962 and was paid off in 1990. In 1962, the vessel was fitted with the latest electronic navigation and survey equipment. The vessel worked in the Western Arctic from 1962 to 1969 during the months from July to September. Most of the work was in areas adjoining the Beaufort Sea, except for 1965, when the vessel surveyed the approaches to Coppermine, now Kugluktuk.[22]

On 26 August 1965, the CSS **Richardson** left Lady Franklin Point and sailed to Port Epworth, where upon arrival a survey was carried out a survey of the inlet at Port Epworth. The CSS

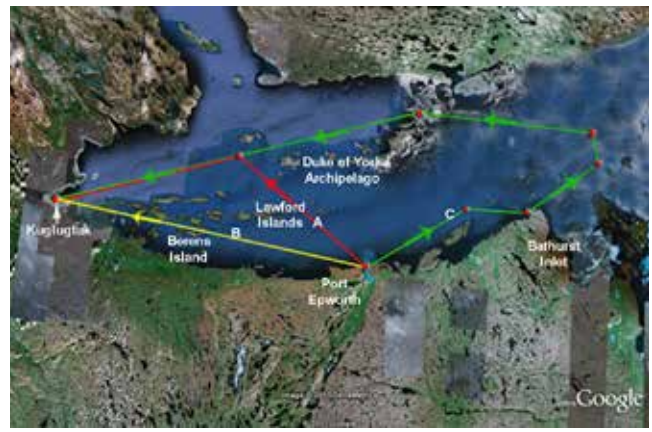

Figure 3: A) Route Chosen by Clipper Adventurer; B) Second Route Option; C) Reciprocal Route taken on 26 August[21]

Chart 7777 edition 1997[23]

Richardson Voyage to Coppermine[24]

Figure 4: CSS Richardson Track Sounding Route on 26 August 1965

CHS Chart Used Onboard Clipper Adventurer[37]

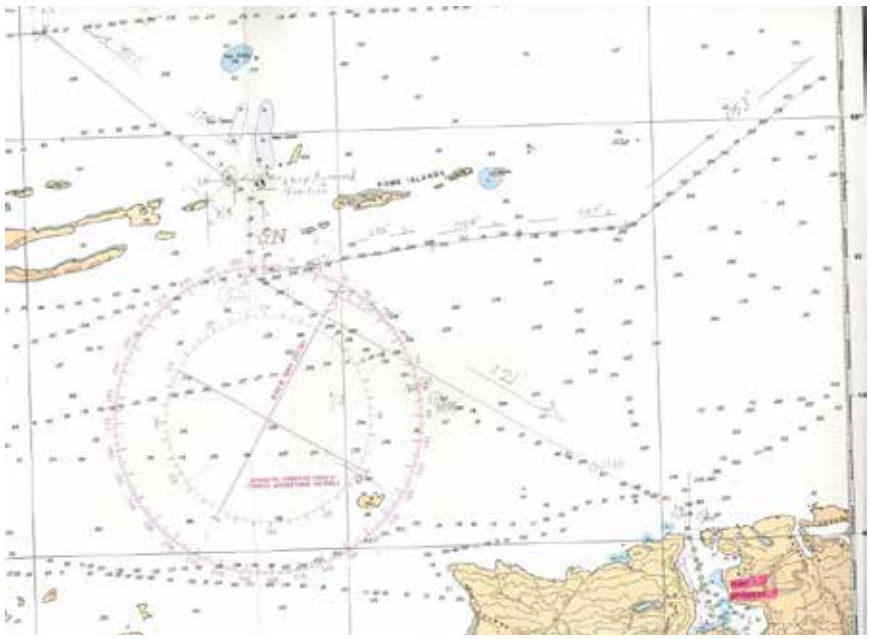

Figure 5: Planned Track of Clipper Adventurer

Richardson departed Lady Franklin Point and sailed south southwest to the narrow passage through the Black Berry Islands, then sailed south toward the middle of the Lawford Island chain to the 68 degrees parallel of latitude, then sailed east to the passage between the Lawford and Home Islands and then through that passage, and then sailed south east to Port Epworth. The track of sounding route from Lady Franklin Point to Port Epworth is highlighted in the left Figure 4, with the original sketch in the right Figure 4.

The navigation equipment of interest in the wheelhouse of the CSS **Richardson** consisted of a Decca Type 404 radar, a Sperry Mark XIV gyrocompass,[25] and a Kelvin Hughes MS 26B single beam echo sounder.[26]

The estimated horizontal error based on using the islands and mainland features as fixed points which were based on uncontrolled aerial photography, was estimated by the CHS to be approximately ± 100 metres or greater.[27] The total horizontal positioning error was estimated to be in the order of ± 130 metres.

Even so, a prudent mariner would know that the horizontal position for the track sounding was only related to the centre of the sounding printed on the chart. The blanks in between the soundings would be understood to have mapped the shallowest soundings. Areas outside of the narrow strip between the soundings would be considered to be not surveyed.

Planned track

The **Clipper Adventurer** used paper charts for navigation, including CHS Chart 7777 edition 1997, on which the desired course was plotted and the waypoints transferred to the route planning software and the Electronic Chart System (ECS).[28]

The Navigation Officer was not familiar with Canadian charts or Arctic shipping operations,[29] and had only previously been to one Canadian port (Vancouver) in 2015, all of which the Master was aware.[30] The only other time the Navigation Officer planned an Arctic cruise was the immediately previous **Clipper Adventure** cruise in the Arctic from 26 July to 09 August 2010.[31] During this cruise, the Navigation Officer compiled the voyage plan for the next cruise.[32]

The captain had previously completed over 60 Arctic voyages, although never to Port Epworth.[33] It was the second year in a row that **Clipper Adventurer** had sailed in the Canadian Arctic and the Coronation Gulf.[34] On 23 February 2010, the extension of the cruise to include Port Epworth was added at the request of the Canadian charterer, as Port Epworth was a geological point of interest.[35]

In the Arctic, following a track of soundings is common practice due the sparse soundings available.[36] In the 1997 edition source classification diagram a magenta dashed line which ran from the south west to the north east through the middle of the chart only contained track and spot soundings. In the 2015 edition source classification diagram this same area, there was an "Inadequately Surveyed" notation added to those parts of the chart.

As shown in Figure 5, following a track of soundings could be an artistic endeavour which is a portion of CHS Chart 7777 edition 1997 used onboard **Clipper Adventurer** which was produced as a Federal Court exhibit.

On the portion of the planned track on a heading of 301 degrees True, the maximum distance from the track of soundings in question to the planned track was 1,170 metres or 0.63 nautical miles. On this leg of the voyage, based on the CHS Chart 7777 edition 2015, the soundings ranged from 50 to 200 metres.

Further, as shown in the top left hand corner, the planned track proposed to cross an unsurveyed area on heading 310 degrees True to reach a track of soundings to the north. This corresponded to 10,480 metres or 5.64 nautical miles of planned track for which there was no bathymetry data at all.

Unfortunately, the vessel data recorder (VDR) onboard **Clipper Adventure** was not backed up properly after the grounding.[38] Hence whatever course the **Clipper Adventure** took before and up to the grounding cannot be examined. However, several of the Federal Court Exhibits provide the selected waypoints for comparison which is provided in the next section.

Waypoint selection

Federal Court exhibit number 21 provided the Voyage Planning Forms used by the Navigation Officer when planning the voyage during the previous cruise in the Canadian Arctic. All of the forms were dated 03 August 2010.

Federal Court exhibit number 139 provided a screen grab of the TimeZero route planning software by MaxSea. Though the start point at Port Epworth may have needed to be changed, the other alterations show that instead of using the planned route from 03 August, on or about 27 August the planned track was changed.

Federal Court exhibit number 140 provided a screen grab of the Transas Navi-Sailor 3000. Unfortunately, there appears that a blunder was made entering the chosen geographical coordinates for Waypoint #5 into the ECS.

Table – Exhibit Number 21 – Voyage Planning Form – 03 August 2010[39]

Point	Latitude	Longitude	Rhumb Line Distance	Heading degrees True			Seconds Difference	
				Calculated	Exhibit	Diff	Latitude	Longitude
# 0	67° 42.3'	111° 55.3'						
# 1	67° 45.8'	111° 57.6'	3.61	346.02	346	0.02		
# 2	67° 46.4'	111° 59.9'	1.06	304.56	303	1.56		
# 3	67° 55.0'	112° 38.6'	16.95	300.49	301	-0.51		
# 4	67° 57.5'	112° 38.6'	2.50	0.00	0	0.00		
# 5	68° 03.7'	112° 57.8'	9.50	310.75	311	-0.25		

Notes: The Rhumb Line distances and bearings from the latitude and longitude coordinates were calculated using Norcom Technology, Geodetic software version 3.2.11.99. Rhumb Line Distance is in nautical miles. The Seconds Difference column is used in the tables below.

Table – Exhibit Number 139 – Screen Grab of MaxSea[40]

Point	Latitude	Longitude	Rhumb Line Distance	Heading degrees True			Seconds Difference	
				Calculated	Exhibit	Diff	Latitude	Longitude
# 0	67° 42.2'	111° 55.4'					6	-6
# 1	67° 45.8'	111° 57.6'	3.70	346.95	347	-0.05	0	0
# 2	67° 46.4'	112° 00.0'	1.09	303.43	303	0.43	0	6
# 3	67° 55.0'	112° 38.6'	16.92	300.55	301	-0.45	0	0
# 4	67° 57.6'	112° 38.6'	2.60	0.00	0	0.00	-6	0
# 5	68° 03.8'	112° 57.8'	9.50	310.75	311	-0.25	-6	0

Notes: The Rhumb Line distances and bearings from the latitude and longitude coordinates were calculated using Norcom Technology, Geodetic software version 3.2.11.99. Rhumb Line Distance is in nautical miles. The Seconds Difference column compared the previous Table with this Table.

Table – Exhibit Number 140 – Screen Grab of Transas[41]

Point	Latitude	Longitude	Rhumb Line Distance	Heading degrees True			Seconds Difference	
				Calculated	Exhibit	Diff	Latitude	Longitude
# 0	67° 42.2'	111° 55.4'					0	0
# 1	67° 45.8'	111° 57.6'	3.70	346.95	347	-0.05	0	0
# 2	67° 46.4'	112° 00.0'	1.09	303.43	303	0.43	0	0
# 3	67° 55.0'	112° 38.6'	16.92	300.55	301	-0.45	0	0
# 4	67° 57.6'	112° 38.6'	2.60	0.00	0	0.00	0	0
# 5	68° 03.8'	112° 57.6'	9.44	311.05	311	0.05	0	12

Notes: The Rhumb Line distances and bearings from the latitude and longitude coordinates were calculated using Norcom Technology, Geodetic software version 3.2.11.99. Rhumb Line Distance is in nautical miles. The Seconds Difference column compared the previous Table with this Table.

Table – Perpendicular Distance from Leg #4 to #5 to Exhibit Number 141 (metres)

Waypoint Selection	Perpendicular Distance	Differences
Exhibit 21 – Voyage Planning Form – 03 August 2010	292.0	
Exhibit 139 – Screen Grab of MaxSea	151.5	140.5
Exhibit 140 – Screen Grab of Transas	142.5	9.0

Note: The latitude and longitude coordinates were converted to UTM coordinates using Norcom Technology, Geodetic software version 3.2.11.99. Perpendicular Distance and Differences distance in metres.

Grounding Area with Waypoints #4 and #5 and Water Depth Point B to C

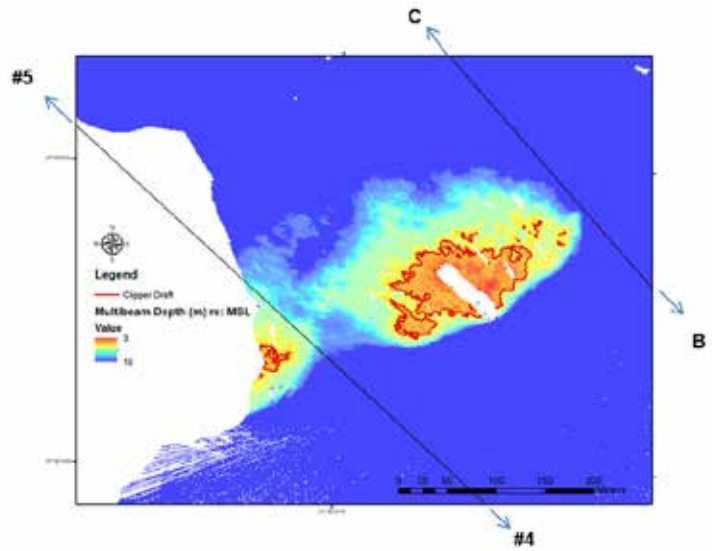

Figure 6: Grounding Area[43]

Relationship of planned tracks and track of soundings to the grounding location

Using the grounding location provided in Federal Court exhibit number 141 and the Waypoints #4 and #5, the perpendicular distance from each of the Waypoint Selections to the grounding location was as shown in the Table below. The planned track established by Waypoints #4 to #5 for all of these perpendicular distances were to the West to the actual grounding location.

The Voyage Planning route was not followed but another was created on or about 27 August and when input into the ECS the longitudinal coordinates for the planned track alongside the rock shoal was input incorrectly.

Unfortunately, the various changes to the planned track that occurred on or about 27 August and the blunder entering the longitudinal value for Waypoint number 5, brought the **Clipper Adventurer** closer to the rock shoal and the grounding location.

If the **Clipper Adventurer** had actually followed the Transas planned track between Waypoints #4 and #5, the minimum depth would have been 6.1 metres, enough to allow the for the **Clipper Adventurer** draft of 4.7 metres.[42] For whatever reason, the **Clipper Adventurer** deck officers did not use the off track alarms available via the ECS or the Anschütz autopilot, or these alarms were switched off.

The **Clipper Adventurer** was neither following the Transas planned track nor was the vessel following the track of soundings. The course taken was in between, where the former and the latter offered safe passage. Unfortunately, the course taken by the **Clipper Adventurer** took the vessel over the shallowest part of the rock shoal.

Figure 6 shows the multibeam echo sounder data collected after the grounding in the vicinity of the grounding area with the 4.8 metre contour. The line in the lower portion of the Figure is the Transas planned track between Waypoint #4 and #5. The line in the upper portion of the Figure is the line between water depth points B and C.

Conclusions

The survey, navigation and positioning issues which are related to the grounding of the **Clipper Adventurer** were as follows:

- The master decided to sail at 13.9 knots in a known limited surveyed area, when the voyage plan only required 6 knots which would appear to be arguably reckless.
- The track of soundings in question was only followed in a general manner, where part of the planned track was 1.2 kilometres from the track of soundings in question.
- Had the voyage continued, the Clipper Adventurer would have sailed 10.5 kilometres over an area which had never been surveyed.
- The Voyage Planning route was not followed but another was created on or about 27 August and when input into the ECS the longitudinal coordinates for the planned track alongside the rock shoal was input incorrectly.
- At the time of the grounding the Clipper Adventure was off track by 142 metres to the East. If the planned track had been followed the vessel would NOT have gone aground.
- At the time of the grounding the Clipper Adventure was not following the track of soundings but was 147 metres to the West. If the planned track of soundings had been followed the vessel would NOT have gone aground.

End notes

[1] Previously published in Soundings, issue 74, Spring 2019, pages 20 to 24.

[2] Statement of Defence dated filled on 19 August 2011, paragraph 118. Also *Canada v. Adventurer Owner Ltd.*, 2017 Federal Court, pages 105 to 141 [henceforth 2017 F.C.], paragraph 30.Online at

Federal Court, Federal Court Decisions, Search by File Name T-901-11 at:http://decisions.fct-cf.gc.ca/fc-cf/decisions/en/item/218549/index do?r=AAAAAQARY2xpcHBlciBhZHZlbnR1cmUB (last accessed: 28 March 2018). Also Transport Safety Board (TSB), Marine Investigation ReportM10H0006, Passenger vessel Clipper Adventurer, Coronation Gulf, Nunavut [henceforth 2012 TSB Report], section "Canadian Hydrographic Service", paragraph 2.Online at TSB, Marine, Investigation Reports, SearchClipper Adventurer at:http://www.bst-tsb.gc.ca/eng/rapports-reports/marine/2010/m10h0006/m10h0006.asp(last accessed: 28 March 2018). The2012 TSB Report was officially released on 26 April 2012.

[3] Online at Wikipedia for MV Sea Adventurer at: https://en.wikipedia.org/wiki/MV_Sea_Adventurer (last accessed on 28 March 2018). On 01 October 2012 the vessel was renamed Sea Adventurer and taken over by another company.

[4] 2017 F.C., paragraphs 1 to 2.

[5] *Ibid*., paragraph 3.

[6] 2012 TSB Report, section "Summary",paragraph 1, and section "Factual Information – History of the Voyage", paragraph 4.

[7] Statement of Defence dated filled on 19 August 2011, paragraph 28.

[8] 2012 TSB Report, section "Environmental Conditions", paragraph 1. The maximum tidal range was 0.2 metres. See also footnote number 89 for further tidal details.

[9] 2012 TSB Report, section "Events Following the Grounding – Salvage Operation", paragraph 1

[10] Online at Ship Source Oil Pollution Fund, 2016-2017 File Portfolio (Incidents and Claims), select Clipper Adventurer [henceforth 2010 Ship Source], paragraph 2 at:http://sopf.gc.ca/incidents-and-claims/2-2-clipper-adventurer-2010/ (last accessed: 28 March 2018).

[11] 2012 TSB Report, section "Factual Information – History of the Voyage", paragraph 5.

[12] Image from Denis Hains, Hydrographer General of Canada, oral presentation "Arctic Canada: Cold, Hard Facts" at U.S. HYDRO Conference, Galveston, Texas, 21 March 2017, slide 5.

[13] Image from online at Jim Walker's Cruise Law News, Sinking, "Clipper Adventurer Cruise Ship Runs Aground in the Arctic" posted on 29 August 2010 at: http://www.cruiselawnews.com/2010/08/articles/sinking/clipper-adventurer-cruise-ship-runs-aground-in-the-arctic/ (last accessed: 28 March 2018).

[14] 2012 TSB Report, section "Canadian Hydrographic Service – Discovery of the Shoal",paragraph 8; and 2017 F.C., paragraph 59.

[15] Low resolution copy of CHS Chart 7777 edition 2015 was provided to the author under licence to the CHS. Not to be used for navigation.

[16] Image from 2012 TSB Report, section "Canadian Hydrographic Service – Discovery of the Shoal", Figure 3. The horizontal extent of the rock face shown is approximately 200 metres.

[17] 2012 TSB Report, section "Factual Information – Voyage Planning".

[18] *Ibid*.

[19] Federal Court List of Exhibits, Court Number T-901-11, Exhibit numbers 21, 139 and 140 which are discussed later in this paper.

[20] Oral deposition of Captain Kenth-Grankvist on 24 July 2012 at page 162, the Master of the Clipper Adventure at the time of the grounding stated that he had decided to travel at that speed to allow himself and the passengers some rest at anchor before having to disembark the next day.

[21] 2012 TSB Report, Figure 1. A higher resolution image was provided as part of an Access to Information Request submitted to the TSB and answered on 25 April 2017.

[22] Online at Friends of Hydrography, Ships, and select Richardson at: http://fohcan.org/ships/richardson.html (last accessed: 28 March 2018); and also Friends of Hydrography, Surveys, and select Arctic and search for Richardson at: http://fohcan.org/surveys/arctic.html (last accessed: 28 March 2018). The vessel is now operated by Seaward Engineering & Research out of Vancouver, British Columbia as the MV Richardson Point. See also Statement of Defence dated filled on 19 August 2011, paragraph 87; and 2012 TSB Report, section "Analysis – Navigation in Inadequately Surveyed Areas", paragraph 1.

[23] Low resolution copy of CHS Chart 7777 edition 1997 – Coronation Gulf – Western Portion, original scale 1:150,000, projection: Mercator, datum: NAD83 was provided to the author under licence from the CHS. Not to be used for navigation.

[24] 1965 Richardson Manuscript, Appendix IX.

[25] Private communication by the author with Seaward Engineering & Research on 27 April 2017.

[26] Radar and echo sounder information from 1965 Richardson Manuscript, page 2.

[27] Private communication by the author with the CHS dated 27 March 2017.

[28] 2017 F.C., paragraph 50.

[29] 2017 F.C., paragraph 50.

[30] Video deposition of David Mora Malca on 21 September 2016 in Panama, video clips 00034 and 00035.

[31] Statement of Defence dated filled on 19 August 2011, paragraph 102.

[32] 2012 TSB Report, section "Factual Information – Voyage Planning", paragraph 6.

[33] 2017 F.C., paragraph 47.

[34] Statement of Defence dated filled on 19 August 2011, paragraph 25.

[35] 2012 TSB Report, section "Factual Information – Voyage Planning", paragraph 6. Confirmed with paper copy of CHS Chart 7777 edition 1997 provided to the author by the CHS under licence.

[36] 2017 F.C., paragraph 49.

[37] Portion of CHS Chart 7777 edition 1997 – Coronation Gulf – Western Portion, original scale 1:150,000, projection: Mercator, datum: NAD83 from Federal Court List of Exhibits, Court Number T-901-11, Exhibit number 68, "Original chart #7777 produced during examination of Mr. Mora". Not to be used for navigation.

[38] 2012 TSB Report, section "Voyage Data Recorder", paragraph 3.

[39] Federal Court List of Exhibits, Court Number T-901-11, Exhibit number 21, "Clipper Adventurer Voyage Plans", page 15. The copy for this page was a bit blurry although readable and this was the clearest copy available.

[40] Federal Court List of Exhibits, Court Number T-901-11, Exhibit number 139, "MaxSea Route 871 Print Out – Port Epworth to Coppermine", page 2. The copy for this page was a bit blurry although readable and this was the clearest copy available.

[41] Federal Court List of Exhibits, Court Number T-901-11, Exhibit number 140, "Transaas (sic) – Port Epworth to Coppermine – 20100827 August 27, 2010 Electronic chart showing planned root (sic)", page 2.

[42] Private communications by the author with Ian Church dated 12 May 2017.

[43] Image provided to by the author with Ian Church on 15 May 2017. The rectangular white from on the rock shoal is the outline of the hull of the Clipper Adventurer.

Survey of India to use drones for mapping of villages in India

Survey of India (SoI) has now approval from DGCA for high definition aerial mapping of villages in India using drones. The mapping agency of India got permission for the purpose under the SVAMITVA scheme of Ministry of Panchayati Raj which stands for 'Survey of villages and mapping with improvised technology in village areas'. The target is to map India's over 6.6 lakh villages by Dec 2024.

The objective of the scheme is to create accurate land records for property rights, direct benefit transfers and panchayat level planning. This program will also reduce land disputes that drag for years. The immediate target is to map 100,000 villages by drones by Dec 2020. This is a massive project of India and will boost the local drone industry of the country. It will offer decent employment to our youngsters working on this project too. SoI should define data, quality & process specs, and award work transparently. SoI should limit to program managing this massive initiative rather than getting into doing it themselves. If they think of doing it themselves it would be a resounding failure due to their resource constraints.

This initiative will be an important tool for the administration at the Local Self Government (LSG) level. The data captured should become a repository not only for the administration but for the NGOs and other stakeholders, who would be bringing in interventions to support the cause of the Village and the Community. *www.medianama.com*

Global Mapper Mobile v2.1 released

Blue Marble Geographics® has announced the release of version 2.1 of its innovative mobile mapping application, Global Mapper Mobile® with updates to both the free and Pro versions. It is a powerful iOS and Android application for viewing and collecting GIS data. It utilizes the GPS capabilities of mobile devices to provide situational awareness and locational intelligence for remote mapping projects. *www.bluemarblegeo.com*

UK Geographic Association welcomes new geospatial strategy

The AGI is proud to be highlighted in this strategy, celebrating the work of our Early Careers Network and our members' long-standing history in developing geospatial standards. The council recognizes the responsibility they have to support UK geospatial community through early career development, skills, standards, ethics, business development, market understanding and to connect with the broader international geospatial community. This coupled with the commitment shown to a broad range of industry domains and implementation of the UN Integrated Geospatial Information Framework highlights the synergy this strategy has with its own mission: to be a thriving UK geospatial community, actively supporting a sustainable future.

AGI is pleased to see that the excellent work achieved in the National Underground Asset Register pilots will advance to a second stage, and the commitment to collaborate with local government and Devolved Administrations on standards, principles and guidance. It will continue to support the Commission in the ongoing work for the Geospatial Data Market and Skills Demand Studies. *www.gov.uk*

Visualize underground utilities using CesiumJS

Cesium has launched CesiumJS that enable visualizing underground data and allow to seamlessly transition from above ground features like entire cities to what's underneath in the same scene, whether that's utility data like water pipelines and electricity cables, or 3D structures like caves and mines. One can visualize all the relevant information in one place without the need to continually switch between specialized tools. For example, one can visualize earthquake occurrences over time and measure their proximity to critical urban infrastructure by adding Cesium OSM Buildings to scene. *https://cesium.com*

THE LEGACY OF A GPS PIONEER

Front

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Dear JAVAD Extended Family and Beyond

As you already know my father passed away Saturday, May 30th from COVID-19. I wanted to get a message out to all the friends of JAVAD to provide some insight into our plans for the future.

There are dozens and dozens of articles on the web and in print about the great Javad Ashjaee, and his 37-year history in this country, and his various achievements. Here, I'd like to address you all on a more personal level.

My father was very proud of all that he had accomplished, including setting up the Moscow office dating back to the late 1980's (through the financial crisis in Russia), the ahead-of-the-state-of-the-art manufacturing facilities in CA (following the US financial crisis), and the technical and operational capabilities that they possess. No other company in our industry was ever at the forefront of innovation and technology like the products we continually introduced into the market, and all of you had an integral part in making that happen. Most of all, my father was proud of his extended "family", as well as the partnership he had created between US and Russia—it was his "success story of cooperation".

Javad Ashjaee taking a break just before InterGeo 2019

We have a group of 200+ energetic, intelligent, passionate, and above all, kind employees, some of whom have been with the JAVAD group of companies for decades. And on May 30th, many of them lost someone whom they had worked with in business for many years. No matter how long it has been, we know that for all of you it was a meaningful impact on your lives.

JAVAD Nuclear Family

JAVAD Russia Family (JGNSS LLC)

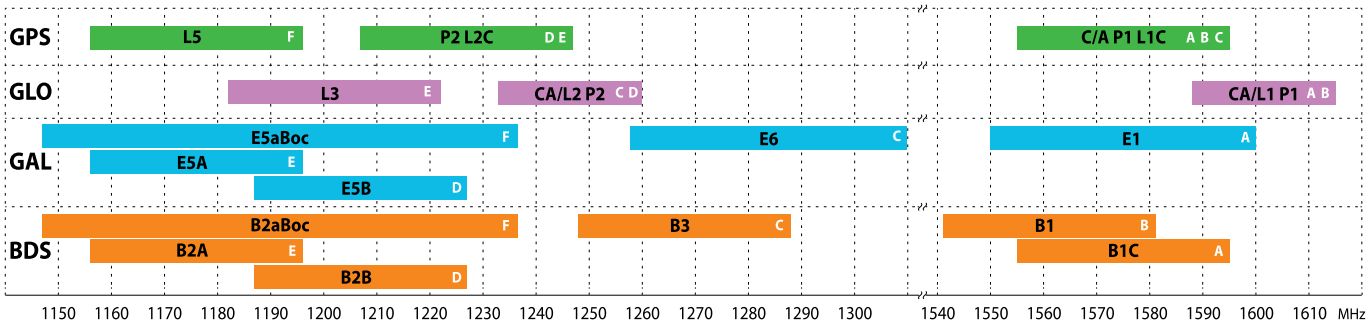
JAVAD Armenia Family (JCOM)




1949 1983 1987 1989

All Available Signals Tracked

...and used in RTK!

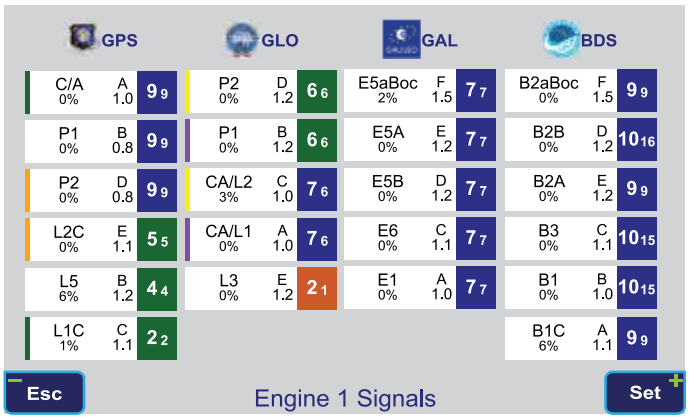


GNSS signals in the improved TRIUMPH-LS Plus with TRIUMPH 3 ASIC
GNSS bands for GPS, GLONASS, Galileo, and Beidou signals are depicted in the above figures

There are a total of 22 signals in 6 frequency bands labeled “A” to “F”. We categorize the GNSS signals, as shown on the right, and assign them a quality score. For example, Galileo and Beidou AltBOC signals are assigned a quality score of 1.5 because of their wider band and higher signal quality.

The columns (in order) represent the following:

- Name of signal and related noise in its band
- Designated band letter and quality score
- Number of satellites broadcasting the signal at the given moment. The multiplication of columns 2 and 3 defines the overall value of that signal for RTK



The Four Super Engines
Available now on TRIUMPH-LS Plus!

Clicking on each engine resets the RTK fix
Long-clicking on each engine shows the settings

This screenshot to the left shows the four super engines. Each column shows the signals that are used for that engine.

The numbers below each engine are:

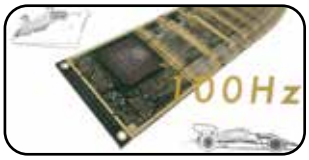
Number of RTK resets (last reason id) and counter of failed fixes

Number of signals used/number of signals rejected

Epochs since last reset

Solution difference from the first engine

Total run time Fixed Epochs



1989 1999 2002 2007

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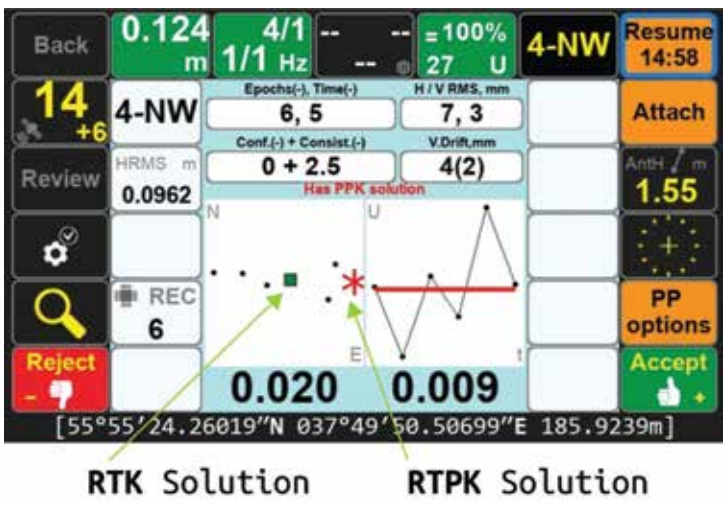
The Highlights

- TRIUMPH-LS Plus combines RTK and RTPK
- RTPK can post process the RTK data and **verify** your results in parallel and in real time.
- If RTK fails, RTPK comes to rescue in a fraction of a second.



2010 2012 2013 2014

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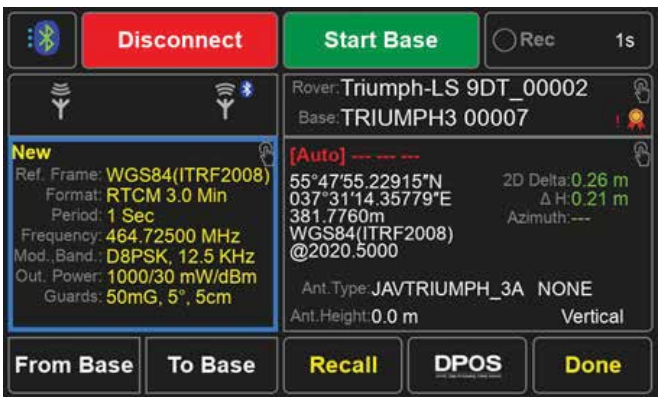
TRIUMPH-3 is self-sufficient for all jobs. No need to pay RTN service providers! The communications are done via integrated UHF, 4G/LTE, Wi-Fi, and Bluetooth channels.

Your own RTK base station is not far from your rover, and RTK solutions will be provided much faster and more reliably.



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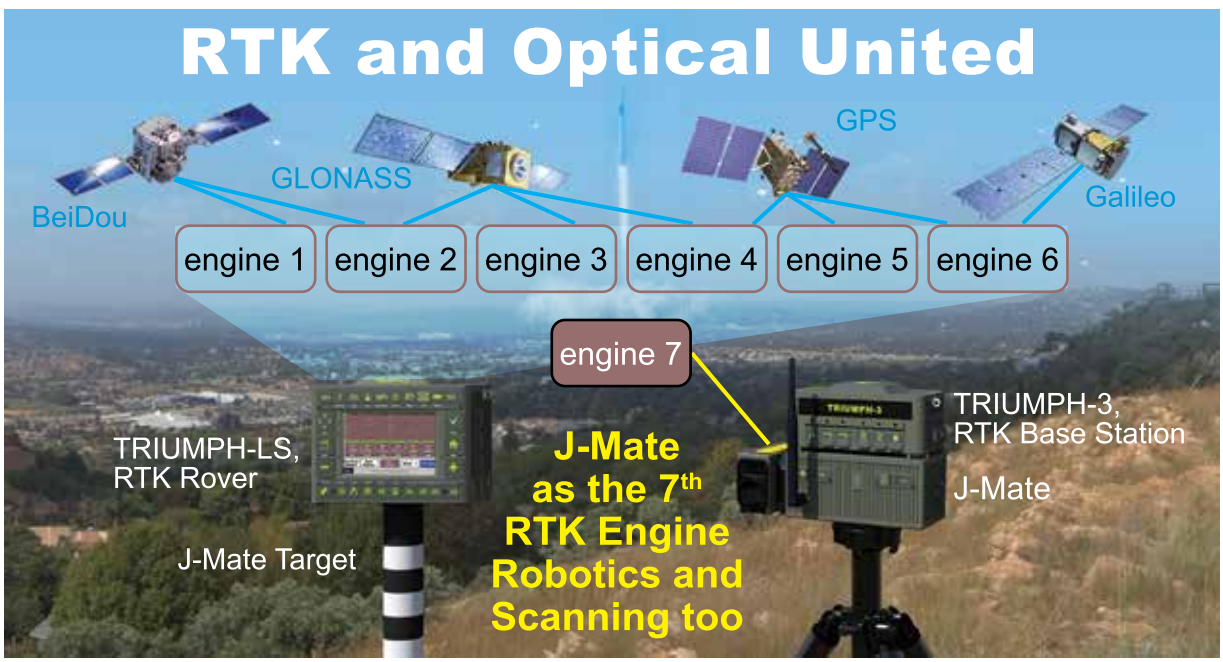

JAVAD USA Family (JGNSS & JEMS)

JAVAD PLS Family (associated with JGNSS)

To honor the legacy and all that our father had put into these companies, we will continue to push ourselves toward the goal of remaining the technological and innovative leader in our industries. That would be the minimum he would expect of all of us. He was so very proud of what had been accomplished but knew that we had to challenge ourselves each and every day to make it better. Everyone we have communicated with is motivated more than ever to carry on his legacy and implement all his visions and dreams.

Those of you who have worked with us know our similarities to our father, and know when we have our minds set, not much will deter us. We may have a gentler hand but can be a force like he was. Of course...our training started since day one, and we have earned some battle scars...

Our father also wrote me recently, "My only hope is that you and Nema focus on company as much as your energy allows." These words are in our heads and hearts every day, and with your help we will make him proud.

He was also a true visionary... including training the next generation early, and in his own special unique way.

Our hearts may be broken, but our resolve and spirits are not, and in fact are stronger than ever. The JAVAD group of companies is special, and the entire world knows this. We will harness his energy to carry on his legacy... and make us top not just in technology but also global presence.

To that end we will live and work each day with that expectation. We will continue to push ourselves to be better and continue to innovate and grow the companies that he started many years ago. This is the approach ingrained in all of us by Javad Ashjaee himself and this is something that we know for sure he would expect of all of us as we move forward without him. The best way to honor his legacy is to strive to make the company bigger, stronger and more successful than ever and that is what we will endeavor to do.

Javad Ashjaee started in 1986 with Ashtech and he will continue with the current JAVAD companies for generations to come. He is now literally with the stars and satellites (@International Space Station), still watching over us...so we better live up to his expectations!

Warm Regards,
Nedda Ashjaee

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Covid-19 and the surveying profession: A New Zealand perspective

Will we be able to maintain a Covid-19 free country or could it be that we will eventually suffer due to the lack of herd immunity? Will we see more Covid-19 business impacts in three to four months? Only time will tell.

John Hannah
Managing Director,
Vision NZ Ltd,
Nelson, New Zealand

These are unprecedented days for the global community. The Covid-19 global pandemic shows every sign of having the greatest global health impact since the 1918 Spanish flu.

As of July 12th, 2020 there have been approximately 13,000,000 reported cases of COVID-19 and about 570,000 deaths across 215 countries and six continents[1] It is clear from the data that the elderly and those with pre-existing medical conditions are most at risk. Although the author of this article falls into one of these "at risk" categories, he is most fortunate to live in an isolated country where the government listened to its medical experts, where its Prime Minister and government exercised strong, compassionate leadership, and where open, factual daily media briefings on the virus and its progress were held.

New Zealand was largely united in its determination to try to eliminate the Covid-19 threat. From March 26th all non-essential activity was locked down for four-and-a- half weeks. Everyone was limited to their own family or personal "bubbles" in what was known as the Level 4 response. This was followed, on April 28th, by a movement back to Level 3 where family or personal "bubbles" could be slightly extended. On May 14th the country moved to Level 2 - a "back-to-work" scenario. Here social distancing rules continued, but group meetings of up to 10 people were permitted. On 8 June we moved to Level 1 (sensible precautions) where work places, shops and sports facilities have fully re-opened and commercial life is returning to normal. As of the time of writing (12th July), the country has gone almost two months without any cases of community transmission. In this time the

How has the surveying profession fared in the midst of this crisis? The short answer is captured in one word, "variable". Those in cities or towns with a heavy tourism focus have seen a significant downturn in workloads. On the other hand, for the larger companies in cities with a broad cross-section of clients and work streams, the impact has been relatively small

The surveying profession in New Zealand was short-staffed prior to the crisis unfolding -there was more work available than skilled professionals available to meet the demand. Thus, with a degree of good fortune, the short to medium term falloff in demand that is likely to occur with reduced economic activity should not present a major problem to the profession

only reported cases have arisen from returning travelers who are confined to government isolation facilities.

The economic cost, however, has been and will be high. Our borders remain closed, the unemployment rate which was at about 4%, is rapidly moving higher (although how high it will become is uncertain) and the tourist industry (worth perhaps as much as 10% of GDP[2]) is decimated. Building activity has fallen sharply, and forward business confidence indicators are weak. All this has happened despite massive government stimulus spending (perhaps 25% of GDP).

How has the surveying profession fared in the midst of this crisis? The short answer is captured in one word, "variable". Those in cities or towns with a heavy tourism focus have seen a significant downturn in workloads. On the other hand, for the larger companies in cities with a broad cross-section of clients and work streams, the impact has been relatively small. The clients who commission large, multi-year projects in the land development or infrastructure sectors remain optimistic. For the smaller companies who perhaps focus more on smaller surveying projects that have shorter completion time-frames, the impacts have been more significant. They typically don't have the work backlog or the variety of professional tasks that would enable them to endure a sustained lock-down period. Some have reduced to four-day work weeks. Their future, which tends to reflect the market segment that can react quickly to financial upheaval, is more uncertain.

Having made the above distinction, anecdotal evidence suggests that the profession has been fortunate. Firstly, the country went into the pandemic crisis in the midst of a season of strong economic growth – particularly in the land development sector in which the profession is very active. Thus, although little or no field work was able to be undertaken during Level 4, office work that could be undertaken from individual home "bubbles" allowed professional activity to continue. Indeed, some were very grateful for the opportunity to at least catch up both on work backlogs and on those legacy tasks that seem to be delayed until "there is time". Productivity, for those who had the work available has perhaps diminished a little. Admittedly, after a total of seven weeks at Levels 4 and 3, the inability to undertake fieldwork was starting to bite all businesses.

Secondly, the country was able to bring the Covid-19 infection rates down quickly - there being very few cases of community transmission. Thus the move back to Level 2, where normal surveying activities could continue (albeit with strong social distancing rules in force), was able to occur reasonably quickly. Necessary field work could again be undertaken.

Thirdly, the professional sector in particular (with some medical and dental specialities excepted), has typically been quite well suited to a "work-from-home" environment. Staff are usually skilled, can work alone, and have the information technology tools to be able to do so. In all the major cities and towns the internet infrastructure is good and has been able to handle the increased digital communication demands.

Finally, the surveying profession in New Zealand was short-staffed prior to the crisis unfolding - there was more work available than skilled professionals available to meet the demand. Thus, with a degree of good fortune, the short to medium term falloff in demand that is likely to occur with reduced economic activity should not present a major problem to the profession. We are, however, noticing some shuffling of staff from those smaller businesses with a more limited client base, to the larger multi-disciplinary firms with the large, long-life projects.

New Zealand has been fortunate thus far. How it will deal with the reopening of its borders remains unknown. Will we be able to safely create a large Australasian or Pacific travel "bubble"? Will we be able to maintain a Covid-19 free country or could it be that we will eventually suffer due to the lack of herd immunity? Will we see more Covid-19 business impacts in three to four months? Only time will tell. Meanwhile for many in our nation and for the time being it is back to enjoying an afternoon or evening at a packed rugby stadium!

End notes

[1] https://www.worldometers.info/coronavirus/#countries

[2] https://www.rbnz.govt.nz/-/media/ReserveBank/Files/Publications/Analytical%20notes/2020/AN2020-04.pdf?revision=6c59d0c8-a81f-48bb-931c-0e38209139ba

AUSPOS and CORSnet-NSW: A match made in heaven

This paper outlines how AUSPOS and CORSnet-NSW are used to support datum modernisation in New South Wales (NSW), Australia, and investigates the performance of AUSPOS across the State

Volker Janssen
Senior Technical Surveyor in the Geodetic Operations team at NSW Spatial Services in Bathurst, Australia.

Simon McElroy
Senior Surveyor, leading the Geodetic Operations team at NSW Spatial Services in Bathurst, Australia

AUSPOS is Geoscience Australia's free online Global Positioning System (GPS) processing service (Jia et al., 2014; GA, 2020a). It has successfully processed more than 1 million jobs worldwide over the last 10 years and was ranked highest in a global comparison of free online post-processing tools (Gakstatter and Silver, 2013).

CORSnet-NSW is Australia's largest state-owned and operated Continuously Operating Reference Station (CORS) network (Janssen et al., 2016; NSW Spatial Services, 2020). It is built, owned and operated by Spatial Services, a unit of the NSW Department of Customer Service (DCS). CORSnet-NSW currently consists of 202 stations, providing fundamental positioning infrastructure that is authoritative, accurate, reliable and easy-to-use for a wide range of applications. Since May 2019, it delivers all-in-view, all-signals, multi-constellation Global Navigation Satellite System (GNSS) data, making it the nation's first CORS network to reach this milestone.

This paper outlines how AUSPOS and CORSnet-NSW are used together to support datum modernisation and improve state survey infrastructure across New South Wales (NSW). We quantify AUSPOS performance across NSW, demonstrating that it routinely delivers Positional Uncertainty (PU) at the 0.02-0.03 m level for horizontal position and 0.05-0.06 m for ellipsoidal height. We also show that AUSPOS provides a much better connection to the Australian Height Datum (AHD, see Roelse et al., 1971) than reported. These results reveal that AUSPOS is a very suitable, efficient and reliable option to establish, propagate and strengthen the NSW Survey Control Network.

AUSPOS

AUSPOS accepts static, 30-second Receiver Independent Exchange (RINEX) data of at least 1 hour duration (recommended minimum 2 hours, maximum 7 consecutive days). The user's antenna type is selected from a drop-down menu, and the height of instrument (measured vertically to the Antenna Reference Point, ARP) is entered. The best available International GNSS Service (IGS) station data and products (IGS, 2020) and the Bernese software version 5.2 (Dach et al., 2015) are employed to compute precise 3D coordinates, using GPS data only. Up to 15 surrounding IGS and Asia-Pacific Reference Frame (APREF, see GA, 2020b) stations are selected as reference stations, generally the 7 closest IGS sites and the 8 closest APREF sites.

Usually after a few minutes, a processing report (pdf) is emailed to the user. This includes coordinates in the two most recent Australian datums (GDA2020 and GDA94, see ICSM, 2020a) and the global ITRF2014 (Altamimi et al., 2016), as well as a physical (normal-orthometric) AHD height for Australian data. The report also provides the computed coordinate uncertainties, ambiguity resolution statistics, and an overview of the GPS processing strategy applied. For advanced users, Solution Independent Exchange (SINEX) files containing more detailed information are available for download.

AUSPOS and CORSnet-NSW

All CORSnet-NSW stations are part of APREF and contribute to the AUSPOS service, including 13 concrete-pillared NSW sites incorporated into the IGS network (Figure 1). This provides a relatively dense network in NSW for generating a reliable regional ionospheric delay model and tropospheric delay corrections to support ambiguity resolution. A precise solution is then computed using double-differencing techniques.

During AUSPOS processing, IGS station coordinates are constrained with uncertainties of 1 mm for horizontal position and 2 mm for ellipsoidal height. Lower-tier CORS coordinates are constrained with uncertainties of 3 mm for horizontal position and 6 mm for the vertical, due to the shorter CORS operation time span, lower data quality or lower-grade monumentation. The GPS data is processed in the IGS realisation of ITRF2014 and then transformed to GDA2020 via the Australian Plate Motion Model. Derived AHD heights are computed by applying a gravimetric-geometric quasigeoid model (AUSGeoid2020, see Brown et al., 2018; Janssen and Watson, 2018; Featherstone et al., 2019) to the GDA2020 ellipsoidal heights. Legacy GDA94 coordinates are obtained from GDA2020 by transformation.

Positional Uncertainty (PU) is defined as the uncertainty of the horizontal and/or vertical coordinates of a point, at the 95% confidence level, with respect to the defined reference frame (datum) (ICSM, 2014). A description of the practical implementation of PU on public record in NSW can be found in Janssen et al. (2019). The coordinate uncertainties of East, North and ellipsoidal height reported by AUSPOS are scaled using an empirically derived model, which is a function of duration, data quality and geographical location, and expressed at the 95% confidence level (Jia et al., 2016).

Supporting datum modernisation

Datum modernisation and further improvement of survey infrastructure is required to accommodate the increasing accuracy and improved spatial and temporal resolution available from modern positioning technologies to an ever-broadening user base. NSW Spatial Services employs AUSPOS as one of several suitable methods to maintain and extend the State's Survey Control Network. To this end, AUSPOS data of at least 6 hours duration is used to propagate the datum in NSW, while AUSPOS data of less than 6 hours duration strengthens the datum. This distinction is made based on the higher quality of AUSPOS solutions exceeding 6 hours duration and their eligibility for inclusion in the National GNSS Campaign Archive (NGCA) hosted by Geoscience Australia.

NSW Spatial Services is currently building an updated 'passive' Survey Control Network (in the Eastern and Central Divisions) with a minimum of one fundamental survey mark observed by 6+ hour AUSPOS every 10 km. Its vision is to ensure that any future user is no further than 5 km (and often much less) from such a fundamental mark providing direct connection to datum. Similarly, levelled AHD marks are observed by 6+ hour AUSPOS every 10 km, often at a far greater density. This will allow users to achieve NSW Spatial Services' vision of a PU of 20 mm in the horizontal and 50 mm in the vertical (ellipsoidal height) component anywhere in the State and easily apply transformation tools to move between current, future and various historical datums and local working surfaces.

The use of AUSPOS campaigns has developed into a capable and reliable alternative to conducting traditional static GNSS baseline surveys, simplifying logistics by removing the requirement of field crews having to occupy particular survey marks at a set time. As a consequence, processing, adjustment and report writing efforts have been significantly reduced or removed. AUSPOS also forms a new and fundamental component of vertical datum modernisation and the propagation of the Australian Vertical Working Surface (AVWS, see ICSM, 2020b).

At present, the GDA2020 state adjustment incorporates approximately 31,000 survey control marks across NSW, i.e. 12% of the 250,000 marks on public record. Consequently, 88% of the marks have been transformed from GDA94 to GDA2020.

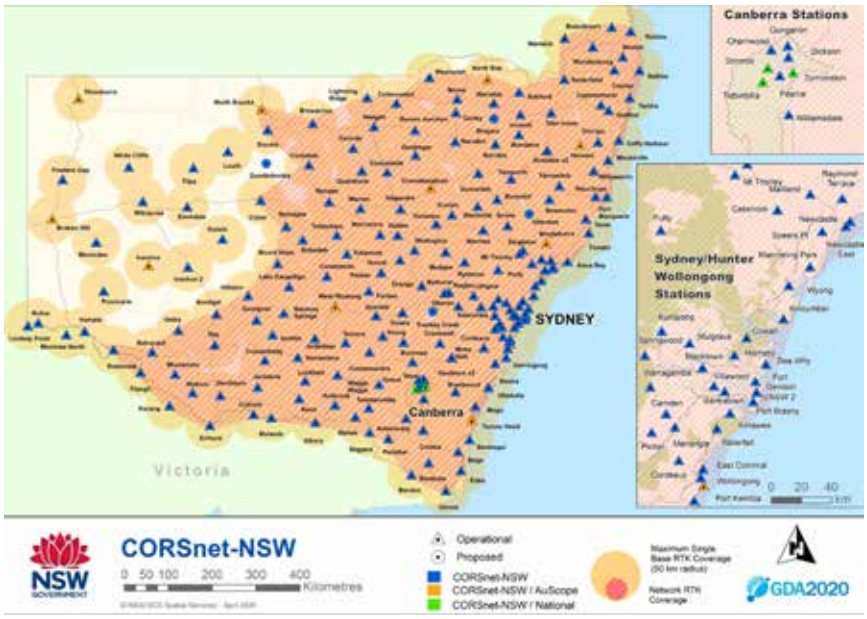


Figure 1: CORSnet-NSW network map (NSW Spatial Services, 2020).

Uncertainties of these transformed GDA2020 coordinates are given null values until these are calculated via inclusion in the state adjustment. As shown in this paper, AUSPOS is a suitable method to accelerate the process of including additional survey marks into the state adjustment in order to improve user access to GDA2020 coordinates and uncertainties.

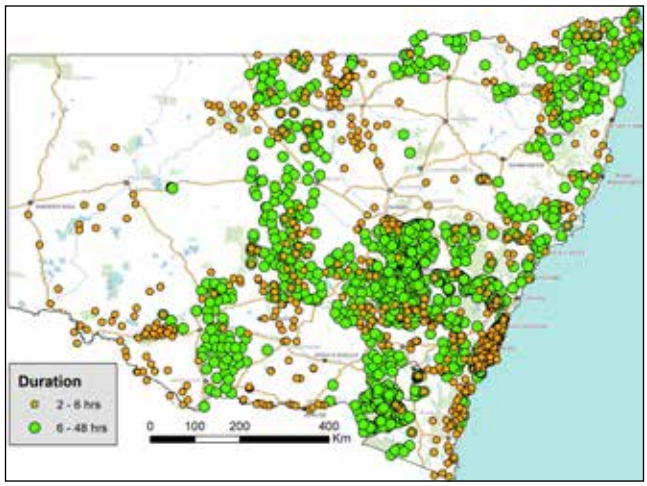


Figure 2: Location of the 2,464 successful AUSPOS solutions analysed across NSW, colour-coded to indicate observation length.

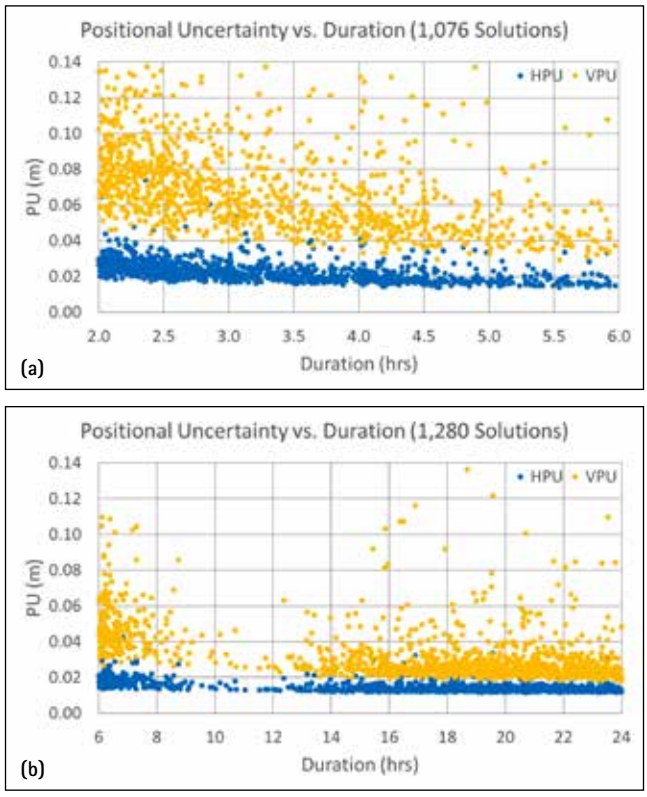


Figure 3: Positional Uncertainty (PU) vs. duration for (a) 2-6 hour data, and (b) 6-24 hour data.

Data and methodology

We used 2,618 GNSS datasets observed by NSW Spatial Services over the last 5 years (November 2014 to August 2019). Data was collected under typical conditions generally encountered in the field, with observation session lengths ranging from 2 to 48 hours. Each dataset was processed individually with AUSPOS version 2.3, using final IGS products.

Some AUSPOS solutions were rejected for this analysis due to warnings in the AUSPOS report, referring to poor ambiguity resolution and/or large uncertainties. Overall, 154 sessions (5.9%) were rejected, including 121 (10.1%) of the 2-6 hour sessions and 33 (2.3%) of the 6-48 hour sessions. Upon investigation of site photos and other metadata, this was generally attributed to ambitious attempts to observe survey marks in locations with substantial tree cover, resulting in poor sky view conditions. As expected, shorter observation sessions were more prone to be negatively affected by these unfavourable conditions. For all 2,464 successful AUSPOS solutions (Figure 2), descriptive statistics were used to evaluate the uncertainties of the resulting GDA2020 coordinates.

We performed three tests:

1. Analysing Horizontal PU (HPU) and Vertical PU (VPU) of the AUSPOS solutions for GDA2020 horizontal coordinates and GDA2020 ellipsoidal heights, respectively.
2. Analysing the repeatability of AUSPOS solutions for reoccupations on the same mark.
3. Analysing AHD results by comparing the AUSPOS-derived AHD height to levelled AHD heights on public record and investigating the AHD-PU reported by AUSPOS.

The results of two further tests can be immediately summarised:

- Whilst AUSPOS PU values are known to be affected (scaled) by latitude, the variation is negligible for user results within NSW.
- Whilst IGS products have continuously improved and CORS density has increased, AUSPOS version 2.3 performance has remained stable, predictable, repeatable and of high quality within NSW.

PU of AUSPOS solutions

First, we investigated the AUSPOS-derived HPU and VPU values. Descriptive statistics (i.e. minimum, maximum, range, median, mean and standard deviation) were examined for the entire dataset of 2,464 successful AUSPOS solutions (2-48 hour duration). To allow examination of the effect the observation session length has on the resulting uncertainties, we also investigated these descriptive statistics for the 2-6 hour and 6-24 hour subsets (Janssen and McElroy, 2020). Figure 3 presents a graphical visualisation of the results, showing PU as a function of observation session length for the 2-6 hour and 6-24 hour datasets.

As expected, a longer observation span generally improves PU. This is demonstrated by mean values of 0.023 m ± 0.006 m (1 sigma) for HPU and 0.069 m ± 0.022 m (1 sigma) for VPU when using 2-6 hour data, compared to values of 0.015 m ± 0.003 m (1 sigma) for HPU and 0.033 m ± 0.016 m (1 sigma) for VPU when using 6-24 hour data. Most of the improvement is gained by increasing the observation length from 2 hours to about 4-5 hours, with minor but not insignificant improvement when it is increased to 24 hours and beyond.

Observation sessions exceeding 12 hours provide AUSPOS solutions of substantially higher quality in the vertical component. An investigation of site photos and other metadata attributed the larger VPU values evident for solutions greater than 15 hours duration to poor sky view conditions caused by substantial tree cover. As an example, Figure 4 illustrates the conditions encountered at the sites producing the three largest VPU values. In spite of these poor conditions, AUSPOS solutions generally achieve acceptable HPU and heights with a VPU of better than 0.1 m.

Cumulative distribution

The cumulative distribution allows us to quantify the percentage of AUSPOS solutions meeting a particular PU threshold. Figure 5 visualises the cumulative distribution in regards to HPU and VPU for the 2-6 hour and 6-24 hour datasets, indicating the relationship between uncertainty and reliability achievable with AUSPOS. The reader can use these graphs as a simple 'look-up' tool to determine the likelihood of achieving any specified HPU or VPU threshold with 2-6 hour and 6+ hour observation sessions.

Across the entire dataset (2-48 hrs), 70.6% of AUSPOS solutions have HPU values of 0.02 m or better, i.e. these solutions have an absolute reported horizontal accuracy slightly larger than the size of an Australian 50c piece (radius of 16 mm) with respect to the national datum. This includes 38.6% of the 2-6 hour AUSPOS solutions and 95.2% of the 6-24 hour solutions with HPU values at this level. Similarly, 95.7% of all solutions have HPU values of 0.03 m or better, including 90.8% of the 2-6 hour solutions and 99.5% of the 6-24 hour solutions.

Regarding ellipsoidal height, 61.0% of the AUSPOS solutions have VPU values of 0.05 m or better across the entire dataset. This includes 23.3% of the 2-6 hour AUSPOS solutions and 89.7% of the 6-24 hour solutions with VPU values at this level. Similarly, 71.8% of all solutions have VPU values of 0.06 m or better, including 42.7% of the 2-6 hour solutions and 94.3% of the 6-24 hour solutions. These results are impressive, remembering that the uncertainties are stated at the 95% confidence level. As expected, a longer observation span improves PU, particularly in the vertical component. The findings illustrate

Figure 4: Pushing the boundaries of reasonable sky view conditions in the field: (a) TS486, (b) SS4115, and (c) MM3634.

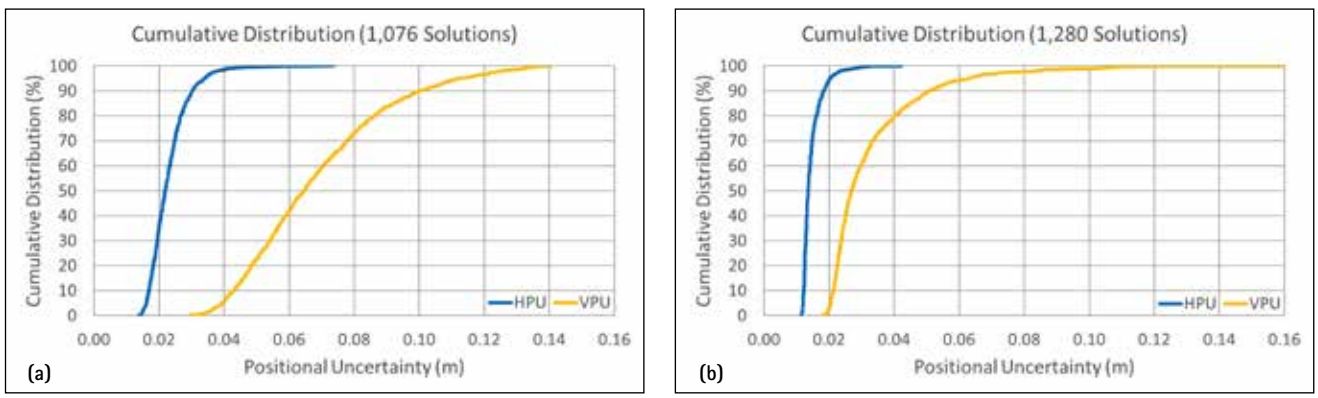
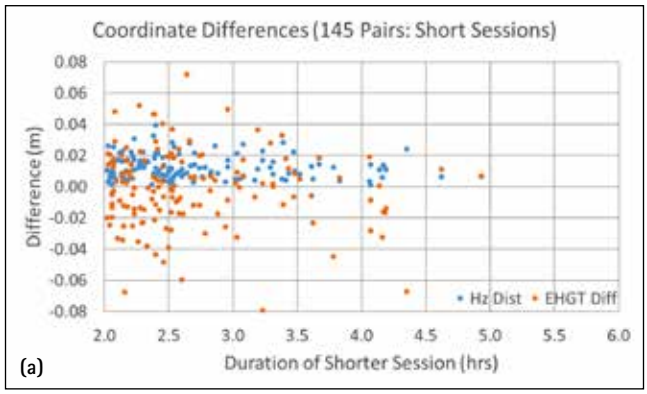


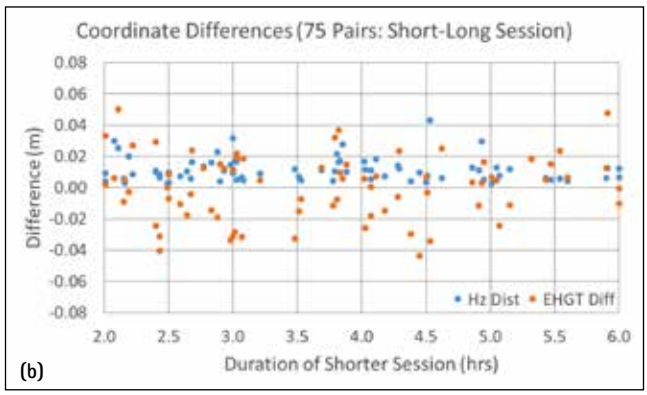
Figure 5: Cumulative distribution of PU for (a) 2-6 hour data, and (b) 6-24 hour data.

why Geoscience Australia stipulates, and NSW supports, a minimum observation span of 6 hours for AUSPOS data to propagate the Survey Control Network in Australia.

Repeatability

Repeatability was investigated by comparing independent reoccupations on the same mark. Where possible, independent pairs of sessions on the same mark were selected for three scenarios: two short sessions (2-6 hrs), one short (2-6 hrs) and one long session (6+ hrs), and two long sessions (6+ hrs). In each scenario, each session was only paired once. Since it is necessary to consider coordinate differences of opposite signs, the Root Mean Square (RMS) is appropriate to quantify the average agreement in the vertical component.





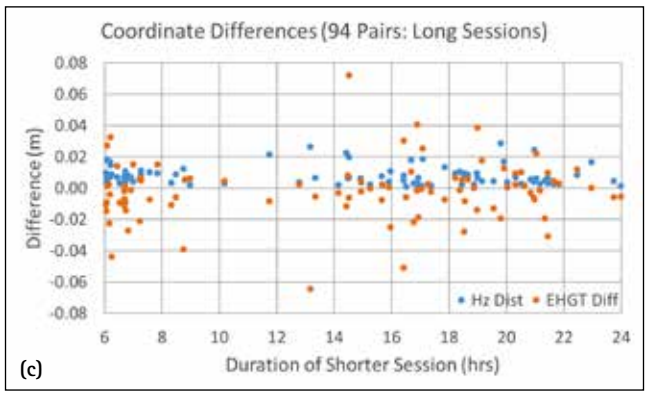


Figure 6: Difference in horizontal and vertical coordinates vs. duration for (a) short-session pairs, (b) short-long-session pairs, and (c) long-session pairs.

Figure 6 visualises the results, referring to the horizontal distance between the two AUSPOS solutions, as well as the difference in ellipsoidal height (shorter minus longer session). Again, it is evident that AUSPOS produces high-quality positioning results with good repeatability. While longer observation sessions improve the precision (repeatability) and reduce the risk of outliers (range), shorter sessions provide suitable results for strengthening the NSW Survey Control Network.

In July/August 2019, trigonometrical station TS3663 PANORAMA (located in Bathurst, close to NSW Spatial Services) was occupied 38(!) times, providing an opportunity to investigate the repeatability of AUSPOS solutions on this high-quality, concrete-pillared mark with excellent sky view. The longest observation session (48 hours) was assumed ground truth, with the AUSPOS results of the shorter sessions being compared against it (Figure 7). The average agreement is 0.006 m ± 0.003 m (1 sigma) in the horizontal component, and the RMS in ellipsoidal height is 0.010 m (1 sigma). This shows that observation sessions of less than 6 hours in length have high reliability and repeatability under good sky view conditions.

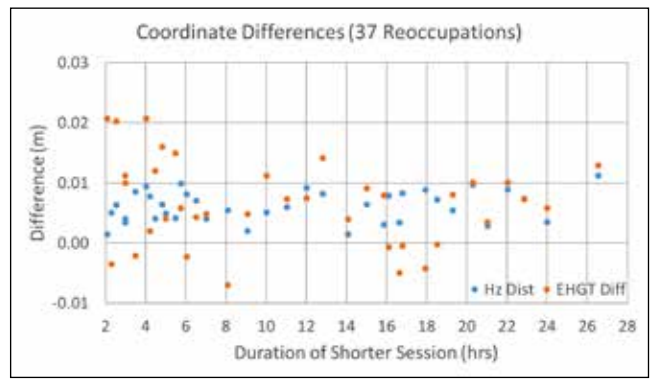


Figure 7: Difference in horizontal and vertical coordinates vs. duration for TS3663 PANORAMA.

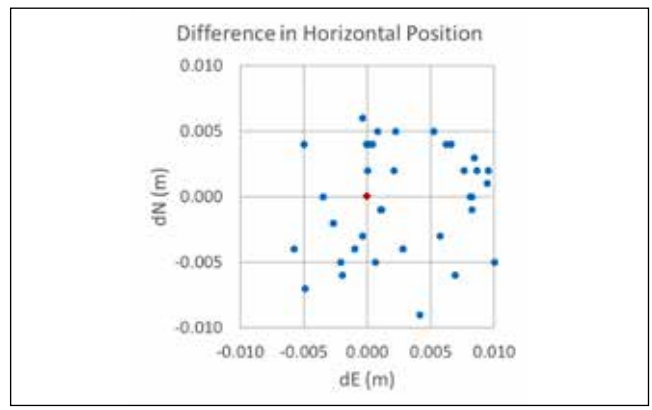


Figure 8: Difference in horizontal position from 48-hour solution for TS3663 PANORAMA (37 reoccupations).

A bullseye plot of the difference in horizontal position from the 48-hour solution is shown in Figure 8, providing a spatial perspective and illustrating the high precision of these results.

AHD connection

For a subset of marks, we compared the derived AHD height determined by AUSPOS (using AUSGeoid2020) to levelled AHD heights of sufficient quality on public record, ensuring full independence from the data used to produce AUSGeoid2020. Figure 9 visualises the results for the 2-6 hour and 6-24 hour data, referring to the difference between the AUSPOS-derived AHD height and the levelled AHD height on public record. The AUSPOS solutions are consistent across all marks and observation durations, delivering AHD heights with an RMS of about 0.040 m (1 sigma) or 0.078 m (95% confidence level) and a range of about 0.35 m (-0.20 m to +0.15 m).

NSW Spatial Services, on behalf of the NSW Surveyor-General, has a legislative, regulative responsibility to maintain and extend the Survey Control Network in NSW. CORSnet-NSW sites comprise a fundamental, high-density and long-term component of AUSPOS infrastructure within the State

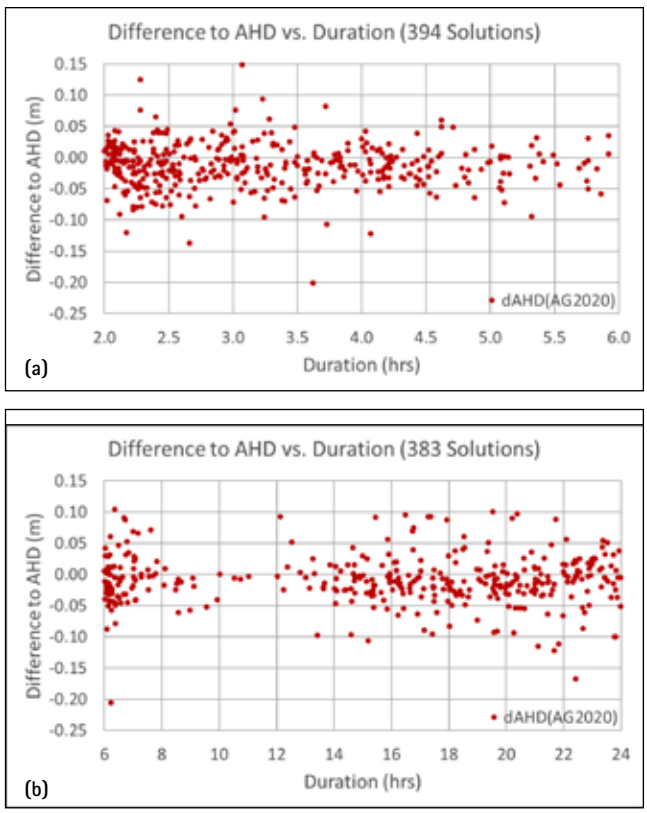


Figure 9: Agreement to levelled AHD vs. duration for (a) 2-6 hour data, and (b) 6-24 hour data.

The derived AHD-PU reported by AUSPOS appears to be overly conservative for the data investigated, providing a mean AHD-PU of 0.182 m, which is more than double the RMS for the difference to the levelled AHD height at the 95% confidence level (i.e. about 0.078 m). This can be explained by the conservative AUSGeoid2020 uncertainty grid values applied, with the best-case official AUSGeoid2020 uncertainty in NSW being about 0.14 m at the 95% confidence level. It is pleasing to see that AUSPOS provides a much better connection to AHD across NSW than reported.

Conclusion

NSW Spatial Services, on behalf of the NSW Surveyor-General, has a legislative, regulative responsibility to maintain and extend the Survey Control Network in NSW. CORSnet-NSW sites comprise a fundamental, high-density and long-term component of AUSPOS infrastructure within the State. AUSPOS and CORSnet-NSW have proven to be an ideal match to establish, propagate and strengthen the NSW Survey Control Network.

In NSW, AUSPOS routinely delivers PU values of 0.02-0.03 m (horizontal) and 0.05-0.06 m (vertical). PU is substantially improved by increasing the observation length from 2 hours to 4-5 hours, and observation sessions exceeding 12 hours provide much higher quality in ellipsoidal height. AUSPOS results have a high degree of predictability and repeatability throughout the State at sites with good sky view, over at least the last 5 years. At sites with tree cover, acceptable HPU and ellipsoidal heights with a VPU of better than 0.1 m can be achieved. The derived AHD-PU values reported by AUSPOS appear to be overly conservative for the data investigated (0.18 m reported vs. 0.08 m presented here), due to the conservative AUSGeoid2020 uncertainty grid values applied by AUSPOS.

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Virtual edition of ESA Space App Camp 2020

For the first time, the ESA Space App Camp is offering a virtual workspace to 20 dedicated developers: a comprehensive preparation phase and an 11-day online Space App Camp, supported by Earth Observation, Artificial Intelligence and business experts. The winners will be rewarded with cash prizes, a unique Earth Observation support package to facilitate the continuation of the work on their winning App idea, exclusive work opportunities and insights at ESA.

The aim of the ESA Space App Camp is to make Earth Observation data and services accessible to a wide range of citizens. The camp participants get introduced to Copernicus and learn about the many ways in which big data from space can enrich mobile apps using a dedicated API for EO data. Those who attend will be tasked with devising innovative apps and feasible business models in one of five subject areas: Smart Green Cities; Food Security; Health; Tourism and Coastal monitoring. This year, an additional topic on Agriculture in honour of former ESA employee Luigi Fusco can also be addressed.

ESA invites 20 developers, artificial intelligence and machine learning specialists from across Europe to exchange new ideas with fellow developers and tackle some of the world's greatest challenges from 11-21 September 2020. *www.azo-space.com.*

Remote sensing and remote data control technology by 3D at Depth

3D at Depth Inc., survey support services, and 3D data solutions recently launched a remote sensing and remoted data control solution to help operators provide a safe, more efficient environment to their operations while increasing their near real-time 3D data intelligence. The remote sensing and remote data control technology is built around expanded capabilities originally embedded in 3D at Depth's proven subsea LiDAR technology

when the company first commercialized in 2014. With the onset of the COVID-19 pandemic, the recent downturn in the industry, and the race to advance autonomy into offshore oil and gas operations, 3D at Depth quickly phased in the technology as part of their current standard services.

3D at Depth developed software simulators that can be installed on the vessel prior to the start of any project to simulate a remote scan or metrology. An additional feature provides flexibility for those vessels with low bandwidth communications to shore. *3datdepth.com*

RS algorithm for landslide monitoring

Chinese researchers have designed an improved remote sensing method for more efficient landslide monitoring.

Synthetic aperture radar (SAR) remote sensing is a potential technique for long-term monitoring of landslide-prone areas. Traditional pixel offset tracking methods work well for fast-moving landslides but still have some limitations.

The researchers from the Chinese Academy of Sciences proposed the improved offset tracking method to optimize a more efficient workflow, as well as an improved algorithm based on homogeneous samples.

The researchers applied the proposed method to study the evolution of the landslide that happened in 2018 in southwest China's Tibet Autonomous Region, using SAR data from the Gaofen-3 satellite and the Advanced Land Observing Satellite-2 (ALOS-2).

In the study, the researchers demonstrated that the SAR remote sensing plays an important role in global landslide monitoring, especially when ground live data are insufficient. *www.xinhuanet.com*

Stand-alone photogrammetry cloud processing solutions by Pix4D

Pix4D has released Pix4Dcloud and Pix4Dcloud Advanced: the new mapping platforms for online surveying workflows and construction site monitoring. These stand-alone cloud products run Pix4D's photogrammetry algorithms for mapping and modeling reality from images.

Pix4Dcloud Advanced extends the functionalities of Pix4Dcloud to address the needs of construction customers with timeline-based monitoring and improved accuracy. Both products now replace the previous Pix4D Cloud platforms. *pix4d.com*

Private sector participation in space activities will be allowed in India

India has approved far reaching reforms in the Space sector aimed at boosting private sector participation in the entire range of space activities. It was approved by Union Cabinet of the country chaired by the Prime Minister.

India is among a handful of countries with advanced capabilities in the space sector. With these reforms, the sector will receive new energy and dynamism, to help the country leapfrog to the next stages of space activities. This will not only result in an accelerated growth of this sector but will enable Indian Industry to be an important player in global space economy. With this, there is an opportunity for large-scale employment in the technology sector and India becoming a Global technology powerhouse.

Space sector can play a major catalytic role in the technological advancement and expansion of our Industrial base. The proposed reforms will enhance the socio-economic use of space assets and activities, including through improved access to space assets, data and facilities.

The newly created Indian National Space Promotion and Authorization Centre (IN-SPACe) will provide a level playing field for private companies to use Indian space infrastructure. It will also hand-hold, promote and guide the private industries in space activities through encouraging policies and a friendly regulatory environment. The Public Sector Enterprise 'New Space India Limited (NSIL)' will endeavor to re-orient space activities from a 'supply driven' model to a 'demand driven' model, thereby ensuring optimum utilization of our space assets.

These reforms will allow ISRO to focus more on research and development activities, new technologies, exploration missions and human spaceflight programme. Some of the planetary exploration missions will also be opened up to private sector through an 'announcement of opportunity' mechanism. *www.hindustantimes.com*

NGA Signs R&D Agreement with Capella Space

Capella Space has signed a Cooperative Research and Development Agreement (CRADA) with the National Geospatial-Intelligence Agency (NGA). The CRADA gives Capella access to NGA researchers for deeper insight into problems and in return NGA gains access to Capella Space's SAR data and analytics services and signifies NGA's first research partnership with an American commercial small satellite SAR data company, in an effort to expand its research capabilities.

The CRADA with Capella Space is part of the NGA's broader Commercial GEONIT Strategy, first released October 2015 and later updated in September 2018. The NGA Commercial GEOINT Strategy provides a vision and plan for continually increasing collaboration with commercial GEOINT companies in order to meet rising customer demands for more timely and persistent imagery, analytics, and contextual information. *www.capellaspace.com*

Global air pollution maps now available to the public

A new online platform that allows for the tracking of air pollution worldwide is now available to the public. The maps, which use data from the Copernicus Sentinel-5P satellite, show the averaged nitrogen dioxide concentrations using a 14-day moving average. The maps not only show changes over time on a global

scale, but also provide the possibility for users to zoom in to areas of interest, for example any city or region over Europe.

The averaged maps also reflect the effects of the COVID-19 lockdown – with drastic reductions of nitrogen dioxide concentrations visible over many areas. These effects can now be easily explored across the globe.

With air quality a serious concern, the Copernicus Sentinel-5P satellite was launched in 2017 to map a multitude of air pollutants around the globe. Copernicus Sentinel-5P carries the Tropomi instrument – a state-of-the-art instrument that detects the unique fingerprint of atmospheric gases to image air pollutants more accurately and at a higher spatial resolution than ever before.

The S5P-PAL is also part of the new 'Rapid Action on Coronavirus and Earth observation' dashboard, also known as RACE. The platform provides access to key environmental, economic and social indicators to measure the impact of the coronavirus lockdown and monitor post-lockdown recovery.

Planet announces 50 cm SkySat imagery

Over the past year, Planet has seen increased demand for its SkySat imagery to fulfill customers' needs for timely, accurate and frequent information across the decision cycle. The COVID-19 pandemic has intensified this trend, as traditional surveying and inspection methods are not currently possible.

To meet the present moment, and demonstrate our commitment to rapidly deliver more value to customers every year, Planet is excited to unveil three new releases as part of our overall tasking offerings. Combined, these releases not only enhance the core imagery for analysis, but also reduce friction to acquire that data.

Higher resolution 50 cm imagery: In just six months, we successfully lowered our SkySat constellation to enhance the spatial resolution of our SkySat imagery from 80 cm to 50 cm for our ortho product.

Tasking Dashboard: At Planet we want to democratize access to our assets, and we hear from all our users a desire to have simpler and faster workflows. Planet's imaging pipeline and delivery infrastructure have been built in the cloud and the Tasking Dashboard and API are the latest results of that foundation. The Tasking Dashboard is a new user interface that allows customers to request SkySat collections, while our new API provides efficient, automated access.

Rapid revisit, with up to 12x revisit capabilities: While Planet leads the market with guaranteed sub-daily revisit, the upcoming launch of six new SkySats will allow Planet to image certain locations up to 12 times per day, at a global average of 7 times per day. This unprecedented capability will provide more rapid response to global events and enable imaging at times of the day previously unseen by satellites *www.planet.com*

Germany launches decentralized contact tracing app

Germany has developed a contact tracing app "Corona-Warn-App" that warns you if you've been in contact with someone who may have been infected with the coronavirus. The app serves as a digital complement to distancing, hygiene and wearing masks. It uses Bluetooth technology and the Apple/Google Exposure Notification APIs," says the Android app page, which has 18,000 reviews already, averaging at 4.6/5.

The reason Germany opted to go for the decentralized approach supported by the Google/Apple API was that its citizens aren't too keen on being spied on by their government. Despite all this there still seems to be some hesitance about downloading the app in Germany, according to Reuters, but maybe there will be a snowball effect once a few intrepid punters give it a go. Either way the German government has given its contact-tracing app the best possible chance of success. *www.cnbc.com*

Indian Government issues draft rules for manufacturing and using drones

The Civil Aviation Ministry of India issued draft rules for manufacturing drones and using it in the country. As per the new policy authorized manufacturer or importer can sell its devices only to an individual or entity approved by the aviation regulator DGCA. The draft policy provides guidelines for those who wish to manufacture, operate and even import the UAVs which are classified as either Remotely Piloted Aircraft Systems, Model Remotely Piloted Aircraft Systems or Autonomous Unmanned Aircraft Systems.

As per new rules, drone importer, manufacturer, trader, owner and operator will need to take approval from the Directorate General of Civil Aviation. An authorized unmanned aircraft system importer or manufacturer must not sell a UAS to any person except an authorized trader or owner. DGCA will have the power to inspect a UAS manufacturing or maintenance facility before granting any authorization under these rules.

"No UAS shall operate in India unless there is in existence a valid third party insurance policy to cover the liability that may arise on account of a mishap involving such UAS," the draft rules added. Only Nano class drones, which are less than 250 grams, will be allowed to operate in India in general, the draft rules stated, adding that only a "qualified remote pilot" will be permitted to operate heavier drones. *https://economictimes.indiatimes.com*

Chennai in India soon to become a drone manufacturing hub

Capital of Indian state Tamil Nadu, Chennai will soon become a drone manufacturing hub, enabling better pandemic and disaster responses using drones.

In the wake of the COVID-19 pandemic, space scientists like Mylsamy Annadurai and senior officials of the state are exploring the possibility of turning

Chennai into a drone manufacturing hub with support from institutions like Anna University and MIT. The draft Unmanned Aircraft System Rules, 2020 recently issued by the Indian Ministry of Civil Aviation, which seeks to relax the rules related to drone use, has made such a possibility more feasible. *https://economictimes.indiatimes*

Simple workflow for earthworks monitoring

Virtual Surveyor has introduced new functionality in Version 7.3 of its popular drone surveying software to create a simplified workflow for monitoring earthworks progress at construction sites. The productive workflow enables construction managers to quickly calculate cut-and-fill changes over time for comparison with the earthworks design plan.

The software is a powerful construction monitoring tool designed to bridge the gap between UAV photogrammetric processing applications and engineering design packages. The software generates an interactive onscreen environment with drone orthophotos/DSMs and/or Lidar point clouds where the user can compare multiple drone surveys in a matter of seconds. *www.virtual-surveyor.com*

Microdrones enters into 3D

Microdrones offers fully integrated survey equipment systems for high wall mapping and 3D modeling applications.

mdMapper3000DµoG 3D aaS fills a niche where traditional manned aircraft 3D mapping can't get close enough to the subject to get the exacting detail for high-end 3D models or high wall mapping.

The newly released mdMapper3000DµoG Oblique aaS adds a fully integrated gimbal to the popular dual IMU direct georeferencing mdMapper3000Dµog system. This provides more opportunity to capture oblique imagery, helpful for high wall mapping and mining photogrammetry applications. *www.microdrones.com*

First authorization in Spain for flights BVLOS

SCR, a company of the everis Aerospace, Defense and Security group, has obtained the first authorization in Spain to perform flights beyond visual line of sight (BVLOS) with drones of more than 2 kg of maximum take-off weight (MTOW).

The permission, which is indefinite, has been granted by the Spanish Aviation Safety and Security Agency (AESA.

The permission will especially facilitate the use of fixed-wing systems in operations where, until now, their use was limited to specific and restricted actions.

A leap forward in the sector. Until now, operations out of sight with drones of more than 2 kg were only allowed in experimental format, with the sole purpose of conducting proofs of concept or demonstrations. However, from now on SCR will be able to offer professional services continuously with platforms up to 25 kg. *https://scrdrones.com*

Testing autopilot against an anti drone system

UAV Navigation has ramped up its security measures by designing a very robust system from both hardware and software perspectives. The quality of the components and their special designs help mitigate the impact of certain high-power signals. For example, the hardware is certified to MIL-STD-810F and MIL-STD-461F. This proves that the system has been tested by an independent party that certifies its level of adequacy.

From a software point of view, it can resist interception due to two main reasons:the non-dependence of GNSS for critical system loops, which allows us to continue operating despite not being able to use GNSS and the multiple cross supervisory logics. Also, the UAV Navigation property ICD (Interface Control Document) that our system incorporates, allows the system to prevent, analyze, and detect any possible interference or system failure.

This involves having multiple high-quality sensors (independent observers) on board and developing advanced estimation logics. Many manufacturers prefer the quickest and cheapest tactic and end up delegating too much logic to the GNSS. That makes the platform more vulnerable to attacks. *www.uavnavigation.com*

Drone-based confined space inspection services

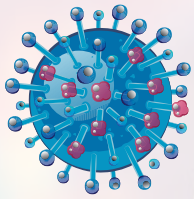
Terra Inspectioneering, a group company of Japan-based Terra Drone Corporation, has been awarded a confined space inspection contract for the Netherlands and Belgium by Dutch multinational tank storage company Vopak.

Under the contract, Terra Inspectioneering will provide non-entry visual testing, ultrasonic thickness testing, and deformation analysis services to Vopak using the proprietary collision-proof Terra UT drone. The drone inspection services will be offered for the tanks owned and operated by Vopak at 11 sites across Belgium and the Netherlands. *www.vopak.com*

Dedrone and BlackBerry partnership

BlackBerry Limited has partnered with Dedrone, a market and technology leader in airspace security, to deliver advanced counter-drone technology to secure the world's most critical sites. As part of this embedded technology partnership, Dedrone is integrating BlackBerry AtHoc software into its products to enable real-time secure alerts when a malicious or unauthorized drone is detected in an airspace.

The Dedrone technology portfolio combines machine-learning software with best-in-class hardware sensors, electronic attack methods like smart jamming, and defeat weapons to provide early warning, classification of, and mitigation against drone threats. *www.dedrone.com*

Tracking C  VID

AI enabled technology to ensure social distancing

Amazon has launched an artificial intelligence-based tracking system to enforce social distancing at its offices and warehouses to help reduce any risk of contracting the new coronavirus among its workers. One of the early solution developed at Amazon applies artificial intelligence and machine learning to the camera footage in the buildings to help site leaders identify high traffic areas and implement additional measures to improve social distancing.

As the company continued to learn and innovate to support the health and safety of associates, it also saw an opportunity to evolve tech even further and promote social distancing behavior in real-time. Given social distancing isn't always natural, the company set out to use augmented reality to create a magic-mirror-like tool that helps associates see their physical distancing from others. Working backwards from a concept of immediate visual feedback, and inspired by existing examples like radar speed check signs, 'Distance Assistant' provides employees with live feedback on social distancing via a 50 inch monitor, a camera, and a local computing device. *www.cnbc.com*

India becomes member of global alliance on AI

India has joined leading nations of the world including USA, UK, EU, Australia among others as a founding member of a league of nations, which has launched a Global Partnership on Artificial Intelligence (GPAI or Gee-Pay).

The first of its kind initiative is aimed to guide responsible development and use of AI, grounded in human rights, inclusion, diversity, innovation, and economic growth. The multi-stakeholder initiative will work towards evolving better understanding of the challenges and opportunities around AI using the experience and diversity of participating countries. It will also support cutting-edge research and applied activities on AI-related priorities.

Canada, France, Germany, Italy, Japan, Mexico, New Zealand, Republic of Korea and Singapore are among the other nations, which have joined the partnership. *economictimes.indiatimes.com*

Developing ethical framework for use of personal location data

The corona virus is spreading around the world at lightning speed. This crisis is not only about DNA and RNA. Where people are and how they move hugely influences the spread of the virus. Therefore, information about location and travel is seen as an important tool in the fight against COVID-19.

However, the great potential of (personal) location data also begs a number of questions: What does it mean for our privacy and democratic values? Now and in the long term? Is the price not too high? It is crucial to collectively ensure that data and apps are deployed in a responsible manner. Geonovum has decided to make a valuable contribution to this. It has developed an ethical framework for the use of personal location data.

The purpose of the ethical reference is to inspire data users, but also policy makers and decision makers to help them collect, use and apply personal location data responsibly. Personal location data are all data that show where people are located and how they move, whether or not they can be traced. This data can, for example, be collected via mobile apps. In the document it is now consulting, you will find a number of tools for ethical behaviour when applying location data. Inspiration is drawn from existing ethical codes and supplemented with input from meetings. *www.geonovum.nl*

UK gives up on centralized coronavirus contacts-tracing app

As per BBC report, the UK has given up building a centralized coronavirus contacts-tracing app and will instead switch to decentralized app architecture.

The UK's NHS COVID-19 app, has not progressed past field tests, after facing a plethora of technical barriers and privacy challenges-as a direct consequence of the government's decision to opt for a proprietary system which uploads proximity data to a central server, rather than processing exposure notifications locally on device. *https://techcrunch.com*

Singapore plans wearable virus-tracing device for all

Singapore plans to give a wearable device that will identify people who had interacted with carriers of coronavirus to each of its 5.7 million residents, in what could become one of the most comprehensive contact-tracing efforts globally.

Testing of the small devices, which can be worn on the end of a lanyard or carried in a handbag, follows limited take-up of an earlier smartphone-based system and has further fuelled privacy concerns about contact tracing technology.

The government did not specify whether carrying the device would be mandatory.

The government's earlier TraceTogether app encountered problems, especially on Apple (AAPL.O) devices where its operating system suspends Bluetooth scanning when the app runs in the background. The pivot to wearables is a signal that Singapore has no immediate plans to adopt contact-tracing technology from Apple and Google (GOOGL.O) rolled out last month, which has several restrictions designed to protect users' privacy. *www.reuters.com*

China launches last BeiDou satellite

China recently launched the last satellite of the BeiDou Navigation Satellite System (BDS) from the Xichang Satellite Launch Center in southwest China's Sichuan Province. The satellite, carried by a Long March-3B carrier rocket, is the 30th BDS-3 satellite and the 55th of the whole BeiDou satellite family. The launch marked the completion of the country's domestically developed BeiDou constellation, one of four global navigation networks alongside with the United States' GPS, Russia's GLONASS and the European Union's Galileo. *https://news.cgtn.com*

UK to scale back plans for independent satnav

British ministers are seeking to scale back plans for a £5bn satellite navigation system that was introduced in 2018 as an alternative to the EU's Galileo project. The ministers are exploring other options, which include using OneWeb, the UK satellite operator that went bankrupt in March, the Financial Times reported, citing sources.

OneWeb has pledged to move its satellite production from Florida in the US to the UK if its management wins government support for its bid, according to the report. Plans for an independent satellite system were announced in 2018 by the then prime minister, Theresa May to ensure national security in the event that Britain were banned from equal access to the EU programme after Brexit. *www.theguardian.com*

Internet-enabled correction service for high accuracy GNSS in Australia

Intelligent positioning solutions provider Position Partners has announced the release of MiRTK. This new correction service for GNSS equipment utilises the internet instead of UHF radio frequencies. It is compatible with all brands and models of GNSS from manufacturers including Topcon, Trimble, Leica Geosystems, Sokkia, Hemisphere and more. Designed for the geospatial, construction and mining sectors, MiRTK works with every make and model of GNSS equipment. It uses a small modem that slides onto the accessory slot of the tripod and connects to the base station via a single cable. Unlike UHF radios, MiRTK is not limited by range from the GNSS base station and does not require line of sight with the survey rover or machine. It is limited only by the Telstra network, so if a user is receiving emails on their phone the MiRTK service will work *https://im-mining.com*

ION GNSS+ 2020 goes virtual

After careful consideration, the ION Satellite Division has decided to hold ION GNSS+ entirely virtually. This decision was made in light of COVID-19 and the domestic and international travel restrictions that we recognize will make it impossible for many speakers and participants to participate in person. The virtual platform is the best way to deliver a meaningful technical program experience to all participants. ION GNSS+ 2020 VIRTUAL will be held over the original dates, September 21-25, in Central Daylight Time. *www.ion.org*

Uinta Mapping and Data Collection Software by Juniper

Juniper Systems has introduced Uinta Mapping and Data Collection Software. It is a powerful hassle-free data collection software built with end-users in mind. Uinta's data collection tools include detailed mapping with points, lines, areas, as well as form-based notes for digital recordkeeping. *www.junipersys.com.*

Power-efficient positioning for the IoT

The European GNSS Agency (GSA) has published a White Paper on "Power-efficient positioning for the Internet of Things", providing an overview of GNSS technologies that are relevant for low-power IoT applications, including those that require hybridisation with other connectivity solutions. The world is embracing Internet of Things (IoT) applications. Billions of internet-connected devices are capable of sensing, communicating, interacting, computing and actuating. These devices are set to become even more integrated into our daily lives and by 2022 it is estimated that around 18 billion out of 29 billion connected devices will be related to the IoT.

With millions of moving interconnected devices in the IoT environment, many applications require or benefit from knowing the location of an individual device. In this context, the latest GSA White Paper looks at how GNSS-based positioning for the IoT can be made more power-efficient, to meet the needs of this growing market.

The White Paper also advises applications that require a position accuracy of one meter or less to use a multi-constellation, multi-frequency receiver. "However, as most low-power IoT applications prioritise extending battery life, a multi-constellation single-frequency receiver is sufficient when positioning accuracy of multiple meters is acceptable," it notes. The report also states that, when deciding on an energy-efficient GNSS technique, the choice of the terrestrial network limits the possible options, as most solutions rely on external data to determine the position via GNSS. *www.gsa.europa.eu*

Major update to BlueSky™ GNSS Firewall software

Microchip Technology Inc. has released a major software update for its BlueSky™ GNSS Firewall product, providing a higher level of resiliency against GPS vulnerabilities for systems dependent on GPS signal reception.

BlueSky GNSS Firewall Software Release 2.0 performs real-time analysis to detect jamming and spoofing for protecting reception of the GPS signal and hardening response and recovery to avoid signal disruption. It includes charting and advanced threshold settings of GNSS observables such as satellites-in-view, carrier-to-noise, position dispersion, phase time deviation and radio frequency (RF) power level to simplify system turn-up and deployment. *www.microsemi.com.*

SatGen now with NavIC (IRNSS)

The latest update to SatGen GNSS simulation software SatGen v3 for PC now incorporates NavIC RF simulation.

Designed to create custom GNSS RF I&Q or IF data files based on user-generated trajectories, the updated software can now accurately simulate the Indian NavIC GNSS satellite constellation alongside existing GPS, Galileo, GLONASS and BeiDou RF signal generation.

The new release, SatGen v3 version 3.12.5, includes full support for simulating the NavIC L5 signal. Alongside this we have released SatGen v3 BETA version 3.12.6, that includes support for simulating the NavIC S-Band signal. *www.labsat.co.uk*

Underground GNSS coverage in Tunnels, Stations etc.

Chronos Technology has announced a partnership with Syntony GNSS to offer GNSS underground coverage in tunnels. GNSS has become fundamental for critical infrastructure applications and yet when entering underground areas such as tunnels, metro/subway, car parks and airport service areas the signal is lost

Syntony's SubWAVE™ solutions expands the GNSS coverage to underground areas enabling the localisation of assets, people and equipment with a standard GNSS chipset, ie standard smartphone or TETRA radio offering underground operators, their staff, emergency services and the general public the benefit of full underground GNSS coverage. *chronos.co.uk*

Ellipse Series 3rd Generation by SBG Systems

SBG Systems present the third generation of its popular range of miniature inertial sensors called the Ellipse Series. The line is composed of four models: the Ellipse-A is a motion sensor, the Ellipse-E provides navigation with an external GNSS receiver, the Ellipse-N is a single antenna RTK GNSS/INS and the Ellipse-D is a dual-antenna RTK GNSS/INS. With its new 64-bit architecture, the Ellipse Series 3rd generation enables the use of high precision algorithms and technology used in high-end inertial systems such as rejection filters, FIR filtering, etc. All Ellipse miniature INS are now RTK-enabled without extra cost and output raw data for post-processing. All these features are made possible in small and robust aluminum enclosure box version, but also in the 17-gram OEM version providing unmatched performance/size ratio.

With its dual frequency RTK GNSS receiver, the Ellipse-D provides a centimetric position. Dual frequency provides a way more robust heading and position computation than single frequency receivers. It allows unmatched performance in attitude (0.05°) and in heading (0.2°). With its dual-antenna capability, Ellipse-D provides precise heading in a few seconds, in all dynamic conditions, and even in challenging GNSS conditions. It is also immune to magnetic disturbances. Ellipse-D is quad-constellation, meaning it could use simultaneously satellites from GPS, GLONASS, BEIDOU, and GALILEO for more signal availability in challenging navigation conditions. *www.sbg-systems.com*

GMV creates a mobile App to ensure a safer return to work

GMV has launched Covclear, a mobile app to ensure a safer and more efficient return to work after the COVID-19 lockdown. The application helps to make sure offices will be a safe workplace while minimizing the risk posed to the health of employees or other persons who are working in open workplaces in an environment of maximum safety and protection. The app is collaborative and relies on a principle of co-responsibility between the company and its employees to protect their own health and the health of their relatives and workmates.

Covclear integrates all the following in a single platform: a daily medical health check of all employees; recording of trips to restricted sites; contact tracing within the firm; control of office access by means of temperature readings; quarantine management; and control of site occupancy. It also publishes the company's healthcare crisis rules. *www.gmv.com*

Carlson Software releases major updates

Carlson Software has released major updates to its Precision 3D Topo 2020 and Precision 3D Hydro 2020 software, enabling new, extremely efficient workflows that utilize the best of a 3D design environment while providing traditional CAD deliverables. The main addition to P3D Hydro 2020 is the inclusion of storm sewer design based on a library of 3D drainage grates and curb inlets. A new and unique "curb line snap" combined with the low point snap leads to fast inlet placement which is followed by hydraulic analysis that includes peak flow, gutter spread and bypass flow calculation. The spreadsheet editor borrowed from Carlson Hydrology allows for quick pipe sizing leading to final design. *www.carlsonsw.com*

10 Million User Milestone for Trimble Connect

Trimble® Connect™ cloud-based collaboration platform has surpassed 10 million users. In response to COVID-19, distributed working has intensified the need for teams to share information and collaborate remotely, leading 1.2 million users to join Trimble Connect in March and April alone. To date, Trimble Connect has hosted more than 80,000 design and construction projects, making it possible for people to collaborate and work together from anywhere in the world.

Trimble Connect is an open collaboration platform for design and construction that connects project stakeholders with the data they need to inform decisions and improve team efficiency. Project stakeholders can share, review, coordinate and comment on data-rich constructible models, schedules and critical project information in real time—reducing costly miscommunication and improving coordination to keep projects on time and on budget. *connect.trimble.com*

Kaarta launches Stencil Pro mobile mapping system

Kaarta has announced beta testing on Stencil Pro, a versatile professional-grade mobile mapping platform with dimensional and visual fidelity. An all-in-one system to scan, process and view captured data in real time, Stencil Pro offers panoramic high-definition 4K imagery and colorized point clouds. With robust surround-view perception in a wide range of light conditions, it is optimized for both indoor and outdoor performance. Featuring a 32-line high-density, low-noise lidar with a range of 120 meters (nearly 400 feet) and a data rate of 600,000 points per second, it produces a highly accurate 3D model in minutes. *www.kaarta.com*

Tersus introduces compact GNSS board

Tersus GNSS Inc. has released the BX40C RTK board to support its series of GNSS boards and provide highly accurate and fast positioning services. It is a compact GNSS real-time kinematic (RTK) board with full constellation tracking for providing centimeter-level accuracy positioning. It can be integrated with autopilots and inertial navigation units to meet various developing requirements. It is suitable for high-precision positioning, navigation and mapping. It supports multiple constellations and frequencies to improve the continuity and reliability of the RTK solution — even in harsh environments. *www.tersus-gnss.com*

Low SWaP-C Miniaturized Rubidium Oscillator by Orolia

Orolia has introduced a breakthrough low SWaP-C Miniaturized Rubidium Oscillator, the Spectratime mRO-50, to meet the latest commercial, military and aerospace requirements where time stability and power consumption are critical. The Spectratime mRO-50 provides a one day holdover below 1µs and a retrace below 1 x 10-10 in a form factor (50.8 x 50.8 x 19.5mm) that takes up only 51 cc of volume (about one-third of the volume compared to standard rubidiums) and consumes only 0.45W of power, which is about ten times less than existing solutions with similar capabilities.

With these competitive advantages, the new Spectratime mRO-50 Miniaturized Rubidium Oscillator provides accurate frequency and precise time synchronization to mobile applications, such as military radio-pack systems in GNSS denied environments. Its improved operating temperature of-10°C to 60°C (military version extended to -40°C to 75°C) is also ideal for UAVs and underwater applications. *www.orolia.com*

First-ever nationwide lane-level precise positioning

Swift Navigation has announced the successful completion of a cross-country drive test in the US. The goal of this first-of-its-kind drive, from San Francisco to New York and back, was to measure the efficacy of Swift's recently expanded Skylark™ cloud corrections service and to demonstrate true nationwide lane-level GNSS correction coverage at the accuracy, reliability and availability levels required by Swift customers. *www.swiftnav.com*

New HawkEye 360 radar

HawkEye 360 Inc. has announced that the company's flagship RFGeo product can now map an expanded catalog of marine navigation radar signals to further improve global maritime situational awareness. With this update, HawkEye 360 introduces the first S-band radar signal and quadruples the number of X-band radar signals in the company's library. It can now cover the most used frequencies for X-band magnetron-based radar systems, providing a more comprehensive view of maritime activity.

HawkEye 360's RFGeo identifies and geolocates RF signals collected by its proprietary satellite constellation. RFGeo is the first commercially available product offering global spectrum awareness across a broad range of radio signals. In addition to the newly announced signals, it can independently geolocate VHF marine radios, UHF push-to-talk radios, L-band mobile satellite devices, EPIRB emergency distress beacons, and vessel Automatic Identification Systems (AIS).

HxGN Content Program updates 3 million sqkm of aerial data

Hexagon's Geosystems division has announced the HxGN Content Program, the largest library of high-accuracy airborne data, is updating 3 million square kilometres in 2020 of high-accuracy four-band orthophotos, digital surface models (DSM) and stereo imagery across the United States and Europe.

In North America, the HxGN Content Program will update 2.5 million square kilometres of aerial data, close to a third of the continental United States. In addition to the standard 30-centimetre resolution in wide areas and 15-cm resolution in urban areas in the U.S., the 2020 program will include 15-cm resolution data in wide areas upon customer request. The Danish DDO program, the premier aerial data provider in Denmark, will also become part of the HxGN Content Program for the first time and will cover the country at 12.5-cm resolution on a biennial refresh schedule. *hexagon.com*

Eos Positioning Systems Releases Eos Tools Pro for Windows

Eos Positioning Systems has announced the release of Eos Tools Pro for Windows 10. It implements powerful new features that enables users to exploit all four global GNSS constellations and a state-of-the-art NTRIP client to access RTK bases and RTK networks all over the world via NTRIP, Direct IP, and wireless radios.

"This is a huge step forward in functionality and flexibility for our Windows users," Eos CTO Jean-Yves Lauture said. "We implemented the latest support for Windows GeoLocation and other features offered by Microsoft in order to allow our customers to use high-accuracy locations directly into their apps."

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