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3D building and cadastral models for valuation

GNSS • Tracking • GIS

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2015: Hope and happiness

All 12 satellites in the GPS IIF series have completed production.

The Air Force launched the eighth GPS IIF satellite on October 29, 2014.

Russia launches new generation Glonass K navigation satellite.

ISRO successfully launches navigation satellite IRNSS-1B and IRNSS 1C.

Also releases IRNSS Interface Control Document.

GAGAN (GPS Aided GEO Augmented Navigation) achieves RNP 0.1 certification.

Beidou system standard achieve recognition
from International Maritime Organization.

The Galileo pair, launched together on a Soyuz rocket
on 22 August, ended up in the wrong orbit.

Some highs and some lows in year 2014.

Let us navigate together in year 2015,

With hope and happiness.

We at Coordinates wish our readers

A happy and prosperous year 2015.

Bal Krishna, Editor
bal@mycoordinates.org

"We have stood for quality, precision and innovation in all fields of wireless communications"

Says Hans-Joerg Strufe, Director of Product Management, Signal Generators, Rohde & Schwarz in an interview with Coordinates

Please tell us about the 'four pillars' that guide the strategy at Rohde & Schwarz?

For more than 80 years, Rohde & Schwarz has stood for quality, precision and innovation in all fields of wireless communications. The company is strategically based on four pillars: test and measurement, broadcast and media, secure communications, radiomonitoring and radiolocation. Thanks to this strategy, the company can address diverse market segments, including wireless communications, the broadcasting and electronics industry, aerospace and defense, homeland security and critical infrastructures. The electronics group, headquartered in Munich, Germany, is among the world market leaders in all of its business fields.

How do you perceive the growth of GNSS technology and applications based on it, in future and possible role of Rohde & Schwarz?

Rohde & Schwarz is addressing various business fields with its wireless solutions where GNSS solutions are deployed, such as the automotive, communications and aerospace & defense industries. In the automotive segment, eCall is using

GNSS positioning in combination with mobile communications. This is an important growth application, given that eCall systems will become mandatory in new cars in many countries worldwide.

In the mobile communications market, location based services are being integrated increasingly. They are typically based on GNSS technology. To ideally address the special testing needs, which are often defined by the network operators who want to ensure a high quality of service, Rohde & Schwarz offers a dedicated test system called R&S TS-LBS. It combines our GNSS simulator with mobile communications testing for a complete test solution. Rohde & Schwarz being a strong partner in both, GNSS as well as mobile communications, is working closely with all key players making sure the right testing tools are available.

> To improve the quality of service for any GNSS application, Rohde & Schwarz offers flexible environment simulation capabilities

And last but not least, GNSS is becoming more and more integrated into the different systems used in the A&D field. All these applications have dedicated environments for GNSS which translate into various conditions where GNSS receivers are deployed. To improve the quality of service for any GNSS application, Rohde & Schwarz offers flexible environment simulation capabilities including shading and multipath effects.

Of the various solutions available from Rohde & Schwarz which ones are based on GNSS technology?

Some Rohde & Schwarz testing solutions also rely on GNSS themselves. For example, GNSS is used for positioning of the vehicle in drive test solutions, so that the measurement data can be attributed to a specific location. In order to assess the RF quality of a network, mobile network operators use reference RF receivers. These so called drive test scanners, such as the R&S TSMW or R&S TSME, have built-in GPS receivers that serve as frequency and time reference. They are much faster and more accurate compared to commercial phones, and provide an independent view of the RF environment. With GPS as an absolute timing reference, drive test scanners

field, Rohde & Schwarz is supported by its French subsidiary Arpège SAS, which implements satellite monitoring systems in close collaboration with the Munich headquarters.

How do you see emerging economies as a potential market for your product and solutions?

Emerging economies are very interesting markets for Rohde & Schwarz because of their fast growth. GNSS is driven in these markets by the prospering population who is very interested in mobile communications and location based services which are becoming standard in newer mobile devices. In addition, some emerging economies want to be independent from GPS and launch and operate their own GNSS systems such as Glonass or BeiDou. Supporting these standards in our GNSS simulator is key to success in these markets.

What is the latest GNSS offering from the Rohde & Schwarz technology stable?

The R&S SMBV100A GNSS simulator from Rohde & Schwarz is a complete test solution for various navigation systems. Looking at the list of various applications which the simulator is already supporting shows Rohde & Schwarz' strong commitment to support the GNSS market. We have included in various GNSS standards such as GPS, Glonass, Galileo and BeiDou. All these can be used in basic and sophisticated environments, supporting complex applications such as a realistic drive through a dense city automatically taking into account the effects of buildings, bridges and so on. In addition, simulation of attitude and body shadowing like on a plane is addressed. The latest enhancements for GBAS, general avionics like DME and VOR/ILS make the simulator complete.

can also validate whether base stations are synchronized, which is relevant for example in TD LTE networks to avoid interference between uplink and downlink.

Please tell us about the Rohde & Schwarz satellite monitoring solutions portfolio?

Satellite monitoring solutions from Rohde & Schwarz include stationary and mobile systems for use on the ground, at sea and in the air. In this

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European Navigation Conference 2015

Technology - Innovation - Business

Centre de Congrès Cité Mondiale
Bordeaux - France

EUGIN

TOPOS CLUSTER AQUITAIN

07 – 10 April 2015

CONFERENCE TOPICS

The 2015 ENC conference will be hosted by the Institut Français de Navigation (IFN) and TOPOS Aquitaine and will be held April 7 through 10 at Centre de Congrès Cité mondiale in Bordeaux, France.

Five good reasons to be there:
• Organized under the auspices of the European Group of Institutes of Navigation (EUGIN)
• High-level scientific activities highlighted during the conference
• Meet all key players in the navigation area and be informed about latest developments in navigation, positioning systems and techniques
• Topics covering a wide range of applications to meet evolving needs across ever-more diverse uses (drones, in-door navigation, etc.)
• Highlighting the resilience and robustness of user equipment which are necessary to prevent end-users from vulnerability

A plenary session will be held to inform the community of the status of the major GNSS programs, including a special focus on Galileo that will be facing early-phase challenges. Several parallel sessions will cover up-to-date topics in navigation.

Registration for the conference is possible as from 1 September 2014 via the conference website.

ABOUT BORDEAUX

Bordeaux is the world's capital of wine and a UNESCO World Heritage Site since 2007. The city is an 18th century architectural gem and counts up to 350 historic monuments.

Bordeaux and the Aquitaine region are long-time and sustainable investors in the space industry and are the co-host of "Aerospace Valley", the international cluster for competitiveness. Aquitaine is a leading region for per capita R&D investment and develops the potential for innovation of start-ups in avionics, space, composite and photonics sectors. Bordeaux is also welcoming the largest inertial confinement fusion experiment in Europe called Laser Mégajoule.

More information : http://www.enc2015.eu

For any further details, please contact the conference secretariat at conference.secretariat@enc2015.eu

Combined spatial–temporal filtering for interference mitigation in GNSS receivers

As an effective counter measure against GNSS interference, this paper presents a combined spatial–temporal filter for interference mitigation in an antenna–array GNSS receiver

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Over the recent past, the vulnerability of Global Navigation Satellite Systems (GNSS) to interference has become a concerning issue (Mitch, 2011), (Pullen, 2012). Nowadays, illegal portable jamming devices are becoming popular to protect the user from being tracked by GNSS in their vehicle. These so-called personal privacy devices radiate different types of interference signals in the GNSS frequency bands and can make conventional receivers inoperable. Counter measures have to be taken to prevent strong interference from blocking the GNSS-receivers for safety critical applications.

A modular architecture concept for an array-antenna receiver is described in (Kappen, 2012). In this architecture a spatial filter at pre-correlation stage (i.e. before correlating the signal with the local satellite signal replica) is proposed for interference mitigation. As proposed in (Kappen, 2012), (Kurz, 2012) presents an implementation of a 2x2multi-antenna GNSS receiver architecture that features a sub-space based digital adaptive filter at pre-correlation stage. Based on the architecture in (Kurz, 2012), a recursive method for coefficient adaptation is presented in (Tasdemir, 2013), which leads to significant reductions in the computational complexity both in hardware and software.

The pre-correlation filters presented in (Kurz, 2012) and (Tasdemir, 2013) use only the spatial degrees of freedom for filtering interferences. The disadvantage of the spatial-only filtering is that the degrees

of freedom are limited by the typically small number of antenna elements. That defines also the maximum number of interferers, which can be mitigated simultaneously. Furthermore, a spatial filter with limited degrees of freedom does not enable a sharp separation of the signal directions. Therefore, the mitigation of an interferer in the spatial domain also leads to the suppression of the satellite signals, if they have a direction close to the interferer's direction.

As stated in (Rounds, 2004), spatial filtering can be combined with temporal filtering, in order to enhance the interference mitigation capability of an array-antenna receiver. In this paper, a combined spatial-temporal filter is presented in order to exploit the spatial, as well as, the temporal domain for interference mitigation. The filter consists of three stages: a notch filter (NF), a spatial filter and an equalizer filter (EQ). The NF at the first stage is realized as a bank of finite impulse response filters (FIR) and suppresses temporally correlated (narrowband) interference in the temporal domain. The spatial filter at the second stage is inherited from (Tasdemir, 2013) and suppresses wide band interference, which gets through the first stage. The last filter stage is required to reduce the negative side effects of the NF on the acquisition and tracking performance.

Notation: Throughout the paper, vectors and matrices are represented by bold roman letters. $\|\cdot\|$ stands for the Euclidean norm, $(\cdot)^T$ for the transpose of a matrix, $(\cdot)^H$ for the Hermitian transpose of a
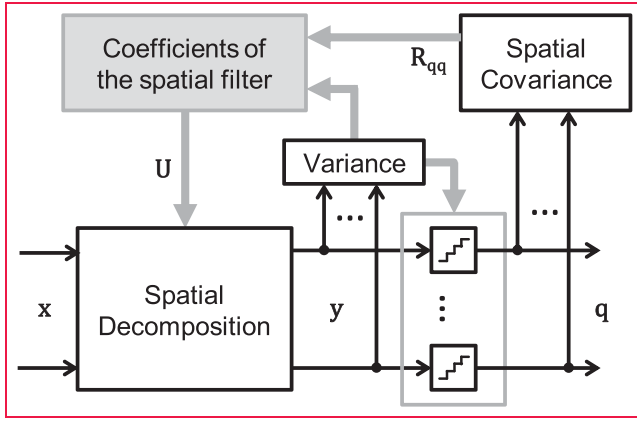
Figure 1: Adaptive spatial filter

matrix, and $(\cdot)^*$ for the elementwise conjugate. $E\{x(k)\}$ is the mean value

$$E\{x(k)\} := \frac{1}{K} \sum_{l=k-K-1}^{l=k} x(l)$$

of a sampled input argument $x(k)$ computed at the time $k \cdot T_s$ over the last K samples. T_s is the sampling period.

Spatial filter

The block diagram of the adaptive spatial filter in (Tasdemir, 2013) is given in Figure 1. White blocks stand for computations with a processing equal to the sampling frequency. In (Kurz, 2012), these blocks are realized in dedicated hardware. Gray blocks stand for control oriented computations mapped to the embedded GNSS processor.

The input vector $\mathbf{x}(k) = [x_1(k) \cdots x_N(k)]^T$ of the spatial filter contains the digitized down-converted complex outputs of the antenna-array elements with N being the number of array elements. In the first step, $\mathbf{x}(k)$ is multiplied by an orthogonal matrix $\mathbf{U}^H$ and is decomposed into N orthogonal signal channels $\mathbf{y}(k) = \mathbf{U}^H \cdot \mathbf{x}(k)$. N_{int} of these channels belong to the interference subspace, if N_{int} uncorrelated interference sources exist. $(N - N_{int})$ channels are interference-free and contain the noise and the GNSS signals "hidden" in the noise.

Decomposition is followed by the *re-quantization* step to reduce the wordlength of the signals. This is done in order to reduce the hardware complexity of the subsequent signal processing stages. In (Kurz, 2012), a wordlength of 2 bits is

chosen for the filter output. In practice, this is a typical precision for the GNSS signals and does not lead to a significant loss of accuracy in the code delay estimation or in the user position estimation (Mezghani, 2010).

The re-quantization of the channels is carried out separately, i.e. the thresholds of the quantizers are individually adapted to the variance (power) $E\{|y_n(k)|^2\}$ of the particular channel ($n = 1, \cdots, N$). As a result, re-quantization equalizes the powers of the individual channels to each other. That means that after re-quantization, the power of the interference channels is suppressed to the level of the noise channels. After despreading (i.e. correlation with the locally generated satellite signals), GNSS signals are raised above the noise and the interference signals.

The decomposition matrix $\mathbf{U}^H$ is derived from the auto-covariance matrix $\mathbf{R}_{qq} = E\{\mathbf{q}(k) \cdot \mathbf{q}^H(k)\}$ of the quantized filter output $\mathbf{q}$. With $\mathbf{V} =$ diag $(E\{|y_1, (k)|^2\}, \cdots, E\{|y_N(k)|^2\})$, $\mathbf{U}^H = [\mathbf{u}_1 \cdots \mathbf{u}_N]^H$ is given by the eigendecomposition of the matrix $\mathbf{V}^{1/2} \cdot \mathbf{R}_{qq} \cdot \mathbf{V}^{1/2}$ and contains the eigenvectors $\mathbf{u}_n$ ($n = 1, \cdots, N$). A computationally efficient method to adjust $\mathbf{U}^H$ iteratively is described in (Tasdemir, 2013).

The last step of the spatial filter is the multiplication of the filter output vector $\mathbf{q}$ by $\mathbf{U}$ to transform $\mathbf{q}$ back to the original orthonormal basis (*composition*). In (Tasdemir, 2013), this

step is shifted to the post-correlation stage. Composition is required, in order to compensate the carrier phase ambiguity induced by the decomposition step.

Temporal filter

In this section, a two-stage temporal filter is presented for interference mitigation at pre-correlation stage. The first stage of the filter is an adaptive NF that attenuates certain signal frequencies in order to remove narrowband interference. As a side effect, the NF generates echoes of the original satellite signal and can negatively influence the signal acquisition and the signal tracking performance at the post-correlation stage. In order to reduce these side effects, an EQ filter is applied in the second stage of the temporal filter.

Notch filter

The adaptive NF in the first stage of the temporal filter is realized as an FIR-filter with M taps (Figure 2). The adaptation of the filter coefficients is based on the power minimization approach (Zoltowski, 1995). The complex tap-weight vector $\mathbf{b} = [b_0 \cdots b_{M-1}]$ of the filter is set to minimize the output power

$$E\{|y(k)|^2\} = E\left\{\left|\sum_{m=0}^{M-1} b_m \cdot x(k-m)\right|^2\right\},$$

subject to $b_0 = 1$. Since GNSS signals are well below the noise floor, the power minimization filter implicitly suppresses interference signals, while letting the noise and the satellite signals through.

After the interference mitigation, the filtered output $y(k)$ is re-quantized to reduce its wordlength. If correctly adapted to the dynamic range of y, output of the quantizer can be modeled as
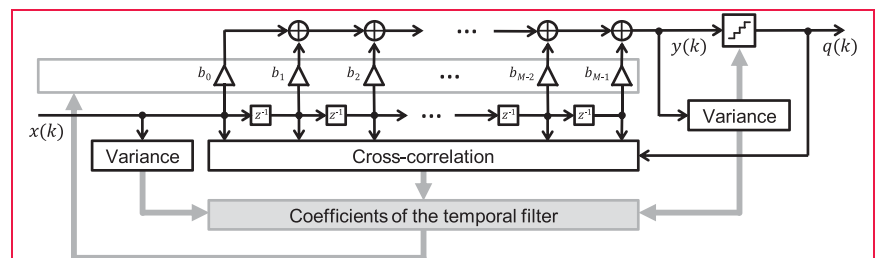
Figure 2: Adaptive notch filter

$$q(k) = \frac{1}{\sqrt{\mathrm{E}\{|y(k)|^2\}}} \cdot y(k) + \sigma_\mathrm{q} \cdot n(k) \quad (1)$$

with $n(k)$ modeling the quantization noise as an additive white Gaussian noise with a power of σ_q^2.

The adaptation of the filter coefficients can be carried out iteratively using a gradient-based algorithm. The coefficients are updated after every K samples, according to

$$\mathbf{b}(k) = \mathbf{b}(k - K) + \Delta\mathbf{b}(k).$$

The update value $\Delta b_m(k)$, by which the coefficient b_m $(m = 1, \dots, M-1)$ has to be changed at the time $k \cdot T_s$, is given by

$$\Delta b_m(k) = -\mu(k) \cdot \mathrm{E}\{y(k) \cdot x^*(k - m)\}, \quad (2)$$

$\Delta b_0 = 0$. Note that (2) requires the computation of the cross-correlation between the input and the output signal of the filter.

According to (Haykin, 1996), convergence of a gradient-based filter adaptation is guaranteed, if the step-size parameter μ satisfies $0 < \mu < 2/\text{tap-input-power}$ with

$$\text{tap-input-power} = \sum_{m=1}^{M} \mathrm{E}\{|x(k - m)|^2\} = M \cdot \mathrm{E}\{|x(k)|^2\}.$$

Therefore, the variance at the input of the filter is monitored, in order to adjust the step-size parameter inversely proportional to the input signal power, as shown in Figure 2.

In order to reduce the complexity of a hardware realization of (2), $y(k)$ can be replaced by the quantized output $q(k)$ from (1). If done so, (2) becomes

$$\Delta \tilde{b}_m(k) \approx \Delta b_m(k) = -\tilde{\mu}(k) \cdot \mathrm{E}\{q(\mathrm{k}) \cdot x^*(k - m)\},$$

with

$$\tilde{\mu}(k) = \sqrt{\mathrm{E}\{|y(k)|^2\}} \cdot \mu(k).$$

Thus, the step-size parameter must be chosen proportional to the standard deviation of the filter output signal. This explains why the signal variance at the filter output is monitored in Figure 2 additional to the input variance.
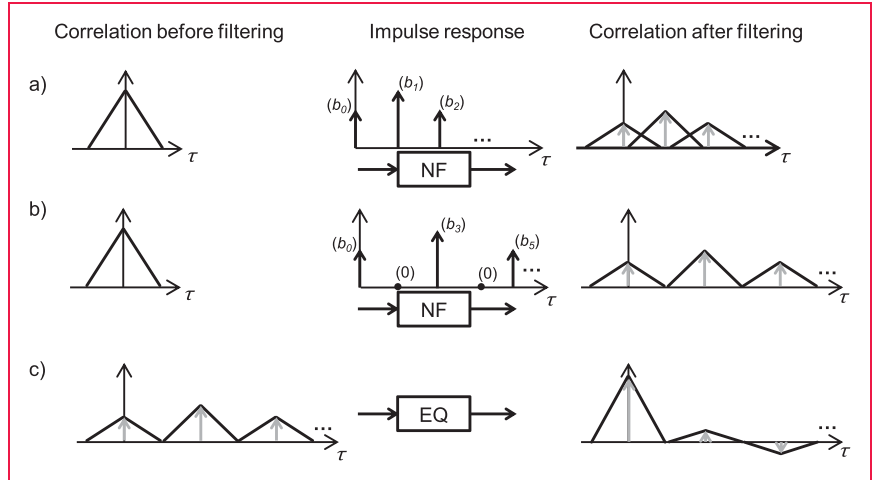
Figure 3: Effect of the temporal filter on the correlation function: a) notch filter with a narrow tap-spacing b) notch filter with a wide tap-spacing c) equalizer filter subsequent to the notch filter

While suppressing interference signals, the NF generates echoes of the original satellite signal as a side effect. As a result of this side effect, time-shifted copies of the main correlation triangle appear in the correlation function of the filter output with the local satellite signal replica (Figure 3a). Similar to the echoes produced by satellite signal reflections (multipath), an overlap of the echo-triangles with the main triangle disrupts the satellite tracking loops. Therefore a tap-spacing > $2 \cdot$ code- chip-duration is to be preferred, in order to avoid an overlap (Figure 3b).

Equalizer filter

In order to suppress the echoes produced by the NF and amplify the main correlation triangle, an EQ is applied in the second stage of the temporal filter (Figure 3c). The EQ is realized as an FIR-filter with M_EQ taps. The tap-weight vector $\mathbf{b}_\mathrm{EQ} = [b_\mathrm{EQ1} \cdots b_{\mathrm{EQ},M_\mathrm{EQ}}]$ suppressing the echoes is the least-mean-square solution of the equation $\mathbf{b}_\mathrm{EQ} \cdot \mathbf{B} = \mathbf{d}$ with

$$\mathbf{B} = \begin{bmatrix} b_0 & b_1 & \dots & b_M & & \mathbf{0} \\ & b_0 & b_1 & \dots & b_M & \\ & & b_0 & b_1 & \dots & b_M \\ \mathbf{0} & & & \ddots & & \ddots \end{bmatrix}$$

a band-matrix composed of the shifted copies of $\mathbf{b}$ and

$$\mathbf{d} = \begin{bmatrix} 0 & \dots & 0 & 1 & 0 & \dots & 0 \end{bmatrix}$$

the desired combined response of the NF and the EQ. $\mathbf{d}$ indicates that all copies of the correlation triangles have to be zeroed

but one. A gradient-based algorithm to find the solution iteratively is given by

$$\mathbf{b}_\mathrm{EQ}^i(k) = \mathbf{b}_\mathrm{EQ}^{i-1}(k) + \mu_\mathrm{EQ} \cdot (\mathbf{d} - \mathbf{b}_\mathrm{EQ}^{i-1}(k) \cdot \mathbf{B}) \cdot \mathbf{B}^H \quad (3)$$

with $\mathbf{b}_\mathrm{EQ}^0(k) = \mathbf{b}_\mathrm{EQ}^I(k - K)$. Since the tap-weight vector $\mathbf{b}$ of the NF is changed slowly by the gradient-based algorithm given in section of notch filter, few iterations of (3) are required after each update of $\mathbf{b}$ to adapt $\mathbf{b}_\mathrm{EQ}(k)$ to the updated value of $\mathbf{b}(k)$. In this paper, only one iteration (I=1) is carried out after each coefficient update period $K \cdot T_\mathrm{s}$.

Combined filter

Figure 4 shows the spatial-temporal filter combining the spatial filter and the temporal filter. As in Figure 1, white blocks represent computations realized as dedicated hardware blocks, while gray blocks are tasks mapped to the embedded processor.

The first stage of the combined filter is a bank of N NFs to suppress temporally correlated interference. The NFs are followed by a spatial decomposition of the temporally filtered signal into its orthogonal spatial components.

Estimation of the spatial and the temporal filter coefficients is decoupled from each other. The spatial coefficients of the filter are derived from the spatial covariance matrix of the quantized output. If the filter coefficients are adapted correctly,
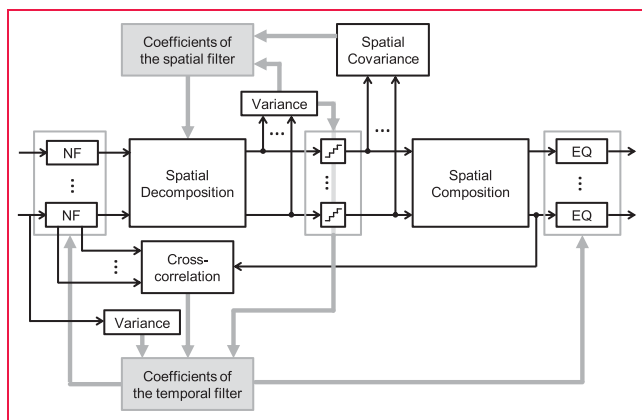
Figure 4: Combined adaptive spatial–temporal filter

narrowband interference is mitigated by the NFs and only wideband interference is detectable in the spatial covariance matrix. In other words, in the steady state the spatial filter ignores narrowband interferers. The coefficients of the NFs are determined based on the cross-correlation between the quantized filter output and the filter input signal. It is a justifiable assumption, that an interferer is received by all antenna elements and the same temporal interference characteristics can be observed for all antennas. Therefore,

it is sufficient to compute the cross-correlation for one antenna and use one common tap-weight vector for the NFs.

Here, the *composition* step, which was shifted to the post-correlation stage in (Tasdemir, 2013), is necessarily computed at the pre-correlation stage. Otherwise the carrier phase ambiguity induced by the *decomposition* step destroys the estimation of the temporal filter coefficients. Computation of the variance at the output of the NF (see Figure 2) can be left out, because the mean variance after decomposition is equal to the mean variance before decomposition.

Simulations showed that the interference mitigation performance of the combined filter was improved if the tap-weight

vector $\mathbf{b}$ of the NFs was normalized by its Euclidean norm after each coefficient update. However, if $\mathbf{b}$ is normalized, it does not converge back to the default vector $\mathbf{b}_0 = [1\ 0\ \cdots\ 0]$, after interference signals disappear. Since the EQ realized as an FIR is not capable of perfectly suppressing the echoes for all possible values of $\mathbf{b}$, the "normalized power minimization algorithm" may slightly degrade the SNR in the absence of interference. In order to avoid an unnecessary generation of echoes in the absence of interference, $\mathbf{b}$ needs to be slowly forced towards $\mathbf{b}_0$, if the temporal filter does not detect and suppress any temporally correlated interference. This can be detected by comparing the input power and the output power of the notch filters.

Simulation results

In this section, the benefits of the combined spatial-temporal filter over the spatial-only filter are discussed based on MATLAB-simulations. A single-antenna receiver
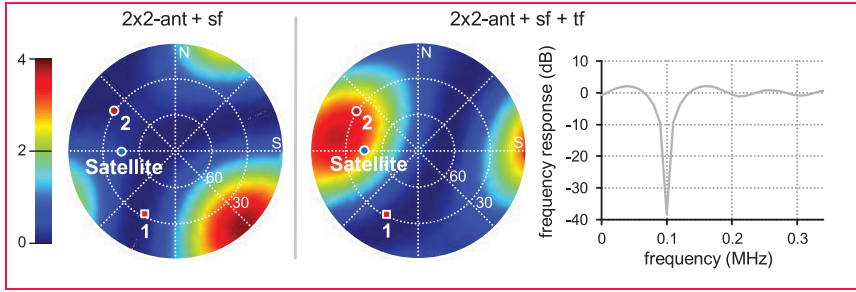
Figure 5: *Simulation 1*: Resulting beam–patterns and frequency response of the notch filter
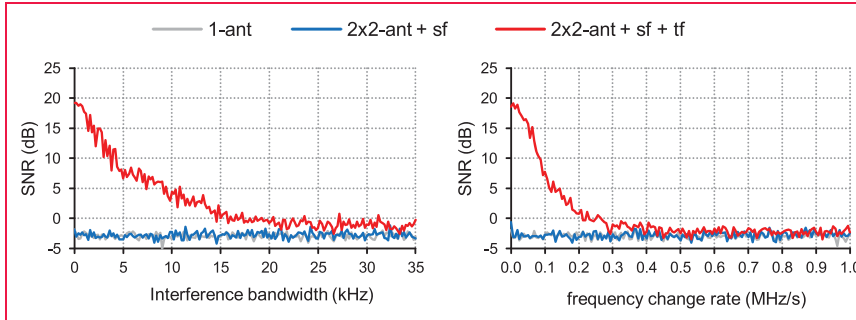
Figure 6: *Simulation 2*: Post–correlation SNR for different interference bandwidths and frequency change rates

Figure 7: Simulation 3: Sky–plot with one satellite, two wideband interference signals (red squares), and three CW interference signals (red circles)

(*1-ant*), a 2x2-array-antenna receiver with spatial-only filtering (*2x2-ant + sf*), and a 2x2 array-antenna receiver with spatial-temporal filtering (*2x2ant sf + tf*) are simulated. The element spacing of the array-antennas are λ/2. Antenna-signals are down-converted to the baseband and sampled at a rate of 2.047 MHz before interference mitigation. The NF and the EQ of spatial-temporal filter have $M = M_{EQ} = 5$ taps with a tap-spacing of 5 samples. Averaging time is 1 ms, i.e. the averaging is done over $K = 2047$ samples. SNR of the received satellite signal (GPS PRN 1) before correlation is -16 dB. A blind adaptive beam-former is applied at the post-correlation stage to form a beam towards the satellite and maximize the SNR (Kurz, 2012).

Simulation 1 examines an interference scenario with two interference sources, in order to demonstrate the differences between the spatial-only and the combined spatial-temporal filtering. Interferer 1 is a wideband interferer (two-sided bandwidth = sampling rate) with an interference-to-signal-ratio (ISR) of 50 dB. Interferer 2 is a continuous-wave (CW) interferer (bandwidth = 0, frequency = f_{L1} + 100 kHZ) with an ISR of 45 dB. Figure 5 shows the combined beam-patterns of the pre-correlation filtering and the post-correlation beam-forming.

As can be seen from the corresponding beam-pattern, the spatial-only filter is forced to attenuate two distinct signal directions, in order to mitigate the interference. As a result, the beam, which should be focused towards the satellite in the interference-free case, is strongly shifted away from satellite direction. In contrast to the spatial-only filter, the combined filter mitigates CW-interference in the temporal domain. The frequency response of the NF is shown in Figure 5 (right), for this case. In total, one spatial degree of freedom is used because of the wideband interference and the post-correlation beam-former is able to form a beam approximately to the satellite direction. Compared to the spatial-only filtering, the combined filter increases the SNR at the post-correlation stage by 6.14 dB.
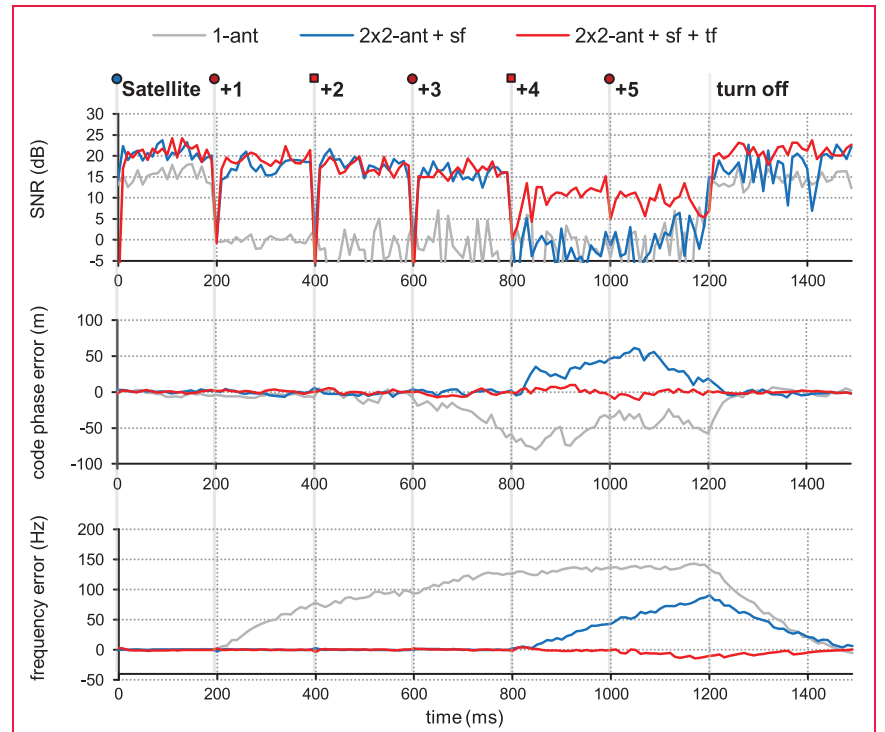
Figure 8: *Simulation 3*: Reaction of different receivers to appearing interference signals

Simulation 2 analyzes the behavior of the combined filter for growing interference bandwidths or for changing frequencies. The frequency of a narrowband can change due to an acceleration of the receiver relative to the interference source. In the simulation, an interferer (ISR = 50 dB, center frequency = f_{L1} + 150 kHZ) radiates from the same direction as the satellite. In this case, the mitigation of the interference signal in the spatial domain also cancels the satellite signal. The estimate of the post-correlation SNR over the interference bandwidth and the frequency change rate is shown in Figure 6. While a CW-signal can perfectly be mitigated in the temporal domain, performance of the temporal filter decreases for growing interference bandwidths and for growing frequency change rates.

Simulation 3 demonstrates the improvement of the combined filter over the spatial-only filter for the case where the number of the interference sources exceeds the *N*-1 spatial degrees of freedom. The directions of the satellite and the interferers are given in Figure 7. All interferers have an ISR of 50 dB. Interferers 1, 3, and 5 radiate CW-signals with distinguishable frequencies (f_{L1} -50 kHZ, f_{L1} + 250kHZ, f_{L1} + 550kHZ); interferers 2 and 4 radiate wideband signals.

Starting without the interferers, an interferer is turned on after every 200 ms. At the time of 1200 ms, all interferers are turned off again. Estimate of the post-correlation SNR, the code phase error, and the frequency error of the signal tracking loops are plotted over time in Figure 8. It can be identified that the spatial-only filter is overextended, if the number of interference sources exceeds (*N*-1). In this case, the SNR drops abruptly and the tracking loops start to drift away from the satellite signal. Especially, the carrier tracking loop is intensely affected and "deceived" by the unsuppressed CW-interference.

Conclusion

This paper presents a combined spatial-temporal filter for interference mitigation in an antenna-array GNSS receiver. The filter is based on the spatial filter introduced in (Tasdemir, 2013) and extends this by a bank of adaptive FIR-filters in the front. These are used as notch filters and take over the mitigation of narrowband interference by attenuating certain frequencies in the frequency spectrum of the input signal. The adaptation to the interference situation follows a gradient-based power minimization method. As a result of adding temporal degrees of freedom to the spatial filter, the filter capacity in the spatial domain is preserved for the mitigation of wideband interference. Undesired side effects of the notch filters on the satellite signal tracking are diagnosed and minimized by adding an adaptive equalizer filter subsequent to the interference mitigation.

Functionality of the filter is verified by simulations using synthetic data. As expected, the benefit of the combined filter approach becomes evident mainly in two cases. 1) If an interference source has a signal direction close to a satellites direction, the satellite signal is also intensely affected by the interference mitigation in the spatial domain. While the spatial-only filter does not distinguish between different types of interference, the combined spatial-temporal filter can rescue the satellite signal from narrowband interference. 2) Significant improvements of the combined filter over the spatial-only filter can also be observed, in case the number of interference directions exceeds the number of spatial degrees of freedom. This case is not unrealistic, since its occurrence does not require the existence of a high number of interfering devices but can also be caused by reflections of one interfering signal. While spatial-only filtering is defenseless in such a situation, the combined-filter provides an improved protection against interference by exploiting temporal characteristics of the interference.

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Tracking ship using INSAT

In this paper the topics of INSAT coverage, INSAT–MSS modem architecture, working principle, RTOS–based data logger, data reception software and commissioning are detailed

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The most basic operation of a vessel monitoring system is to determine the location of the vessel at a given time, and periodically send this information, usually by satellite, to a monitoring station ashore. Most of vessels are tracked using the purple finder. This finder uses various satellites like Inmarsat, Globalstar and Thuraya for tracking the vessel. INMARSAT-C has been the most considered choice, since INMARSAT transceiver is already fitted onboard many ocean-going vessels as required by GMDSS (Global Maritime Distress and safety System).

The carriage and operation of VHF-based Automatic Identification System (AIS) onboard vessels, as required by the revised SOLAS (Safety of Life at Sea) international convention, has greatly improved the identification and tracking of vessels in coastal waters. However, it needs to be extended in coverage, at least over the entire EEZ (Exclusive Economic Zone). It is also adopted as an Automatic Location Communicator (ALC) in the VMS (Vessel Monitoring System) of many regional fishery management organizations (RFMOs) and countries. Implementation of the long-range mode of AIS with INSAT-3C satellite communication and the

multipurpose performance of such a system is discussed in the paper.

The designed ship track system as shown in figure 1 is installed in NIOT research vessel. Data logger collects the date, time and positional details (Latitude, Longitude) from the in-built GPS transmits, and transmits the GPS details through INSAT-MSS modem using serial (RS232) port. Reception hub receives the data from MSS transponder on INSAT-3C satellite. The hub sends the data to NIOT mail server. Data reception software running on server checks the mail server continuously and shows the exact ship location, generates *.kml (Keyhole Markup Language) file depending on the period selected, calculates the average ship speed and generates a back up of the data in database for future use.

System architecture

System contains Data logger, INSAT-MSS modem with in-built GPS, 24 volts DC supply as shown in the figure 2. RS-232 is used for data logger to communicate with INSAT-MSS modem. Data logger gets the GPS data from the inbuilt GPS available in INSAT MSS modem and stores it in the memory. Depending on the slot assigned data logger transmits the data through INSAT-MSS modem.

Data logger, a Single Board Computer (SBC), is an expandable embedded controller designed for industry applications to replace PC or PLC devices in harsh environments. It supports Input/Output (I/O) expansion bus that is used to implement various I/O functions as shown in figure 3. The salient features of data logger are Digital input/output channels, Analog/Digital channels, 4 serial ports, 2 no's of RS-485 port of 3000V isolation,
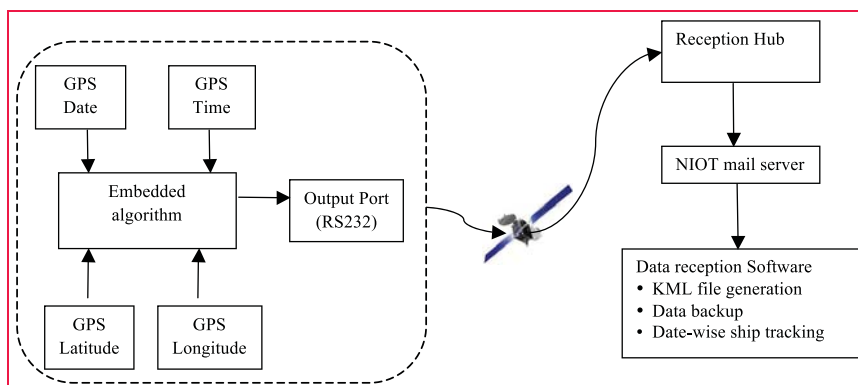
Figure 1: System architecture for ship tracking
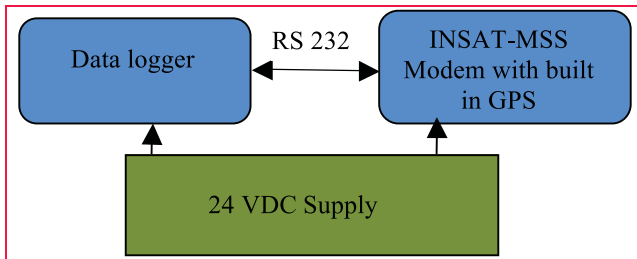
Figure 2: System architectue
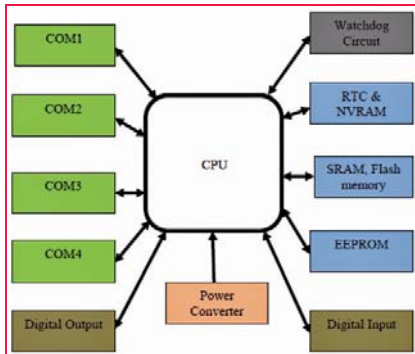
Figure 3: Data logger architecture

Real Time Clock (RTC), Non-Volatile Random Access Memory (NVRAM), Static Random Access Memory (SRAM), Flash memory, Electrically Erasable Programmable Read Only Memory (EEPROM) and Watchdog circuit. Data logger has 64-bit internal hardware serial number, 1 LED (Light Emitting Diode) display used for power or communication indicator, 5 digit 7 segment LED display and I/O buffer. Data logger supports 10 types of I/O Expansion Board used to expand the features of the controller. Depending on the type of embedded firmware programs and I/O Expansion Board, the data logger is used as a single versatile controller. Data logger uses Mini RTOS (Real Time Operating System). The Mini RTOS is a set of commands or code that manages the computer how to process information. RTOS runs programs, manages files, controls information processing, directs input and output, and performs many other related functions.

Figure 4: INSAT–DRT Transponder Coverage

Figure 5: INSAT–MSS transponder coverage

The memory details of the data logger are 512 K bytes SRAM, 512 K bytes Flash, 2 K bytes EEPROM, 31 bytes NVRAM. The nominal working voltage is non-regulated 10 to 30 volts (DC) at 3 watts power consumption. The operating climatic conditions are -25°C to 75°C, (0 to 90) % humidity.

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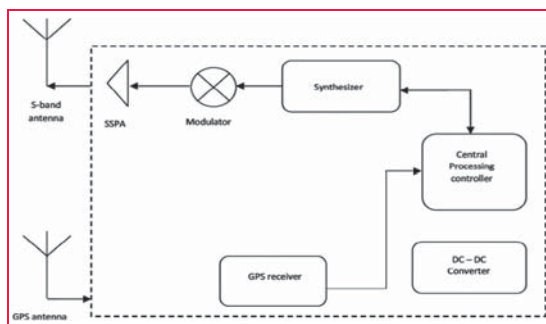
Figure 6: INSAT MSS modem architecture

Table 1: INSAT–MSS Modem details

Sl No.	Specification	Details
1	Maximum Data size	55 bytes
2	Frequency	2.6 GHz
3	Operating Voltage (DC)	10 to 24 Volts
4	Idle Current	40 mA
5	Transmitting current (Nominal) at 12V	1.9 A
6	Satellite	INSAT-3C
7	Transmission Cost	Rs 1,500/- per month
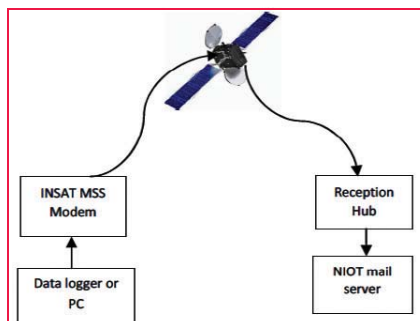
Figure 7: INSAT MSS reporting network

INSAT details

Depending on the frequency of operation, INSAT modems are of 2 types, namely INSAT-DRT and INSAT-MSS.

INSAT-DRT:- INSAT-DRT (Data Relay Transponder) works in UHF (Ultra High Frequency) band (402 MHz). INSAT-DRT modem transmits from remote location to satellite and from satellite to the reception hub in C- band. Received data is processed in data reception server for data quality. It is extensively used in land-based AWS (Automatic Weather Station), ship-based AWS, tide gauge network, MET-Ocean Buoys and other observation platforms by IMD (Indian Meteorological Department), INCOIS (Indian National Centre for Ocean Information Services), NIOT (National Institute of Ocean Technology) and ISRO (Indian Space Research Organisation). It supports a transmission rate of 300 bps (Bits per Second). INSAT-DRT transponder has coverage in Africa, Asia and Australia continental mainland and ocean area also as shown in figure 4.

INSAT-MSS:- INSAT-Mobile Satellite Services works in S-band (2.6 GHz). Modem transmits the data to the satellite and the same is been received in hub in

C-band. INSAT-MSS has a less coverage compared to INSAT-DRT as shown in figure 5.

INSAT-3C satellite has a wide coverage of India mainland, Bay of Bengal, Arabian Sea and Indian Ocean. The modem used in this paper works in inner lobe area only covering Indian mainland, Bay of Bengal and Arabian Sea due to a small antenna dish and less transmission power apt for scientific applications. Antenna size and power consumption should be minimal for easy installation, maintenance and longer system life in remote locations.

Both modems work in TDMA (Time Division Multiple Access) mode. In this paper, INSAT-MSS modem is used for ship tracking. In the next section, INSAT-MSS modem architecture, the reporting network has been explained in detail.

The details of INSAT-based modem are explained in detail in following section.

INSAT MSS modem architecture

The INSAT-MSS terminal uses SXC transponder of Indian geostationary satellite INSAT-3C. The INSAT-MSS terminal mainly consists of S-band synthesizer, BPSK modulator and SSPA, GPS receiver, Central processing controller, DC-DC converter, S-band and C-band antennas[1] as shown in figure 6.

Central Processing Controller (CPC) controls the modem hardware and GPS receiver data. The DC to DC converters keeps the output voltage level (9–36VDC) to the required voltage level irrespective of the load. The GPS receiver is used to collect date, time, latitude and longitude and stores in to CPC. Binary Phase Shift Keying

(BPSK) is digital modulator scheme that conveys the data by changing or modulating the phase of reference carrier signal. The Synthesizer generates required range of frequencies from a single fixed oscillator to lock the frequency to transmit the data.

The analog part of INSAT modem has been designed with Solid State Power Amplifier (SSPA) which takes advantage of current cutting edge technologies in both design and manufacturing, thereby resulting in high reliability, high performance and cost effective alternative to the Traveling Wave Tube (TWT).

All these sub-systems are housed in an IP65 enclosure suitable for marine conditions. The power supply and interface connector are located outside of the terminal. Users can configure terminal ID, frequency of operation by using RS-232 interface. MSS terminal operates in TDMA (Time Division Multiple Access) mode which has unique ID code operated in S-band and transmits messages at 300bps. The INSAT MSS modem works in S-band at a frequency of 2.6 GHz with down-link in a C-band.

INSAT–MSS reporting network

Data logger sends the data through RS-232 to INSAT-MSS modem for transmission which is received by the INSAT-3C satellite. The Reception hub receives the data from satellite and sends it to NIOT mail server immediately without delay as is shown in figure 7.

INSAT–MSS modem details

A control string '@#N' is required at the start of data to transmit and avoid false triggering. To receive the latitude, longitude, date and time from the built-in

Figure 8: Flow chart of program logic

GPS, the command is '@#G'. The power consumption during idle mode of INSAT-MSS modem is 40mA. The idle mode current of satellite modem contributes a major part in the power budget while sizing the communication system, as this modem is idle for most of the time and transmission takes only a few seconds with peak current. The details of INSAT-MSS power consumption and cost are shown in table 1 which also indicates that INSAT-MSS is economical compared to Iridium, which needs about Rs 40,000/month.

In–built GPS details

INSAT–MSS modem has an inbuilt GPS receiver. It supports NMEA (National
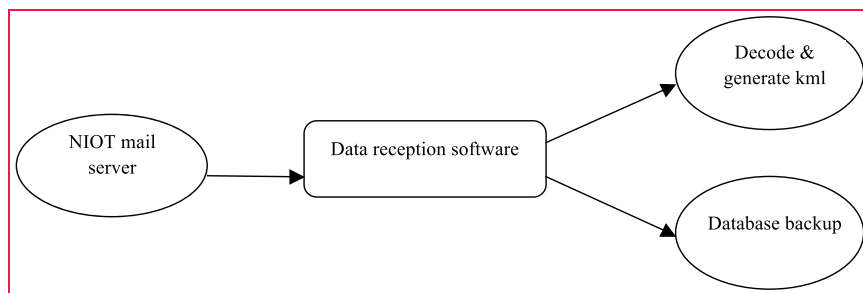
Figure 9: Data reception software

Marine Electronics Association) format. The modem takes a minimum time of 45 seconds to acquire the GPS and send the same to data logger. GPS data contains date, time, latitude, longitude details at that particular time.

Program architecture

Data logger checks its RTC (Real Time Clock) time continuously for 0th minute of every hour to send GPS request to INSAT-MSS modem. Data logger checks if the received GPS data is valid or not. If the GPS data is invalid then data logger sends the GPS request for a maximum of 3 times. GPS data is stored in temporary memory. Data logger waits for the allocated transmission slot, since the modem is used in TDMA mode. When the RTC is exactly the same as the time slot allotted for the particular ship, data logger transmits the latitude, longitude, date and time through INSAT-MSS modem. Data logger runs in infinite loop as shown in figure 8.

Data reception software

Data reception software runs continuously on server computer. It receives the data from the NIOT server, decodes it and generates the .kml file showing the ship
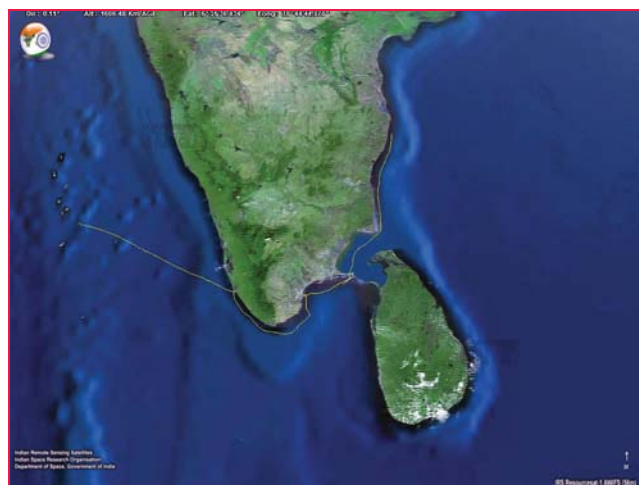
Figure 10: Ship track

track as shown in figure 9. The software features are to calculate the distance traveled for the particular selected period, GPS data backup for future reference, continuous ship tracking, etc. In future, the software can be upgraded to calculate the average speed, Expected Time of Arrival, sending Vessel position reports through SMS, E-mail, etc.

Commissioning of Track ship system

Track ship setup was installed on Coastal Research Vessel Sagar Purvi in Chennai, India. INSAT-MSS modem was installed on the top most location in the ship. The data logger inside the ship was powered with 24 volts uninterrupted power supply. The vessel being tracked sailed from Chennai to Kavaratti Island (Lakshadweep) via Tuticorin, Kollam. The same has been shown in Bhuvan (Gateway to Indian Earth Observation), an Indian Geo-portal in figure 10. Bhuvan is a software application which allows the exploration of a 2D/3D

representation of the Earth's surface. The browser is specifically tailored to view India, offering the highest resolution in this region provided with local four languages. Apart from visualization, Bhuvan provides timely disaster support services, free satellite data and products download facility and rich thematic data-sets. Bhuvan is using crowd-sourcing approach to enrich its maps and collecting Point of Interest data.

Conclusion

The tracking of ships using Indian satellite has been successfully implemented, tested and commissioned. The positional information has been exported to an Indian Geoportal, Bhuvan. The system can be used for better tracking in Indian waters using domestic satellite. Commercial decision-making, fleet management and cost control can be improved by using the tracking system. Presently, only one industry provides ship tracking services

using various satellites. The developed system is very cost-effective compared to the commercially available vessel tracking services. Ships can be tracked in the vast Indian Ocean region if INSAT-DRT modem is used, since the INSAT-DRT satellite footprint is large.

Acknowledgement

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Implementations in planning of public services in Riyadh

This plan aims to improve the level of these services in the city, fill the existing gap and identify the future needs of Arriyadh

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The provision of public services is considered as one of the basic goals which city managements all over the world seek to realize. In particular, the provision of public services indicator is considered as one of the most important urban indicators which reflect the quality of life for city residents. In this regard, the High Commission for the Development of Arriyadh, that is responsible for planning and comprehensive development of the city, has approved an overall plan for coordination and provision of public services in Arriyadh city.

This plan aims to improve the level of these services in the city, fill the existing gap and identify the future needs of Arriyadh. The plan also includes the establishment of a database at city level, which will include all information, spatial data for public services in terms of locations, distances and ownership, and any other information that may help the relevant agencies to develop their future plans and priorities.

The plan was prepared in coordination with relevant public agencies through a technical committee formed for this purpose. This committee comprises 15 representatives from public agencies concerned directly with public services in the city, where these agencies in addition to the High Commission for the Development of Arriyadh city include Arriyadh Municipality, Ministry of Education, Ministry of Health, Ministry of Interior (General security, Arriyadh Police, Arriyadh Traffic Police Department, General Directorate of Civil Defense, Passport Department), Ministry for Islamic Affairs, Endowment, Dawa and Guidance, Ministry of Higher Education, Technical and

> The plan was prepared in coordination with relevant public agencies through a technical committee formed for this purpose

Vocational Training Corporation, Saudi Red Crescent Authority, Central Department of Statistics and Information, and Saudi Post.

The plan included the collection of data related to the quantity and quality of public services from different public agencies, and a field survey of different public services facilities in the city of both public and private sectors was also carried out. This included information related to ownership, metadata, number of labors and beneficiaries of these facilities, as well as identifying their locations, such as if they were for developed locations or lands allocated for public services or if they haven't been developed in approved plans.

The phasing in the plan included the following:

a. **Phase 1:** This phase is concerned with the collection of information and an overall field survey for the public services in the city.
b. **Phase 2:** This phase is concerned with the evaluation of the current situation and the development of planning standards. The numbers of currently-needed public services and their distances have been identified as well as the future needs till 1450H.
c. **Phase 3:** This phase is concerned with the development of an executive program to achieve public services needs in Arriyadh city.

Methodology

The Establishment of Geographic Database

The provision of a geographic database for public services in Arriyadh city is one of

Geographical database for public services – 1431		
Information sources		
Secondary sources of information	Information sources related to sectoral policies	Information sources
Data and reports issued by international agencies	Saudi Arabia Five-year plans	ADA database
	MEDSTAR	Stakeholders database
Specialized reports and researches for different services.	The guide of preparation and update of structure plans for cities and rural areas- MOMRA	Aerial images for periods of time
		Social characteristics
		Field survey

Figure 1: Geographical database for public services – 1431

Figure 2: Represents the main features for the public services data collection from its sources.

the main requirements of the plan, where it provides spatial data about public services as well as achieving the following:

- The geographic distribution of public services in terms of quality and quality at city level.
- Compare provision of public services in Arriyadh city with those in cities across the world.
- Estimate the level of these public services provision with the population needs according to the city, sub municipalities and neighborhoods.
- The provision of scientific bases which help the decision-maker to improve of public services in the city.
- Identify the future qualitative and quantitative needs of these public services.

Based on the above, the importance of database provision is clear, because it contains accurate and updated information of public services and their locations in the city, that was based on the overall geographic database existent in the High Commission for the Development of Arriyadh.

The work methodology in this plan was based on the review of all information sources, data, and aerial images, as well as data of social and demographic characteristics and five-year plans of the Kingdom and MEDSTAR.

Data collection and field survey

The available data from basic sources and before the field survey was classified into several levels as follows:

- Services without spatial coordinates and metadata.
- Services with available spatial coordinates but the service metadata is not available.
- Services without spatial coordinates but the service metadata is available.
- Different information and statistics (urban, social, population, etc.).

After the data collection process, the data is indexed, classified and numbered. This is followed by the analysis process, and from the comparison process, the following were found:

- Identify the services points which will be targeted during the field survey.
- Identify the survey area.
- Identify the time framework for the field survey process.

Figure (2) represents the main features for the public services data collection from its sources.

Due to the need for updated spatial metadata for the public services in Arriyadh city, the filed survey process has been carried out in accurate and scientific manner. The field survey covers the development protection limits for
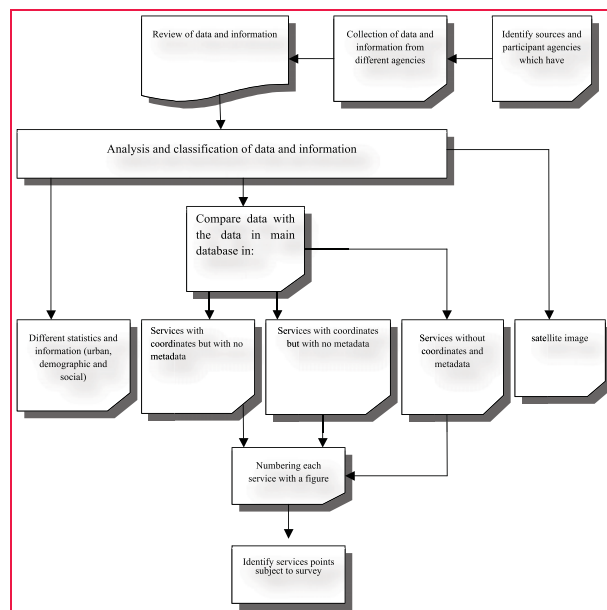
Arriyadh city with an area estimated at 5,400 km2 (figure 3).

To ensure the compatibility of the field survey deliverables with database requirements, specifications and analysis requirements, it was necessary to develop a detailed methodology for the field survey that deals with the field survey deliverables, questionnaire design, survey area division, identify and train the required staff, and identify the mechanism
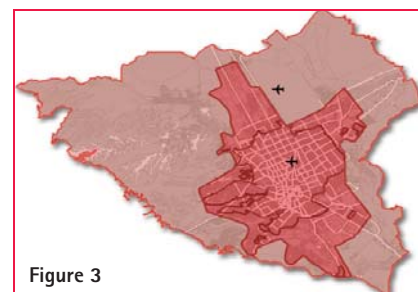
Figure 3
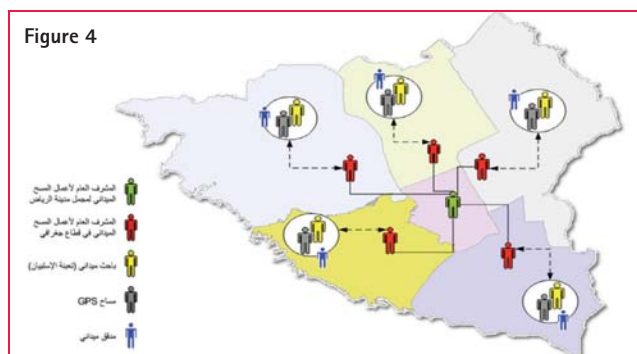
Figure 4

of coordination between the survey teamwork and download and verify data.

The field teamwork is formed from 24 groups distributed all over Arriyadh city, where each group includes a surveyor, researcher, field auditor and watchman.

The field survey is carried out in accordance with the recognized scientific bases when carrying out such studies, including ensuring the collection of accurate information and filling the questionnaire for the required service. Then locations and coordinates of service and the metadata related to each service are ensured, as well as the quality control process in collecting, classifying and downloading information to the (GIS). These processes are done in accordance with international standards.

The survey teamwork provides surveyors with the necessary maps, navigation equipment and coordinates, so the meters of equipments used in monitoring the public services points were set, where these specifications should be unified in all equipment in order to ensure the accuracy and harmony of monitoring works.

The teamwork has carried out an inventory of all required services and has monitored their points on the ground. After that, a coding system for these services has been prepared by identifying a 'CODE' for each service. This code is introduced (GPS) during the monitoring process to facilitate the data classification and utilize them in (GIS) programs. The table 1 shows the way of classifying the service type and its code:

The field teamwork has carried out the Cadastral Survey and registered metadata of the location, code, number and service location which were monitored in accordance with the coding system approved for services by using (GPS

Garmin Etrex) with accuracy of 2 m.

Registration of survey information and data in geographic database

By the end of the field survey and Cadastral Survey, the (GIS) teamwork has registered the metadata digital information to be processed in the geographic database framework.

After the collection, revision and registration of information, the most prominent characteristics of the current situation of these services have been reviewed and compared with the international indicators. Then, the current situations have been evaluated and analyzed through the revision of available data and in the light of the approved planning standards. The degree of these services are measured, and the suitable distribution at city level, sub municipalities and neighborhoods. The indicators related to service quality have been concluded and compared with measurements targeted from services agencies and international standards, particularly in terms of medical and educational services.

This was carried out on two levels, the first is the statistical level and the second was through comparison with the current standards (not updated). These standards depend on the scope of service in meters, as well as the serviced population and the land area allocated for each individual by using (GIS) as follows:
- The first level: The statistical tables for the current situation of services which show the facilities number for each service and the extraction of urban indicators and compare them with the current indicators.
- The second level: The analysis and comparison with current indicators that require identification of service scope for each service, and

calculate the serviced population and land area in which the service is provided. This process is done through Thiessen Polygon, in which the following are carried out:
- Calculation of the scope of service a mathematical equation which calculates the average rate for distances from the service centre to the periphery range.
- Calculation of serviced population.
- Calculation of land area rate of service for the population.
- This information is collected within a specified range, then formatted into (EXCEL) and included (Pivot tables) to check their compatibility with the current standards.

Analytical model

In the light of the above, an analytical model has been established by (GIS) to evaluate the current situation and estimate the future needs of public services in terms of number and distance through the following inputs:
1) The available data for numbers and distances of public services:
   - The main database existent in ADA.
   - Databases existent in agencies involved.
   - Aerial images for successive periods.
   - Field survey.
2) Numbers and distribution of current population and predictions:
3) The planning standards to provide public services, in this plan, planning standards for the provision of public services in Arriyadh city have been revised and developed based on the following considerations:
   - Evaluation of compatibility of the current situation of public services provision with the current standards that are applied when lands are planned by Arriyadh municipality.
   - Comparison of the current standards with the local and international standards in other similar cities.
   - Consideration of urban fabric of neighborhoods and the demand level compared to the available supply.
1. Analysis of current situation of public services and the extent of current standards applications.

Table 1:

Use	Service Category	GPS Code
Medical	Private hospitals	PH
Medical	Hospitals (governmental)	GH
Educational	Primary schools – bys	PBS
Educational	Intermediate schools – girls	ISG

2. Comparison of current standards with local and international planning standards in other similar cities.
3. Consideration of urban fabric of neighborhoods and demographic distribution and demand level compared to available supply.

Developed planning standards

It was found from the analysis that there was a multiplicity in standard sources used by agencies related to public services, and there is a variance in the effectiveness of standards currently applied, in particular, standards used in planning lands in the city. For example, it was found that the standard used for primary schools for boys is the provision of a school for each 3.600 people and this is considered as a very high standard compared with other cities where it has been modified to become one school for each 6.000 people. While the standard used for hospitals was specified by the provision of one hospital for each 160.000 people, is considered as a suitable standard, so it was adopted in the developed standards.

It was found that the current standards focus on the required services at the level of neighborhoods, where there are no standards related to traffic centers, universities and public libraries and others, as suitable standards have been developed for these services and included with the developed standards. In the light of this, developed standards of public services related to Arriyadh city have been obtained jointly with the relevant services agencies which participate in the preparation of this plan, where the evaluation of the current situations and specification of the future needs of public services in Arriyadh till 1450H was based on these standards.

The most prominent results and issues of public services

The identification of deficit and surplus process in the provision of public services is based on viewing the current situations in terms of quantity and quality related to the number of services and coverage level, as well as the land distance available to

The executive plan, particularly the approved projects included in the operational plans of agencies related to services, can be monitored through 'performance indicators'

fill the current and future gap. To realize these goals, a comparison was carried out based on population and current population densities, calculation of density average in all neighborhoods and the adoption of revised standards used for all services on sub municipality level.

Results have been presented in detailed reports of the plan through charts and tables which show surplus and deficit for each service on all sub municipalities level, that will facilitate the development of plans in future to fill the gap and improve the level of public services in the city. The standards proposed for services that are included in the study have been applied to identify the current deficit and surplus. The most prominent results are as follows:
- Mosques are properly provided at city level, although there is variance in provision or deficit at neighborhood level.
- Educational services are considered as the service that suffers most from deficit and poor distribution at city level, whether kindergarten or primary and secondary schools for

boys, also schools for girls suffer from deficit, particularly secondary schools. Universities suffer from poor distribution as they are concentrated in the north and central part of the city.
- Medical services suffer from poor distribution where some sub municipalities suffer from deficit.
- Security services and police stations, particularly civil defense, suffer from a big deficit at a neighborhood level.
- There is also a deficit in the provision of parks and recreational services, especially playgrounds and public parks city level.
- The percentage of public services located in leased buildings rise where it is estimated at (46%). This influenced the provided service and location appropriateness, and an unwanted situation resulted from the lands which were allocated for public services and still owned by the private sector. This is in addition to the change of some land uses allocated for public services to other uses, the lack of financial support necessary for expropriation or the implementation of public services buildings in allocated lands. Through the evaluation of the current situation of public services, some issues that face the city have been identified as follows:
- Change uses of some lands allocated for public services, where the total distance of public services lands established for other uses is estimated (at 31 km2), whether for leasing or concession by service agencies.
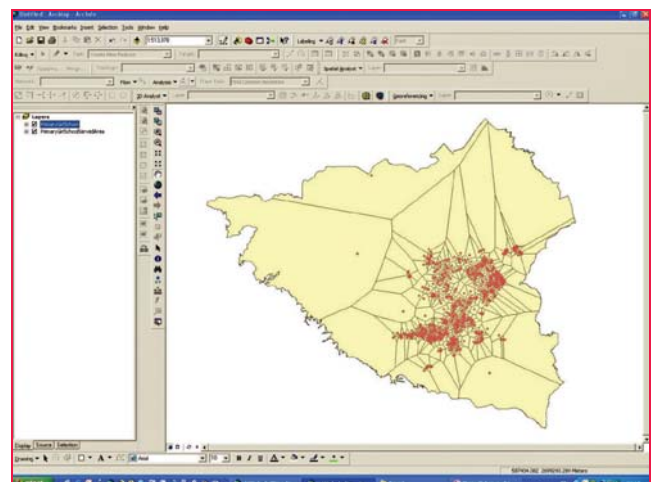
Figure 5: Thiessen Polygon
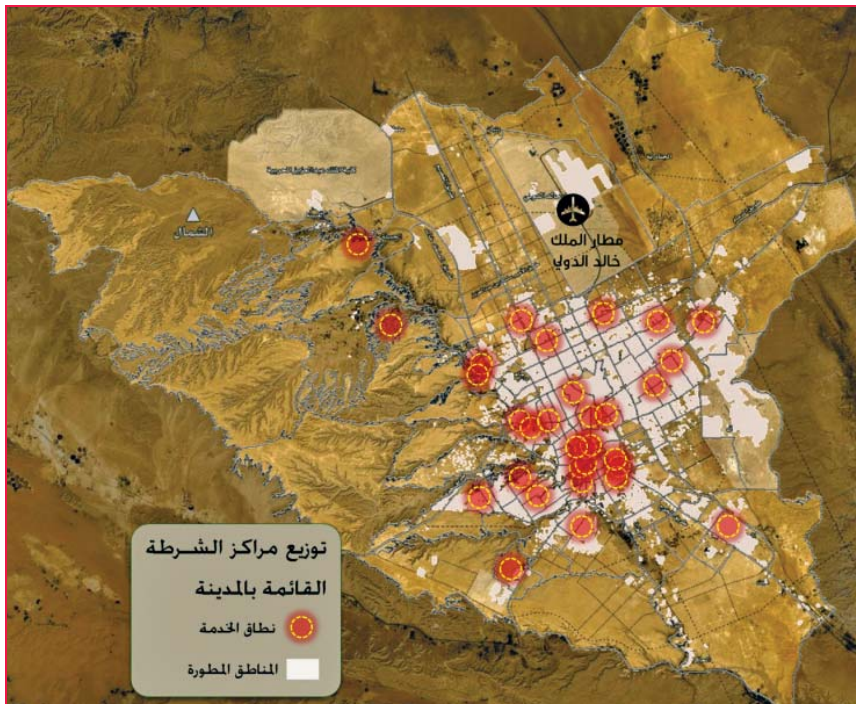
Figure 6: Shows a typical sample of services of police stations and its scope of service in the city.

- The percentage of leased buildings of public services is high where the buildings of public services located in leased buildings is estimated at (46%).
- The lack of lands owned by public services agencies, particularly Ministry of Education, Ministry of Health, and security agencies.
- Regarding the need for unifying planning standards related to public services, it was found that no conformity of previous standards of public services in the city compared with international standards, as well as concentrating on the provision of services at local level, and ignoring other levels such as hospitals and universities.
- The weak coordination mechanisms between executive agencies of public services in terms of planning and executive aspects related to priorities and providing the necessary financial support.
- The clear lack of data and information related to the public services that are not connected with spatial data through (GIS). This led to lack of knowledge of agencies about their service locations and slowdown of monitoring, implementation and updating aspects.
- The expected impact of new policies in providing public services (medical insurance, Wasil postal service, E-government, electronic education and distance education). This reflects on the standards related to providing these services and their scope in the city.

Executive program

The executive program reflects the executive plan for coordinating and providing public services and its management in Arriyadh city, where it is concerned with filling the gap in public services and fulfilling the current and future needs till 1450H. The program represents a planning reference for relevant executive agencies related to public services. It includes the following:

- **Identify priorities:** Priorities have been identified according to seven indicative atlases that show type, volume and location of services required at neighborhood level for each service. This is in accordance with time priority identified by four phases till 1450H and estimated costs to provide these. The identification of priorities was based on the level of requirement for each service, taking into account the aspects related to availability and quality of the service, current and future population,

as well as urban growth trends.
- **Available means for lands provision:** The continuation of the current situation of reserving a percentage of lands when planning for public services, and in case of unavailability of lands, ownership for targeted locations is expropriated. The establishment of land bank at city level will allow land swap between public services agencies. Contract with the private sector to provide necessary lands is followed by the commissioning, maintenance and operation of services against money paid periodically, and then the ownership is transferred to the government.
- **The available means for finance:** The continuation of government expenditure where services are implemented from the public budget, are approved for different service agencies in accordance with a schedule consistent with the implementation phases included in the implementation program. Participation of the private sector in financing, building and operation, followed by ownership of services is then transferred to the government. **In** the joint development with developers, the developers of comprehensive development projects of residential and commercial complexes are committed to build public service facilities located within their projects.
- **The available means for implementation and management:** The implementation and management of public services facilities is carried out through public agencies. Participation of the private sector in financing, building and operations, is followed by transfer of ownership of services to the government after an agreed period (BOT). This is in order to mitigate the burdened budget, and improve level of services such as establishing new postal, educational and medical services. Transfer of the responsibility of management, operation and development to the private sector by management contracts for a period of time are made against an amount of money according to the performance improvement. Leasing assets owned by the government, such as medical and educational services.

Galileo update

Second call of H2020–Galileo now open

The second Horizon 2020 (H2020) call for Applications in Satellite Navigation, managed by the European GNSS Agency, is officially open. With a budget of EUR 25 million for the 2015 call, the deadline for submitting proposals is 8 April 2015.

To accelerate EU space policy, the H2020 call focuses on growth and impact across all market segments, including transport (road, rail, maritime, aviation), high precision surveying, location based services (LBS), agriculture and emergency services. Priority is also placed on raising productivity and competitiveness while reducing adverse environmental impact.

Horizon 2020, as the biggest EU Framework Program for Research and Innovation, targets the development of new space enabled applications in different focus areas such as health, citizen safety, mobility, smart cities, sustainable resources monitoring and management, regional growth, low-carbon energy infrastructure planning and protection, and disaster management and climate control, including natural catastrophes. *www.gsa.europa.eu*

Spoof-proof Galileo receiver wins satnav award

An innovative and cost-effective Galileo signal receiver designed to simplify the use and speed-up uptake of Galileo navigation services has won the European satnav Oscar.

Developed by Airbus engineers, the receiver offers considerably higher levels of security and reliability than

GPS while using a comparatively simple system architecture.

Instead of having a Security Module integrated into every individual end-user receiver, the concept – developed by Kogler and his colleague Jan Wendel – relies on complex assistance servers and secure communications links.

The assistance server, equipped with a complete PRS receiver with a Security Module, receives the satellite data and transmits them to the users via the secure links. The end-user receivers thus don't need to be equipped with the Security Modules while maintaining the exact same level of security as the primary receivers. *http://eandt.theiet.org/*

ESA will attempt to improve orbits of errant Galileo satellites

The European Space Agency announced plans (November 10, 2014) to implement a series of maneuvers to reposition one of two Galileo full operational capability (FOC) satellites left in the wrong orbit this summer, as a prelude to its health being confirmed. The aim is to raise the lowest point of the satellite's orbit — its perigee — to reduce the radiation exposure from the Van Allen radiation belts surrounding Earth, as well as to put it into a more useful orbit for navigation purposes.

Should the two-week operation prove successful, then the sixth Galileo satellite will follow the same route. The Galileo pair, launched together on a Soyuz rocket on 22 August, ended up in an elongated orbit travelling out to to its apogee. ◣

The executive plan, particularly the approved projects included in the operational plans of agencies related to services, can be monitored through 'performance indicators' for each of the approved services projects by measuring the scale of achievement in these projects according to the approved schedule.

Recommendations

- Approve the database related to the public services in Arriyadh city, and design a joint portal between relevant agencies in order to update data continuously and periodically, monitor and follow up on the implementation of projects, and measure their consistency with the planning standards. This must be consistent with the trends of the establishment of E-government.
- Approve the developed planning standards included in the plan and consider it as the main reference for lands planning and distribution of services locations in Arriyadh city.
- Emphasize on stopping transfer of lands allocated for public services in approved subdivisions (schools, hospitals and others), and be committed to the decrees of Council of Ministers.
- Establish 'the Land Registry Center for public services lands in Arriyadh city' that is concerned with the inventory of public services lands and specify their ownerships, transfer them to identified services agencies and set procedures necessary for swapping these lands in accordance with needs and surplus for each agency at neighborhood levels.

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The paper was presented at 9th National GIS Symposiun in Saudi Arabia at Damman during April 28-30, 2014. ◣
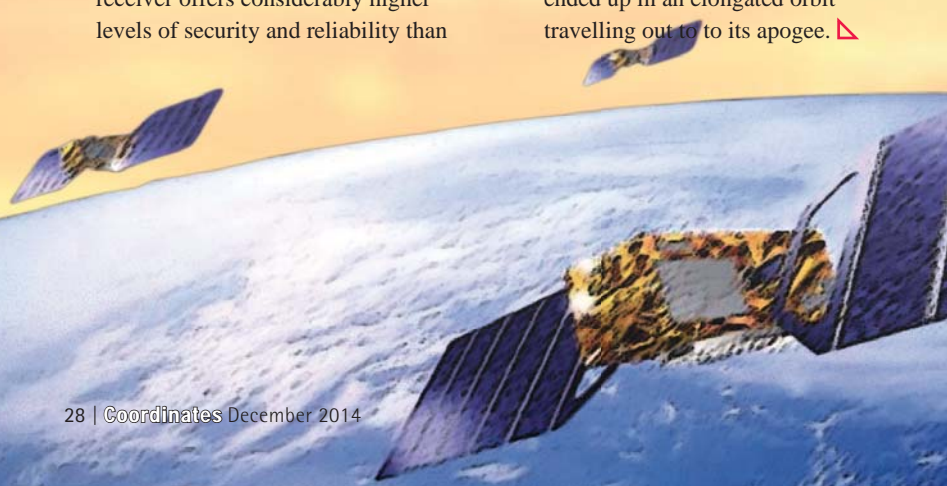
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IN FIVE PLATFORMS
RTK & Auto-Verify

J-Field is the most advanced controller software for Geodetic and GIS applications. With our Auto-Verify feature, we claim that it never ever gives a wrong fix. We have offered to reward $10,000 to any U.S. Professional Land Surveyor who can prove otherwise.
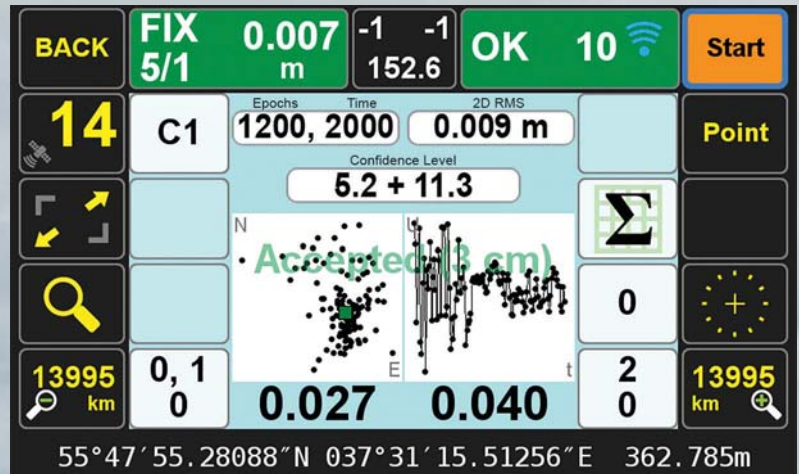
RTK with J-Field in five platforms:

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Not only the best RTK Systems, they all can also be used as base stations and any other applications.

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TRIUMPH-1M has same features as TRIUMPH-LS but without integrated controller.

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- **24 Hours Battery Life**

- **Interference monitoring of all GNSS and UHF channels**

- **Visual Stake out**

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- **6 parallel RTK engines**
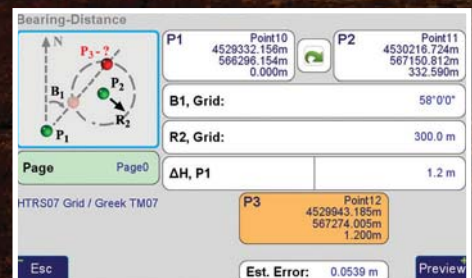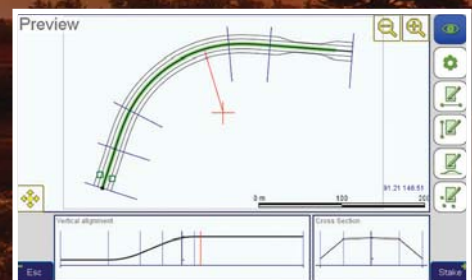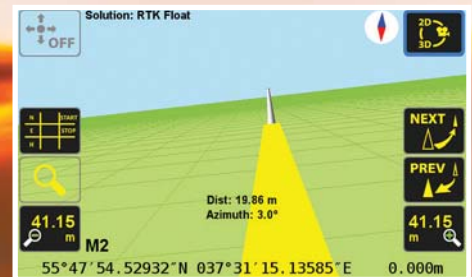
TRIUMPH-NT

Receiver+Radio Modem+Controller+Pole

Similar to TRIUMPH-LS
but without integrated
GNSS antenna.

TRIUMPH-NT and GrAnt
antenna makes a complete
RTK system.
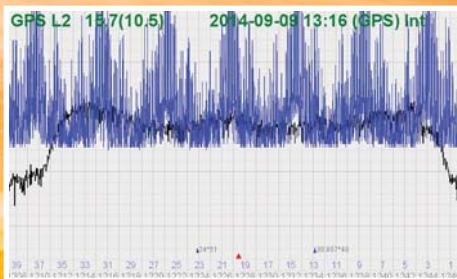
Built-in GNSS Spectrum Analyzer
to detect interference in all GNSS bands.

TRIUMPH-NT + GrAnt
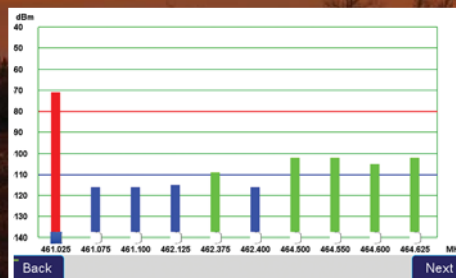
Built-in UHF Scanner
In certain areas, the UHF airwaves may
be congested and if you're corrections are
being broadcast at the same frequency as
another surveyor is using, there may be
irratic communications.
Built-in UHF Scanner shows condition of
each UHF band.

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The Rugged Field Controller

Victor-LS is a rugged field controller. It runs J-Field and can be used with TRIUMPH-1 and TRIUMPH-2.

Base	GEO	55°54'01.30723"N	037°23'50.26652"E	244.461m
	GRID	26021.015m	-6423.657m	244.191m
Rover	GEO	55°47'52.87472"N	037°31'20.76734"E	366.064m
	GRID	14623.098m	1406.924m	365.916m

Dir:325°30'37"   Dist:13828.612m   ΔH:-121.603m

FIX:5   Sats:7+5
HRMS:0.008m   VRMS:0.010m   RMS:0.013m
HDOP:0.988   VDOP:1.319   PDOP:1.648
TDOP:1.082   GDOP:1.972

95% Confidence Ellipse
σ_1:0.014m σ_2:0.013m
θ:33°47'16"   σh:0.020m

Esc

TRIUMPH-1M + Victor-LS
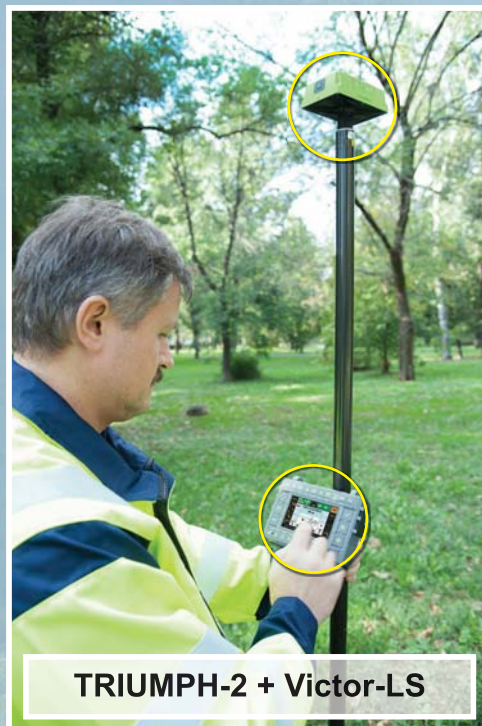
TRIUMPH-2 + Victor-LS

OMEGA

Rugged GNSS Unit

OMEGA is the most advanced GNSS receiver. It does not include integrated antenna and controller. It is suited for applications like **machine control** and in **marine** and **avionics** applications.

Adding GrAnt and Victor-LS makes a complete RTK system.

It is well suited for **monitoring and network stations**.

OMEGA + Victor-LS + GrAnt

TRIUMPH-2

Scalable GPS

Static → GLONASS → RTK Base → RTK Rover

TRIUMPH-2 tracks GPS L1/L2, GLONASS L1/L2 and Galileo E1.

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TRIUMPH-F1

864 Channels, All GNSS Signals, Bluetooth, WiFi, UHF, GSM, Spread Spectrum

TRIUMPH-F1 can be used as TRIUMPH-1 for field work as base or rover.
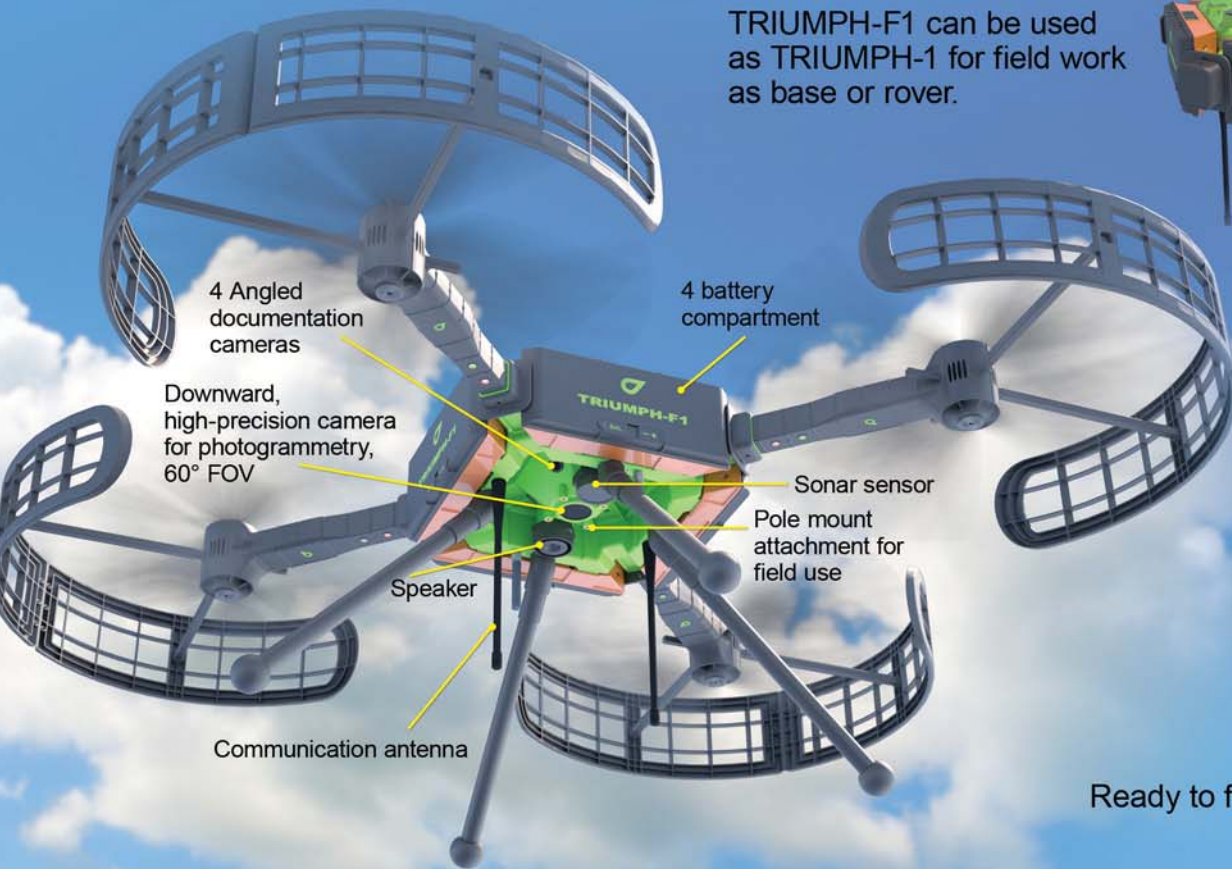
4 Angled documentation cameras

Downward, high-precision camera for photogrammetry, 60° FOV

Speaker

Communication antenna

4 battery compartment

Sonar sensor

Pole mount attachment for field use

Ready to fly in Q1 2015.

Power button

Communication indicators

Motor LEDs

Flight status indicators

2 micro SD slots

8 motors & propellers (detachable)

SIM card slot

Battery indicator LEDs

GYRO status indicator

USB connector

Integrated battery charging connectors
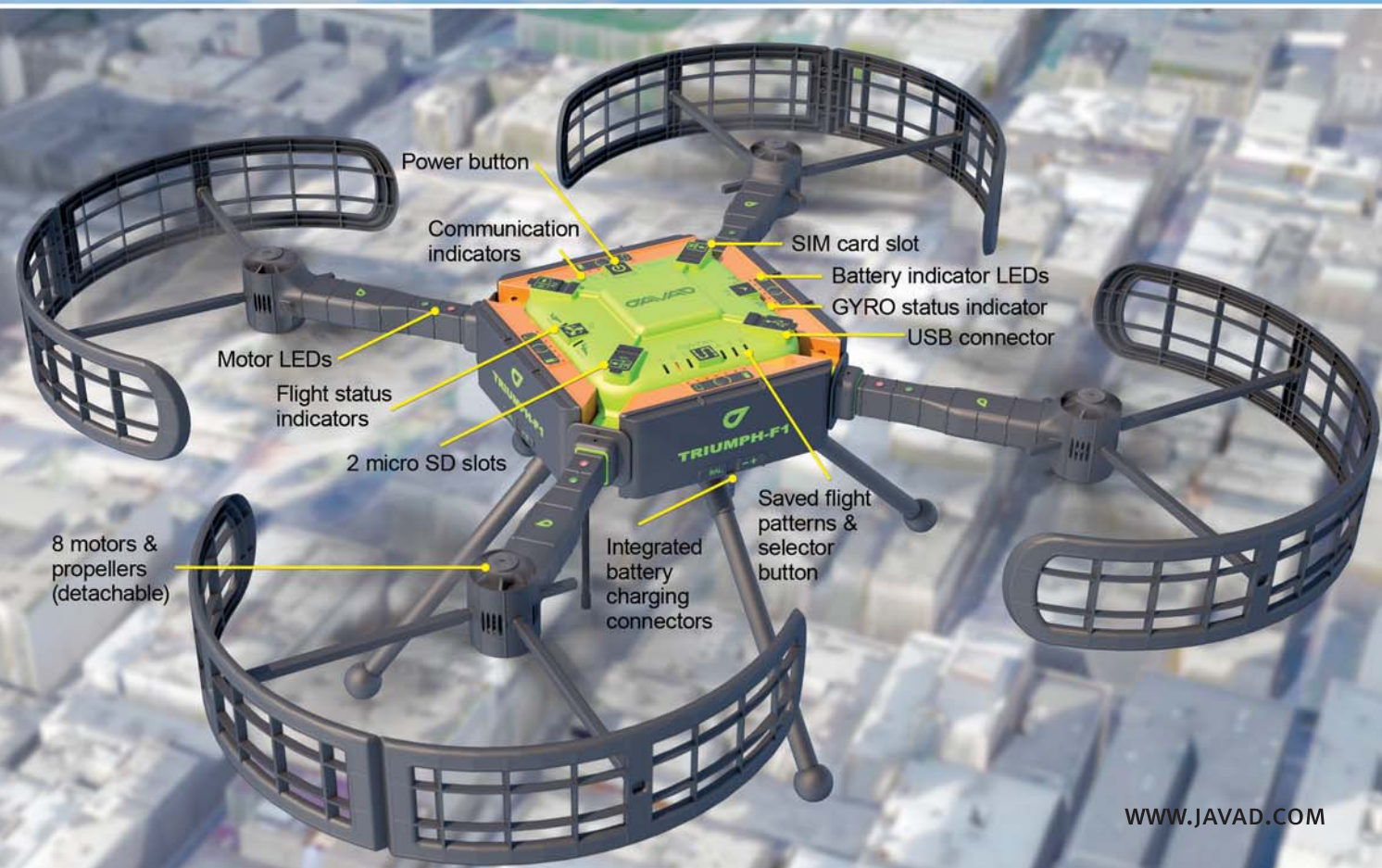
Saved flight patterns & selector button

Semantically rich 3D building and cadastral models for valuation

The current valuation practices in various countries are analyzed: Turkey, United Kingdom, USA, Germany, and the Netherlands. The (possible) role of semantically rich 3D building models and 3D cadastres in relation to valuation and taxation is explored

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Valuation of real estate/ properties is in many countries/ cities the basis for fair taxation. The property value depends on many aspects, including the physical real world aspects (geometries, material of object as build) and legal/ virtual aspects (rights, restrictions, responsibilities, zoning/development plans applicable to the objects spaces). The aim of this study is to investigate the opportunities provided by the semantically rich 3D building and cadastral models for valuation and taxation. In this paper we investigate the following related aspects:

1. Relationship between physical real world objects and legal (virtual) objects,
2. Use of (semantically rich) 2D and 3D descriptions of both physical real world objects and legal (virtual) objects for valuation, and
3. Maintenance of the 3D information.

Background on building and cadastral models and data

Building models (physical objects)

The representation of physical buildings with digital building models has been a subject of research since four decades in the fields of Construction Informatics and GeoInformation science. The early digital representations of buildings mainly appeared as 3D drawings constructed by CAD software, and the 3D representation of the buildings was only geometric, while semantics and topology were out of modeling focus. On the other hand less detailed building representations, with often focus on 'outside' representations, were also found in form of 2D /2,5D

GeoInformation models These models contain geometry and linked semantic information in compliance with the feature model of the GIS domain (as explained in ISO 19125-1). Since the start of 2000s, detailed models containing geometric, topology and semantic information have began to emerge with the advent of Building Information Models.

Isikdag & Underwood (2010) defined Building Information Modeling as "the information management process throughout the lifecycle of a building (from conception to demolition) which mainly focuses on enabling and facilitating the integrated way of project flow and delivery, by the collaborative use of semantically rich 3D digital building models in all stages of the project and building lifecycle". From this same perspective a Building Information Model(s), i.e. BIMs can be defined as "the (set of) semantically rich shared 3D digital building model(s) that form(s) the backbone of the Building Information Modeling process". These models are capable of containing geometric/semantic information regarding the building indoors and outdoors, in a very high level of detail (i.e. models can be regarded as LOD ∞, or LOD N models), where a model in some cases contain the geometry/semantics of nut & bolt or a picture frame in the house. The complexity of the BIMs (in terms of object relations) is very high and furthermore as the population of the entity instances (i.e. the data) of the model increases, it becomes costly to store and perform advanced queries on the models. Another model that is found valuable in 3D representation of buildings, has its roots in geoinformation modeling. A

well known schema of GML (an OGC standard which is developed mainly for the exchange of geoinformation), namely CityGML (OGC,2012, Gröger and Plümer, 2012), offers digital representation of models in different levels of details, LOD 4 of the model offers possibilities of indoor representation. As explained by OGC City Geography Markup Language (CityGML) Encoding Standard (2012), "Buildings may be represented in LOD0 by footprint or roof edge polygons. LOD1 is the well-known blocks model comprising prismatic buildings with flat roof structures. In contrast, a building in LOD2 has differentiated roof structures and thematically differentiated boundary surfaces. LOD3 denotes architectural models with detailed wall and roof structures potentially including doors and windows. LOD4 completes a LOD3 model by adding interior structures for buildings. For example, buildings in LOD4 are composed of rooms, interior doors, stairs, and furniture."

Land administration (legal/ virtual objects)

Land administrations systems (land registry, cadastre) have different origins in different countries. The information was sometimes collected for taxation purposes and in other cases for legal security. Over the years, in many countries the land administration systems more and more served both applications; e.g. in the area of spatial development or spatial planning. In this context the term multi-purpose cadastre is used. Based on the initiative of the FIG (International Federation of Surveyors), ISO has developed the standard Land Administration Domain Model (LADM), ISO 19152:2012. In the standard, land administration is described as the process of determining, recording and disseminating information about the relationship between people and land (or rather 'space'). The LADM standard defines a basic administrative unit ('basic property unit') as an administrative entity, subject to registration (by law), or recordation, consisting of zero or more spatial units ('parcels') against which (one or more) *unique* and *homogeneous* RRRs (rights, e.g. ownership right or land use right, responsibilities or restrictions)

are associated to the whole entity, as included in a land administration system. A parcel can be described by 2D or 3D geometry or even by textual descriptions (Lemmen at al, 2010). *Homogenous* means that the same combination of RRRs equally apply within the whole spatial unit. *Unique* means that this is the largest spatial unit for which this is true. Making the unit any larger would result in the combination of rights not being homogenous. Making the unit smaller would result in at least 2 neighbor parcels with the same combinations of rights. The objects (parcels) are called legal or virtual objects, because they do not need to be visible in the real world. However, it should be noted that quite often the boundary of a parcel coincides with a physical real world object; e.g. a fence,

wall, edge of road. In case of 3D parcels, this is even more true; e.g. the geometries of physical objects such as tunnels, building (parts) or other constructions correspond also to legal spaces with unique and homogeneous RRRs attached. Perhaps valuation is not directly a 3D cadastre topic, but is it strongly related, because most property tax systems are one way or the other based on an assessed value of the property and relevant in context of multi-purpose cadastre.

Relationship between physical and virtual objects

A (3D) building registration is something else than a (3D) Cadastre. Cadastre is about the legal spaces. That is, spaces described by geometry (and topology)

Figure 1: LADM Core classes (in color and 'LA_' prefix) and LADM external classes (with 'Ext' prefix), taken from ISO 19152:2012
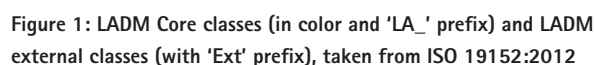
where certain rights, restrictions or responsibilities (RRRs) are attached to. So, all kinds of building details, such as different rooms/ spaces, may not always be relevant (when same RRRs apply). Only when the RRRs are different then also a separate geometry is needed. So, most likely only a part of the indoor building modeling information may be relevant in 3D Cadastre context (and perhaps that geometry is even implicit; e.g. a 3D boundary defined by the 'middle of the wall'). The geometries of the real world (physical) objects and the geometries of the legal objects should be consistent and we should design rules for this. Further, one could argue that when in a certain jurisdiction one has the responsibility to pay certain amount of tax based on the function/ type of a room/ space in a building, then this would fall under the definition of a legal space. This will further reinforce the link between 3D cadastre and building models. The Annex K from ISO 19152 (Figure 1), is a UML diagram showing in color core classes of the LADM standard: green, LA_Party (person), yellow, LA_RRR (right, etc. such as ownership)/LA_BAUnit in blue, LA_SpatialObject (parcel) and showing not in color the LADM external classes (with stereotype <<blueprint>>, e.g. ExtTaxation, ExtValuation). LA_BAUnit stands for basic administrative unit, a group of LA_SpatialObjects with same RRRs attached. LA_SpatialObject has several specializations, such as LA_LegalSpaceNetwork (shown in diagram, including link to ExtNetwork, the physical network registration) and LA_LegalSpaceBuildingUnit (not shown in diagram, but could be linked to physical building registration). LADM is more a conceptual framework defining concepts and terminology, than prescriptive standard. A country should first develop an LADM country profile supporting the legislation of the country (and described in concepts of the international standard), before transforming this into a land administration implementation.

Valuation in various countries

In this section we will analyze the various valuation approaches and the role of 2D/3D geometries in countries such as: Turkey, United Kingdom, USA, Germany, and the Netherlands The section is concluded with a short analysis on the potential use of 3D geometries for the purpose of valuation.

Turkey

There are 2 different types of valuations. The first one is regarding the sales of the properties to calculate the market value, and the second one is valuation for taxation. The two types have many similarities in calculations and some small differences.

Determining the Market Value

The first type is called Real Estate Appraisal or Real Estate Valuation. In Turkey, experts in this field work as 'government certified valuation experts'. There are 3 commonly used methods for determining the market value of the built properties:

a) The first one is comparison with a reference sales price approach. This method includes finding a set of similar properties, comparing the attributes of the property-in-focus with these similar properties and estimating the value of the property.

b) The second method of valuation is income approach; e.g. such as rent. There are several techniques in use with this approach.

c) The third method for valuation is the cost approach. When this approach is used the value of the land lot needs to be calculated separately and added to the value of the building, in order to find overall value of the property. There are also several techniques in use with this approach. The land lot valuation uses "total floor area" based valuation for residential buildings, and "total building volume" based valuation in industrial buildings by using zoning parameters such as Building Coverage Ratio (BCR) and Floor Area Ratio (FAR) and HMax (maximum allowable building height).

Determining the Taxation Value

The valuation for the purpose of taxation is accomplished by local or greater municipalities in Turkey. The valuation of the houses and flats are determined by valuation commission of the municipalities. The tax is known as the property tax. The law regarding the property tax is Law No. 1319. The regulations that explains how the taxation value of the house would be determined, is dated 29.02.1972 as Cabinet Council Decision 7/3995. As mentioned in Bal (2014) according to this regulation there are 3 methods for valuation.

a) First one is comparison method. This method is similar to the first approach of market value determination. The similarity between the property in focus and other properties that the sales prices would be compared needs to be similar in terms of 1. use (Residential, Office, Other Specific Building), 2. building construction type (Steel Framework, Concrete Framework, Stone, Stone Frame, Timber, Shanty, Sun-dried / Mud Brick), 3. building quality (Luxury, Class 1, Class 2, Class 3, Simple Construction) and 4. comparison factors (proximity to businesses/ parking/ gardens/ schools/ public transportation/ seafront/ main road; existence of urban infrastructure: gas, electricity, sewerage; dimensions of the property, number of rooms; comfort, elevator, heating/ ventilation/ air conditioning; landscape that can be viewed).

b) The second method of valuation is income method. This method is much simpler than the similar approaches presented in section for market valuation. The Annual Gross Income is calculated as Average Annual Rent that can be earned in the neighborhood of that property. The value of the property is then determined as: Asset Cost = Annual Gross Income x 10.

c) The third method is costing method. When this method is used the value of the land lot needs to be calculated separately. In this method the value of the property is calculated as follows: Asset Cost= Gross Floor Area x Unit Cost with Unit Cost= Cost of 1 sqm. of the building based on its building type, use and quality. The Unit Cost charts are published and distributed by the Ministry of Finance every year.

In the current practice neither the facade areas of the buildings nor the floor plan areas are derived from the digital building models, in addition the factors such as having heating/ ventilation/ air conditioning are not checked using the models. It is foreseeable that the efforts towards the use of 3D semantically rich building models for valuation would be beneficial for the process. From the viewpoint of the comparison approach it will definitely provide opportunities for better comparison based on factors listed. From the viewpoint of the costing approach, the use 3D models will form a basis for preparation of detailed and accurate costing (e.g. using quantity surveying method), in addition the floor level also has an impact on costing for taxation.

United Kingdom

In the UK the valuation of the houses are done by the UK Government Valuation Office Agency, mainly for forming the base for Council Tax calculation. As explained in Valuation Agency (VOA, 2014) 'Understanding your Council Tax Banding', the Council Tax in England is a local tax based on what a home would have sold for at a fixed point in time:1 April 1991. The income from council tax is collected by local councils to help pay for local services. The table below shows the range, based on 1 April 1991 values, for each band in England. Each year, the local council sets the level of council tax and can tell you the amount payable, for each band.

Valuation Band	Open Market Value as at 1 April 1991
Band A	Not more than £40,000
Band B	£40,001 to £52,000
Band C	£52,001 to £68,000
Band D	£68,001 to £88,000
Band E	£88,001 to £120,000
Band F	£120,001 to £160,000
Band G	£160,001 to £320,000
Band H	More than £320,000

In UK taxation scheme a property is defined as "A separate unit of living accommodation, occupied by the same person(s) and within the same area of land, comprises a 'dwelling', together with any garden, yard, garage or other outbuildings attached to it. In tax calculations each property is allocated to one of the eight bands, A to H, ('A' being the lowest) according to its national value on 1 April 1991. As explained by VOA, the agency takes account of the size, age and character of the property as well as its location when allocating a council tax band. This allocation of a band is in fact a valuation of the property with a very limited accuracy and referring to market data around 1 January 1991. For council tax, the basis of measurement for all houses and bungalows is the building's gross floor area, including wall thicknesses. This will include bay windows, chimney breasts etc., but will generally exclude areas with headroom under 1.5metres (e.g. under sloping ceilings in attic rooms).

The basis of measurement for most flats and maisonettes is net floor area with measurements taken between the wall surfaces of each room (not skirting boards). Bathrooms, WCs and associated lobbies, as well as connecting corridor areas within a flat would not usually be measured. As with houses, areas with headroom of less than 1.5 meters will be excluded. Individual properties might need to have their banding re-considered when:

- A house decreases in value because: 1. part of it is demolished, 2. substantial changes take place in the local area (for example a new road is built nearby), or 3. alterations have been carried out to make it suitable for use by a person with a physical disability.
- The owner starts or stops using part of your home to operate a business, or the balance between business and domestic use changes.
- A home gains a higher value because a previous owner has carried out major improvements, such as building an extension.
- A self-contained unit is built, such as an annex to house an elderly relative.
- A house has been split into individual flats, or flats have been merged into one home.

A banding is also done for different kinds of self-contained units. A self-contained unit is a building or part of a building constructed or adapted to make it capable of forming a separate unit of living accommodation. This could be, for example, an annexe for an elderly relative, or adjoining properties knocked through, and occupied as one unit, but retaining essential facilities of two. Common examples of properties that are identified as self-contained units are: 1. Annexes, or 'granny' flats, often designed and built for elderly relatives, 2. Accommodation for wardens in student accommodation. 3. Previously separate but adjoining houses/ flats now occupied as one residence, 4. Former servants' quarters in large houses.

In summary the valuation in UK is had been done implicitly by the government in 1991, hence the role of the use of 3D information is not clearly identified in UK valuation process. Newly constructed properties are also assigned a nominal 1991 (2003 for Wales) value and banding. Also the banding is reconsidered when a property is changed as mentioned. For banding newly constructed properties and changes in banding the Valuation Office Agency needs recent information of the property on type, size, age and location. A 2D or 3D model can help presenting these data to the Valuation Office Agency. Although explained in government documentation the exact (rules) of the valuation (such as explained in the former section regarding Turkey) are not explicit and made publicly available. Local authorities set a council tax rate and value based on the banding of the property.

Next to the banding system for residential properties in the UK the non residential properties are valued every five year for the business rates. For these business rates the rental value of the property is valued by the Valuation Office Agency. For these business rates the Valuation Office Agency not only needs information on newly constructed (non residential) properties and information on changes, but also information on all properties for the periodical revaluation. However the 2015 revaluation is postponed to 2017 to save costs.

USA

Property tax in the USA (Wikipedia USA, 2014) has a long history, and was already well established in most of the then 15 states, by 1796. We will discuss

property tax in the US, with regard to real estate, as opposed to cars or certain business property or inventories. In contrast to other forms of tax (including property tax on aforementioned non-real-estate), real estate property tax will generally not cause (unexpected) budget shortfalls – at least in theory. The process is such, that revenue equals tax levy, except, presumably, for significant economic, political, or other disruptions, between assessment and payment:

- Fair market values are estimated, throughout a respective region. Multiplication with a local assessment ratio (such as 0.96) yields individual assessed property values v_i. (Assessment ratio may vary between categories, such as residential, farming, etc.).
- Contests of assessment may lead to "corrections" in individual assessed values v'_i.
- Known required total revenue r and all known corrected assessed values v'_i (plus exemptions, credits, etc) allow subsequent derivation of a required local tax rate (which may also vary between categories, possibly even distinguishing between inhabited and vacant buildings). This yields assessed tax, for each individual property. It also yields the required total revenue, apparently quite reliably. There are, of course, political, economic, and legal constraints: some local rules may limit individual yearly property tax increases. Similarly, political and economic considerations result in similar constraints.

Implementation of valuation, assessment, and values of assessment ratio and tax rate vary significantly across USA counties, cities and school districts, also depending on the legal framework set up by state legislation. Local jurisdictions can levy overlapping property taxes (within potential state regulations). Revenue tends to be used for school districts and other local expenses. States and the federal government generally do not tax real estate property, but the resulting income and capital gains.

Despite significant local variations, property taxes are generally based on some measure of fair market value, multiplied with a local assessment ratio and a tax rate. When a property has recently been traded between unrelated parties, then that transaction value serves as fair market value, for some period of time. Beyond that, the fair market value has to be assessed, to some degree subjectively, by an assessor. Preferential treatment might be given to certain property categories (such as farms, non-profit organizations, etc.) or businesses the government would like to specifically attract. Also, fair market value may be determined, based on actual, or based on optimal use. Residential and farm property tend to be more likely to be assessed, based on actual use, than some other real estate categories. Many local rules allow for homestead exemptions, such as exempting the first $50,000 of primary residences from property tax. Valuation techniques tend to be based on:

- Recent sale transaction between unrelated and non-compelled parties.
- Otherwise, sales of comparable properties, based on similar:
  - Type, use, and size.

- Location.
- Improvements (features, materials, style, amenities, even existence of a fixed kitchen island, or number of power sockets). Owners may avoid certain forms of development to limit assessed values. This has been recognized as an issue, leading to a separate consideration of land and improvements.
- Desirability, proximity to schools.
- RRRs. In order to reduce assessed values, owners may sometimes ask to have rights restricted that they do not plan to exercise, anyway.
- Economic conditions.
- Otherwise, original or replacement cost, minus depreciation.
- Or, if applicable, income generating ability.

In the USA the valuation to market value and assessment for taxation purposes is (nearly) always done by using statistical modelling using multiple regressing types of models.

It would be hard to represent local rules and variations, and subjective judgment, in even a sophisticated 3D building model or cadastre. However, statistical models may yield local parameters, beyond mere assessment ratio and tax rate. A limited number of common concepts, plus several local correction factors f_i may model local variations, successfully.

Applicability of 3D Building Models and 3D Cadastres

Due to the many aspects that can affect assessed values in many USA locales, 3D building models and cadastres seem to be great potential tools to support the computer assisted appraisal models (CAMA) and assessment of properties, as well as communication to the public.

Some very detailed aspects, such as wooden floor, number of power sockets, and fixed kitchen islands, used in the appraisal models appear to require very rich 3D models, with a combinatorial explosion of complexity. It should be possible, though, to limit the models to aspects common to many locales, as opposed to local idiosyncrasies. Any

aspects not in common use, any subjective or only loosely defined concepts could be represented as SPECIAL_CASE_FACTOR or SPECIAL_CASE_OFFSET in various strategic areas of a global model. A homestead exemption of the first $50,000 of a property value could be modeled with the same formula as a local rule that only taxes the first $100,000 of improvements, to reduce sprawl. We may not have to explicitly model all the many different concepts, individually, by name.

Germany

Property tax in Germany (Wikipedia Germany, 2014) has been uniformly regulated, since 1938. In the context of the reunification in 1990, property tax in the new states ("east") has been adapted and merged into the federal system, with some differences remaining between old ("west") and new states.

Property tax in Germany (Grundsteuer) is similar to the equivalent in the US, in many ways. There is a property value (Einheitswert), multiplied with a factor (Grundsteuermesszahl) similar to the USA assessment ratio. Multiplied, they yield the Grundsteuermesswert, similar to the USA assessed value. Multiplied with a tax rate (Hebesatz), they yield the assessed tax (Jahresgrundsteuer).

Semantically, however, there are differences:
- The Einheitswert is not a fair market value, but a federally standardized value proxy. This is similar to a USA county that would estimate assessed values, based on building and land square footage, local population density, type, use, and income generating capabilities, alone. It does not aim to reflect actual market value, and only reflects relative market value differences between multiple properties, very approximately. A neighbor A with a property of slightly lower market value than neighbor B might nevertheless end up paying slightly more in property tax. Large distortions are very unlikely, though, particularly considering local building codes and other restrictions. When comparing non-neighboring properties

in far-apart locations, relative distortions of Einheitswert compared to market value may increase. This is less relevant, though, due to the different tax rates in such far-apart locations.
- The Grundsteuermesszahl is federally determined, not locally (such as the USA assessment ratio). This does not limit local flexibility, though, since setting the tax rate, locally, allows all the flexibility needed. Similar to the assessment ratio, also the Grundsteuermesszahl varies, depending on property type.
- The Hebesatz, similar to the USA local tax rate, is determined, locally, and can vary, depending on property type. Numerically, both Grundsteuermesszahl (given in ‰) and Hebesatz tend to have significantly different value ranges than their equivalents in the US. The concepts are otherwise quite similar, though. The fact that the Einheitswert is not the real market value and is multiplied with two hard to understand percentages might make the property tax in Germany less intuitive. Many homeowners may primarily remember the fairly static amount due, and ignore the complicated underlying math. For the more technical purpose of modeling property tax, complexity should be similar to the US, though.

Similar to the USA:
- German property tax is considered very predictable revenue, since it is guaranteed by the property value, and the current owner, personally. In case of sale, the new owner can also be liable for the property tax the old owner has not paid. The new owner will thus verify that there is no such remaining balance.
- Individual properties can be exempted from property tax, such as to attract business, protect historic buildings that generate little to no income, etc.
- Exceptions similar to homestead exemptions exist.
- Local governments receive the revenue of the property tax.
- Property tax is determined for land and buildings, separately.
- Current use, as well as potential use, and RRRs, can affect property tax. An owner might request (not necessarily

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successfully) to further restrict their RRRs, yielding a lower property tax.

Applicability of 3D Building Models And 3D Cadastres

The current property tax in Germany, despite its similarities to the USA system, would not depend on quite that much detail in a 3D building model or cadastre. Many aspects, such as wooden floors or granite countertops have no bearing. Many of the more conventional aspects of 3D models and cadastres, such as RRR, though, could be very useful in modeling German property tax.

The Netherlands

For the valuation for market purposes, for instance for sales and other types of real estate transactions in the Netherlands there is no specific regulations. Certified appraisers working in this field can use Cadastral information on RRR. For the valuation the appraisers also need information on object characteristics. They have to collect these characteristics of the object to be valued themselves. A very limited part of these data can be derived from the Key-register for buildings and addresses in the Netherlands. However the appraiser is responsible for the accuracy of the data he is using on building year and area of the property. Therefore mostly he collects these characteristics himself, for instance by measuring the property using construction drawings. Also the certification scheme for certified appraisers is a responsibility for the market parties involved. There is no official regulation for the skills of the private certified appraiser.

The valuation and assessment of real estate for government purposes is regulated by the Act for Real Estate Assessment (in Dutch: "Wet Waardering Onroerende Zaken (WOZ)" (http://wetten.overheid.nl/BWBR0007119). English translation: http://www.waarderings-kamer.nl/default.aspx?sec=content&id=1064). The assessed value in the Netherlands is therefore called "WOZ-value" of a WOZ-object. The WOZ-object is a built or not built real estate property, a part of a real estate property (when this part is used by a tenant and is a separate (lockable) unit with all facilities) or a complex of properties (owned by one person and used as unit by one user).

Since 2007 the valuation of all properties (WOZ-objects) is done every year and on real market value. For the valuation the appraiser looks back one year, so the assessed value for the year 2014 is based on the real estate market on 1 January 2013. For all residential properties the valuation is made using the methods of comparable sales. Because of the number of properties to be valued (about 7.5 million residential properties and 1 million non residential properties each year) techniques for mass appraisal are used with computerized valuation models. For non-residential properties the valuation is based on income approach (using information on market rents) or cost approach (base on actual investment in building project of coarse taking into account depreciation for older properties).

The WOZ-value is important because it is the basis for a number of taxes in the Netherlands. The municipalities levy a real estate tax. For residential property the owner pays around 0,1 to 0,2 % of the assessed value as a yearly tax to the municipality. The rates for non-residential properties are mostly higher and for non-residential properties the user of the property pays tax as well (the owner occupier of non residential properties pay twice). But the municipality can also levy other taxes based on the WOZ-value, for instance a sewer tax). Polderboards in the Netherlands (other type of local government in the Netherlands that take care for 'dry feet' even when a large part of the country is below sealevel) also levy a property tax from the owner of the property as a percentage of the assessed value. On national level the central revenue office uses the WOZ-value for levying income tax, inheritance tax, corporation tax and more.

The municipality is responsible for the valuation and this is checked at national level by the Council for Real Estate Assessment (in Dutch: 'Waarderingskamer'). The municipalities (in 2014 403 municipalities) often use the services of companies to perform the actual valuation or cooperate to be able to have highly specialized staff for the work. A large part of the work is collecting and updating the data for the valuation models. For collecting and updating data we distinguish:

- Market data. Municipalities get all sales prices out of the national key-register for cadastral information. Municipalities collect themselves information about properties on the market (internet advertisements) on rent prices for commercial properties like offices and shops and building costs of specific properties like schools, hospitals and industrial sites.

- The legal (and planning) status of the involved properties or in LADM terminology: the RRRs. The municipality finds the legal information in the key-register for cadastral information, but because of the regulation in the Act for Real Estate Assessment primarily information about the owner of the property is important. Planning information is derived from the municipal zoning maps.

- Object characteristics. Most of the information on type, and size of properties, building years, quality of materials, quality of facilities within the building, maintenance condition etc. is collected and updated specifically for the valuation and assessment. Use and updating information on building year and size of property is often done in connection with the key register on buildings (also a municipal responsibility) and the key register for large scale base maps. Collecting and updating information is mostly not done directly in the field, but is done in the office using recent (yearly) aerial photographs and street view type of images (cyclorama's). The information in the pictures is transferred into administrative object characteristics as type of building or grade for maintenance condition, because only these administrative object characteristics can be used in the automated valuation models.

For change detection automated techniques are used for comparing aerial photographs for consecutive year or comparing aerial photographs with existing digital maps. In practice nowadays there is

only limited direct use of 2D geometries, mostly because size of property and type of building can not be derived from these 2D models. However there is an intensive use of 2D aerial photographs enriched with streetview images. One can imagine that semantically rich 3D models in which the surface of buildings is shown with picture images, will not only help to automatically detect comparable building (at comparable locations), but also help the appraiser updating object characteristics for the valuation models.

Applicability of 3D Building Models and 3D Cadastres

Combining the appraisal with 2D or 3D geometry also can help to convince the owner of the property that the municipality has made a reliable assessed WOZ-value for his property base on accurate object characteristics. In the near future, the WOZ-values for residential properties must be publically available in context of a fair and transparent government. A web-based WOZ-viewer will be introduced, not only showing the value of a single property, but also the values of the surrounding properties. In the first phase this will be presented using 2D geometries (user can choose between map or aerial photographs). But in case of apartment complexes and some other configurations it can be hard to select a property within a 2D geometry and 3D geometries may be needed.

Analysis

From the above valuation cases we learn that current valuation practice are primarily using administrative data for the valuation models. Models that use 2D or 3D geometries directly for valuations are not yet implemented in practice. However 2D and 3D models are becoming more and more important for updating the information within the valuation models and for presenting valuation results with the underlying data to for instance the owners of properties.

It can be expected that when 3D geometries are available and can object based be combined with object characteristics a growing number of systems for computer assisted mass appraisal will get

possibilities to use these characteristics in conjunction with the geometric data on size, location and comparability.

Improve valuation possibilities in the future

With the realistic expectation that in the near future up-to-date and semantically rich 3D building models and 3D cadastres will be realized and data accessible via SDI, the future valuation may become significantly more efficient and flexible. The effect of this would differ by country, since some valuation/assessment procedures are more resource consuming than others. On the efficiency side, a uniform (file/database) data source and automated analysis should clearly offer improvements, compared to currently usually manual information aggregation and personal judgment, often "in the field".

Also, it is not clear that assessment would necessarily be solely based on measures or proxies of market value. There already are many exemptions, separate assessments of land and improvements, assessment ratios and tax rates that differ by locale, type, and use, all of which expressly deviate from property tax being proportional to value. Sometimes income generating ability of either property or owner are taken into account, sometimes not. A retired owner of a (historic) castle may be more successful pleading for property tax exemption than the retired owner of merely an above-average house. Clearly, there is an interest in taking parameters into account that are unrelated to value, but clearly can be modeled in 3D building models or cadastres. Uniform handling and implementation of such factors is not only fair, but also allows the government to more effectively achieve the intended policy goals (of either favoring or disincentivizing various concepts).

New 3D representations should be investigated as well. Typically buildings are represented by BIM, e.g. Industrial Foundation Classes (IFC) (MSG, 2007)) or CityGML. The two standards have different concepts, i.e. they represented the building structure from two distinct views: the constructor (IFC) and the user
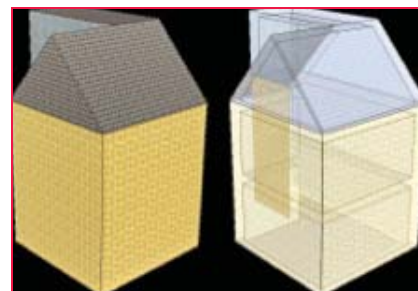
Figure 2: CityGML LOD2 and CityGML LOD+

(CityGML) view. Which model is more appropriate to be used for property tax is further to be studied in detail. IFC models provide many details but are still not that commonly used. In contrast, CityGML LOD1 and LOD2 exist for many cities all over the world. LOD1 and LOD2 however represent only the outer shell of the building and have no interior information. Ongoing research suggests that outdoor LODs can be automatically enriched with interior information.

Boeters 2013 has shown in this research that LOD2 can be extended with information about floors and thickness of the walls and slabs. The research was performed on request of the Municipality of Rotterdam, the Netherlands. The goal was to compute the internal net area (i.e. the area that can effectively be used), which is used amongst others also for taxation. The Dutch standard NEN 2580:2007 (NEN 2580, 2007) and later BAG (Fuld, 2007) provide guidance how to compute the net internal area. The two documents differ in some of the specifications, but these differences have been not properly reflected in the registration of internal net area. To check these values for the entire city of Rotterdam, CityGML LOD2 models were extended automatically to LOD2+ (LOD2 + interior floors). LOD2+ was reconstructed with knowledge about number of floors (from BAG) and assumptions on the thickness of walls and floors (related to the year of construction). Figure 2 shows the original LOD2 and the extended LOD2+. The applied approach was tested for one neighborhood in the City of Rotterdam. Although the approach is not very accurate (due to many assumptions and lack of information), the comparison between the computed LOD2+ and the registered net internal area, have shown interesting results. For the majority

of the buildings the net internal area was smaller than the registered values available in BAG (73.4 %). The net internal area from the LoD2+ model was 16% smaller than that registered in BAG. Further investigations of the results, have clarified that the most of the differences come from the area under the gable roofs. According to BAG, areas with a roof less than 1,5m have to be subtracted from the net internal area (Boeters 2013).

This research has clearly shown that 3D representations can support mass computation of net area and consequently facilitate taxations of properties. The representations should not necessarily be very detailed, which allows for uniform automatic approaches.

One might argue that 3D building models and cadastres for property tax excel at taking objective factors into account, but devalue the art of personal judgment. This is not necessarily true, since subjective factors or offsets could easily be modeled (though they may reduce automation). But one might also object that factors that can be formalized may ultimately enjoy higher legitimacy, anyway.

Conclusion

Despite the fact that analyzed valuation cases in the selected countries are primarily using administrative data for the valuation models, it was argued in this paper that models that use 2D or 3D geometries directly for valuations would have some significant benefits. However, for fair annual valuations, it is clear that the used models and data need to be up-to-date.

There is the debatable question of who should be allowed to update authoritative 3D building models and cadastres, based on which processes, and yielding which level of accuracy or reliability. Who should pay for it? Would volunteered data sets be included? Digital signatures authenticating each update may be useful. But in general we can say that in the future, owners of property, but in general "the crowd" will play a greater role in keeping information up to date and this can also help updating functional 3D data systems.

It might also be possible to assign levels of confidence, for each update. Any automated assessment analysis on top of such data may be able to derive an overall level of confidence for the resulting assessment. Prior to changing the formula to derive property taxes, officials could first query, what level of confidence is currently assigned to the existing data the new formula would be based on. Instant and virtually cost-free analysis of feasibility can presumably only benefit policy decisions.

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Importance of international standards on ethics

The paper explores the opportunities and very real benefits that could be afforded not only to professionals working in land, property and construction but also to clients, the public and society more generally by the setting, promotion and monitoring of international standards on ethics

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> Acting ethically should be part and parcel of being a professional – a defining characteristic – a key component in the package of standards that professionals should meet

Trust and reputation

Trust lies at the heart of any relationship and certainly at the heart of any business relationship. It flows from concepts such as 'my word is my bond' and 'you reap what you sow'. It is also said that trust is hard won but very easily lost and then very hard to recover.

There continue to be instances where trust has been lost regarding businesses or indeed sectors, for example, the global banking crisis, the press and the unauthorised use of personal information by governments to name but a few.

Trust can also be measured – it isn't just a philosophical concept. There are a number of research and survey tools used globally that look at the public's view on trust of countries, organisations, professions and individual professionals. For example:

- the Edelman Trust Barometer – which explores four factors that influence trust in business – industry/sector, country of origin, enterprise type and leadership. – in the 2014 findings – it was found that only one if four general public respondents to the survey trust business leaders to correct issues and even fewer – one in five – to tell the truth and make ethical and moral decisions.
- The Ipsos MORI Trust Poll. This poll based in the United Kingdom (UK) asks people for the views on whether they trust a range of people in different professions or backgrounds, for example, doctors, teachers, police, civil servants, business leaders, politicians and bankers etc. Doctors rate as the highest in terms of being trusted to tell the truth with 89% of respondents rating them as trustworthy, the police register with 65%, the ordinary man/woman in the street at 64%, estate agents are at 24%, bankers and journalists at 21% and politicians generally at 18%.

Inevitably, things from time to time do go wrong and all businesses may face crisis. The key is how the business then reacts and what it does next. There are examples of companies who try and hide what has happened. The classic example is the case of Enron, and the way the Executives tried to hide losses and continue to position the company in a much better financial light than it actually was. Equally, there are examples of where companies have tried to put right what has gone wrong.

In the Institute of Business Ethics 'Occasional Paper 5 – The Recovery of Trust: Case studies of organisational failures and trust repairs' - highlights a number of case studies to show how trust can be re-built. The case of Mattel's multiple product recall in 2007 highlighted how quickly a problem in the supply chain can become such an issue that it threatens the reputation of a company. The issue was over some products contained high levels of lead-tainted paint, which posed a serious health risk to children. The manner in which Mattel reacted was critical. The day Mattel was alerted to the problem it ceased production of the toys affected, promised full cooperation with the national regulatory authorities and initiated a thorough investigation. Once Mattel had enough data they launched a massive global recall. Mattel used its

code of ethics as the blueprint for dealing with the problem. They also issued communications to their staff reasserting the company's commitment to integrity and external openness also prevented accusations of a 'cover up' or negative and speculative press coverage. Mattel then began inspecting every potentially affected toy themselves. In doing so, the company claimed to have prevented two thirds of the toys reaching consumers, as well as showcasing a significant investment in its benevolence and integrity. Mattel issued a full apology to its customers. By the end of 2007, Mattel had recalled more than 20 million toys from 43 international markets. Costs were estimated at $40m, and the stock price fell 30% in five months by December 2007. However, the recall crisis seems not to have damaged their corporate reputation. Sales for 2007 finished 6% up, and a poll of American consumers found that 75% approved of Mattel's response to the failure.

Another interesting case is that of Siemens, when in 2006 regulatory investigations revealed that hundreds of employees had been siphoning off millions of Euros into false non-existent consultant's contracts, false bills and shell firms, in order to pay bribes to win contracts. The scandal shamed Siemens, not just with stakeholders and investors but also the German public and it brought humiliation to thousands of its employees. Yet Siemens' belated full response to the scandal has been widely praised by many independent anti-corruption and ethics experts. Initially Siemens played down the extent of the problem and senior Executives made public pledges to restore the firm's battered reputation just a month later. Many viewed this approach as incompetent.

However, Siemens then took a number of steps. As well as a number of international investigations going on, Siemens announced their own investigation – which was undertaken by New York law firm Debevoise & Plimpton. The firm took a rigorous approach and it was not until the following year that the most serious revelations came to light. The CEO and Chairman left the company and the newly appointed CEO announced a month long amnesty for employees to come forward. Forty whistleblowers came forward. The Board also appointed Michael Hersham, co-founder of Transparency International to serve as an adviser. Under his guidance, Siemens rolled out a set of strict rules and processes on anti-corruption and compliance across the business. They hired 500 full time compliance officers and their new investigations unit was led by a former Interpol official. Training was also put in place on anti-corruption for employees.

Overall, the scandal cost Siemens 2.5 bn Euros, as well as the costs of an exhaustive analysis of its financial transactions, bail payments for indicted executives and fees of around 63 m Euros to outside advisers. The firm was also barred from dealing with certain clients. The cost to employees of two long years of shame under intense and hostile public scrutiny, especially in Germany, is harder to calculate.

Why standards are important

Professional bodies, trade associations and businesses attach a lot of importance and weight to setting standards that their members or employees are required to meet. This makes absolute sense, if we take a profession, there will be many thousands of individual professionals often working in in many different countries; common sets of standards are essential to ensure consistency in how the profession acts and the safeguards that are implicit and explicit for the protection of clients and the public.

For professionals it is important to outline exactly what we mean by standards. It is really a package of standards that we are talking about, this includes:
- entry standards;
- technical standards;
- regulatory standards; and
- ethical standards.

The first set clearly have to be met in order to gain entry to the profession, the second two are about 'what you have to do' in order to comply with being a professional, however, the final set requires a different question to be asked. The question is not 'what must I do' but 'what is the right thing to do'. When considering this package as a whole, it is very powerful and acts to safeguard against professionals complying with the letter of the standards and moves the actions and behaviours into complying with the spirit of the standard.

Or to put it another way, professionals need to be able to meet each of the standards at the same time, the standards are not there to be 'cherry picked' at particular times or situations. Professionals can't follow some of the standards and not others. Indeed the strength of the package of standards is just that; they must be met as a whole. There is no point being the most technically brilliant professional within your profession if you act in an unethical way, similarly, there is no point being the most ethical professional within your profession if you are not technically competent. Either way they are a risk to your client, the public and the profession as a whole.

The other important component in all of this is regulation or quality assurance of the standards. Clearly it is not enough just to have standards in place, what are the checks and balances that sit behind those standards, how do you show that professionals live up to those standards, that clients and the public are protected when things go wrong and standards are not met.

Ethical standards

One of the key things about ethical standards is that they set the right tone as it where, with regard to the right way to behave, irrespective of external circumstances or factors such as commercial pressure, boom or good times, times of austerity or collective culpability – 'it is ok everyone else is doing it'. As well as having regulation behind ethical standards to help encourage professionals to act ethically; it is also essential that there is supporting information in place to help professionals maintain the ethical standards and are

supported in an appropriate way if they need to raise concerns, speak up or even whistle blow. Many professional bodies have provided conceptual frameworks for this purpose, for example, the conceptual framework at the Royal Institution of Chartered Surveyors (RICS) can be found at: www.rics.org/ethics . This conceptual framework includes definitions around the ethical standards, examples of the kinds of behaviours or actions that would help to demonstrate meeting the standards, questions that individual members could ask themselves, specific guidance around issues like conflicts of interest and speaking up, a decision tree, case studies and there is a confidential helpline that members can use.

Ethical standards at RICS are regarded as so central to what RICS members are about and stand for that RICS' International Governing Council made it a requirement on all practicing members to keep up to date on the ethical standards on an on-going basis, essentially on a rolling three year cycle. RICS has provided all members with access to a free e-learning course around ethics and the ethical standards which has been translated into nine languages, as an option to meet this requirement. Again providing this information and using these approaches can help to embed the ethical standards with members.

International ethical standards

So ethical standards play a key part in the whole standards and behavior debate and encouraging many professional bodies and trade associations have ethical standards and to a greater or lesser extent supporting information for their members.

This is interesting when it comes to consider the idea that RICS and other organisations are jointly looking at in terms of building international standards across land, property and construction, in particular, the work on valuation and property measurement. International standards on valuation have existed for some time and a number of organisations have signed up to those standards through

Doing business ethically, is actually good for business in lots of ways

the International Valuation Standards Council. The property measurement coalition of organisations came together last year at an initial meeting held at the World Bank in Washington. At that meeting the coalition signed a declaration to agree to develop international property measurement standards and to sign up to those standards on behalf of their organisations and their members.

This approach is incredibly powerful – a coalition of organisations, representing many tens of thousands of members globally – all agreeing a shared set of standards. This not only helps to raise standards and enhance client and public protection but also provides consistency in approach that is good for business. A consistent method of valuing property globally coupled with a consistent method of measuring properties globally can only be a good thing.

Work is now underway to begin to bring together a coalition to look at building international standards on ethics. This is an important piece of the jigsaw and again obtaining the agreement of a range of organisations to sign up to and embed ethical standards is very powerful. So valuations are undertaken in an appropriate way and properties are measured in an appropriate way and with international standards on ethics all professionals will do the work in an ethical way.

In many ways, ethical standards lend themselves well to being developed as high level or principles based standards for the purposes of international standards. Indeed, this has already been put in place for the world of accountancy. Through the International Federation of Accountants (IFAC) and the International Ethics Standards Board for Accountants (IESBA), high level international ethical standards have been set for accountants

globally. These standards have gone through a whole consultation exercise globally with interested stakeholders from business, governments and of course accountancy professional bodies and trade associations. The accountancy professional bodies and regulators follow the standards and require their members to do so as well. So the precedent has already been set in one profession globally.

There is a great opportunity here to do the same across land, property and construction. However, there is potentially an even greater prize that can be achieved. Ethical standards are not technical in nature and can potentially work across a whole range of professions or be applicable to a whole range of professionals, not just in land, property and construction but much wider, such as engineers, architects, builders, others involved in the business transactions of land, for example, lawyers, accountants, financial institutions, financiers and company secretaries to name a few. So whilst the initial focus of the coalition work on ethics will be ethical standards for professionals working in land, property and construction; the possible next stage of that work may be towards building international ethical standards that can be applicable across a whole range of professions. Think how powerful that would be if you had whole professions signing up to one set of ethical standards globally. This would help to bring consistency and high standards, especially when backed up by regulation or quality assurance, to business, clients, the public and other stakeholders globally.

Ethical regulation

The importance of quality assurance or regulation has already been mentioned in this paper. It is worth exploring the tenants of what 'good regulation' or 'ethical regulation' looks like. Regulation evolves and can change in focus at different times. For example, good regulation in the past has been focused around 'lighter touch regulation' (in an attempt to place appropriate burdens and costs on business), and there have been calls

for more effective regulation (in light of concerns about failures in regulation, for example, in the financial sector).

To be effective and ethical regulators need to not only meet the principles of better regulation but also go further. The principles of better regulation are:

- proportionate – regulation being introduced where its aims are clear and focus is on the problem or risk identification;
- targeted – regulators should focus their resource according to an assessment of the risks;
- transparent – regulators should be open though taking account of legal requirements around data protection etc;
- be accountable – regulators should be prepared to justify their decisions and be open to public scrutiny;
- be consistent – a lack of consistency will lead to a lack of trust in the regulator.

However, as Sir Christopher Kelly in his report 'Standards matter – A review of best practice in promoting good behavior in public life' highlights there are other considerations that also need to be looked at, for example:

- pay attention to public opinion – to help judge what standards of behavior are appropriate. However, regulators will need to be prepared to go against public opinion where that is justified but explaining why;
- communicate – with those that they regulating but also the general public and other stakeholders about the standards they are promoting and why they are important;
- be willing to use their discretion – to refuse to investigate trivial matters;
- achieve clarity about what falls within their responsibility – and what does not;
- have a range of appropriate and timely sanctions at their disposal – an effective disciplinary toolkit; and
- be robustly independent – of those they regulate.

So, as well as the importance of standards and the interplay between entry, technical, regulatory and ethical standards the other fundamental aspect is the quality assurance or regulation against those standards. This combination goes to the heart of protecting clients and the public but also has major benefits for the professionals and other stakeholders as well. Helping to raise standards, improve behaviours and knowledge of professionals can only be a good thing.

Embedding international ethical standards

Whilst the idea of trying to embed ethical standards across a range of organisations within land, property and construction and also across other professions may seem like a mammoth task, in reality, it is no different to say the RICS introducing and embedding ethical standards amongst its members – yes there are challenges but the building blocks to help meet those challenges are the same. For example, providing the conceptual framework, including information defining the standards, examples of the behaviours that will go to demonstrate the standards, further information around the main ethical issues professionals will come across, for example, conflicts of interest, speaking up or whistle blowing, promoting trust in the profession, acting in the best interest of your client but also the wider public advantage, decision trees, case studies and help lines. A key element is placing a requirement on professionals to keep up to date on ethics as part of their CPD obligations. The final piece in the puzzle is the checks and balances of regulation to ensure that the standards are followed.

The business case for ethics

Clearly, behaving ethically goes to the heart of what being a professional is about and so acting ethically is the right thing to do irrespective of whether it is good for business or not. However, there is good news – it may go without having to be said but acting ethically is good for business. There is hard data to show this link as well. For example, the work undertaken by the Institute of Business Ethics (IBE) – Does Business Ethics Pay? – Ethics and financial performance, and Does Business Ethics Pay? - Revisited – the value of ethics training.

In the initial research the IBE looked at a group of companies quoted in the FTSE 350 index at 31 December 2001. In broad terms the research showed that:

- there is a strong positive association between having a code of ethics, addressing non-financial risk effectively and being amongst Britain's most admired companies;
- 19 of the 24 companies that have consistently been in Management Today's previous tables of Britain's Most Admired Companies have codes of ethics; and
- between 1997 and 2001, there was strong indicative evidence that large UK companies with codes of ethics produced an above average performance when measured against a similar group without codes. Those companies with codes out performed those without codes in three of the four measures of financial performance used in the study – Market Value Added (MVA), Economic Value Added (EVA) and Price/Earnings Ratio. The fourth measure – Return on Capital Employed indicator showed less difference between the two samples.

The IBE update report – Does Business Ethics Pay? – Revisited looked again at companies in the UK within the FTSE 350 and used accounting ratios to reflect actual historic performance (Return on Capital Employed and return on Assets), and market measures to reflect market perceptions of the companies and are more forward looking (Total return and Market Value Added). The updated research also looked at how companies performed and split the research into companies that merely reveal their ethical codes – Corporate Revealed Ethics (CRE) and companies who embed their ethical policies into their organisations - Corporate Applied Ethics (CAE). The results, in broad terms, showed that:

- companies with CRE underperformed

when compared to those with CAE for all of the financial performance measures used; and

- there is a more positive relationship between training in business ethics (applied ethics) and financial performance compared to having no training.

Interestingly, the researchers in the Revisited research look at 80 listed previous related studies looking at the impact and relationship of ethics and corporate social responsibility measures on financial results. The results were that:

- 38 studies showed a positive relationship;
- 18 studies showed no significant relationship;
- 7 studies showed a negative relationship; and
- 17 studies showed a mixed relationship.

Conclusion

Acting ethically should be part and parcel of being a professional – a defining characteristic – a key component in the package of standards that professionals should meet. Professionals should act ethically because it is the right thing to do. Professional bodies, trade associations and other organisations such as business attach a lot of importance to having in place ethical standards that their members or employees follow. We have discussed the importance of not just setting ethical standards but also embedding those standards into what members or employees do on a day to day basis. Conceptual frameworks, helplines, training and regulation can all help to embed ethical standards.

The good news is that acting ethically, doing business ethically, is actually good for business in lots of ways. Acting ethically helps to build the reputation of individuals, firms, professions; it attracts people to want to work for ethical organisation or become a member of a profession that is seen as having high ethical standards, it improves employee and member retention; and, of course, research has shown that it is good for the financial performance of companies and organisations.

It is also good for client and public protection - the expectation or assurance that professionals will act ethically. This is enhanced with matters like training and regulation – or applied ethics as opposed to revealed ethics. There is a good opportunity here to bring together professional bodies, trade associations and other organisations to look at having consistency in terms of ethical standards globally; to sign up to those standards and help embed them for the benefit of their members but also clients, the general public and other stakeholders. The question is how far can this go? Certainly the aim should be to work this across land, property and construction but what about across a much broader range of professions.

The paper was presented at FIG Congress 2014, Kuala Lumpur, Malaysia, 16-21 June 2014.

The geo industry is ready for a networked world

INTERGEO 2014, 7 – 9 October 2014, Berlin, Geermany

INTERGEO 2014 in Berlin has clearly demonstrated that the industry really has secured its place in the digital, networked world. Geoinformation has evolved from a specialist niche and is becoming part of mainstream IT. The trade show focuses on products and applications in a digital world. The geoinformation industry is being, and will continue to be, shaped by applications that address important social issues. INTERGEO reflects these issues.

"Our thanks go to Google, for all the attention that geo applications have gained since the launch of Google Earth." This is how one INTERGEO exhibitor summed up the current market dynamic in the innovative geoinformation sector. Technology leads to applications and complex data streams yield crucial information – this puts the geoinformation industry at the heart of important social developments in a digital world.

INTERGEO – a growing forum for dialogue and the industry

This trend is reflected at INTERGEO in increasing internationalisation and rising exhibitor and visitor numbers. A brief look at the figures shows an increase of around ten percent in overall visitor attendance (over 17,000 in 2014) and in the number of visitors from outside Germany (around 35 percent of the total). More than 45 percent of visitors said that they were responsible for or involved in decision-making processes. According to the results of the visitor survey that are now available, the most popular topic with visitors this year was GIS software, followed by surveying equipment and integrated surveying solutions. This year's conference attracted some 1.400 delegates.

> It was demonstrated that geoinformation is increasingly finding its way into areas of major social importance, including e-government, digital administration and security

Dr Karl-Friedrich Thöne, INTERGEO organiser and President of the DVW (German Society for Geodesy, Geoinformation and Land Management) sums up the success of the event: "The numbers prove that our trade fair and conference addressed the right subjects. Full rooms and a great atmosphere in the exhibition halls and conference rooms are in my opinion the best indication that the 20th INTERGEO is on the right track."

Olaf Freier from the organisers, HINTE GmbH, adds: "Once again, INTERGEO brought together the big international players in the geo community. As an industry forum, INTERGEO is ideally placed to meet the need for knowledge-sharing and orientation in the complex field of data capture and data use. In 2015, we will be building on and expanding our position as the largest UAV forum in the German-speaking world."

Added value from public data

Spearheaded by Germany's Ministry of the Interior and Ministry of the Environment, the third national INSPIRE Conference was also a great success. Here, too, it was demonstrated that geoinformation is increasingly finding its way into areas of major social importance, including e-government, digital administration, security and disaster protection. In her keynote speech, German Federal Environment Minister Dr. Barbara Hendricks clearly expressed her support for open data. She said that the federal government had adopted a guiding principle of releasing publically obtained data into the value-added chain. "The public should not have to pay for the same thing twice," Dr. Barbara Hendricks said.

The event, organised by the GeoBusiness Commission (GIW Kommission), also focused on the "market activation of public geoinformation". Parliamentary State Secretary Brigitte Zypries made an urgent appeal for coordinated collaboration: "Cooperation and coordination are key to developing the geoinformation industry. This applies equally to federal government, regional administrations and industry."

Positive image of INTERGEO boosts recruitment campaign

Attracting up-and-coming talent is still essential to keeping the market dynamic. In this respect, INTERGEO has clearly proved itself as an international careers forum. The international student meeting, JobSHAKER and targeted campaigns by associations and companies have taken effect. In the words of DVW President Thöne: "The number of students in Germany and Austria studying geodesy and geoinformation is rising significantly!" As the leading trade fair and conference for geodesy, geoinformation and land management, INTERGEO conveys the positive image of a high-tech industry, which is crucial when seeking to encourage the next generation into this future-oriented sector.

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► Austech Surveying and Mapping starts operations in Australia

► Russia's Mail.ru acquires OpenStreetMap-powered Maps.me

► Pix4D offers autonomous mapping with DJI Phantom

► Nigeria uses GIS to study ICT gap clusters

► Consumer LBS market to grow at CAGR 37% through 2018

► Altavian awarded $4 million contract by US Army

U.S. warns EU against making Galileo mandatory

The U.S. government has alerted the European Union that any preferential treatment the EU gives to its Galileo positioning, navigation and timing network will likely violate World Trade Organization (WTO) agreements signed by the United States and the 28-nation EU.

In particular, U.S. government officials voiced concerns that the EU is weighing equipment mandates for aviation, car-accident reporting and emergency-call regulations that could unfairly tip the scales in favor of Galileo to the detriment of U.S. GPS-enabled hardware.

A senior GPS official recently said the US and the EU have signed a wide body of satellite navigation agreements designed to promote open market access and interoperability.

These protocols include the WTO's Agreement on Technical Barriers to Trade, which prohibits discrimination among goods based on nontariff measures including regulations and certification procedures. *www.spacenews.com*

Innovative hail suppression project awarded

The University Challenge is one of the highlights of the annual European Satellite Navigation Competition (ESNC). In 2014, the University of Applied Sciences Rosenheim (Germany) won over the international expert jury with its hail suppression project RO-BERTA.

Hail Navigator is a novel system designed to reduce damage caused by hail. Based on the premise of suppressing the formation of hail by injecting silver iodide into clouds, Hail Navigator combines navigation with a precipitation reporting system that can guide pilots to optimal locations for hail suppression missions. The system is complemented by weather observations (including precise times and locations) reported by local citizens via a smartphone app, which aids the validation of weather prediction models. These

models constitute an important factor in deciding whether a hail suppression flight is necessary. *www.uni.esnc.eu*

Ehancing search & rescue service using GNSS

Cospas–Sarsat's extension to MEOSAR (Medium Earth Orbit Search and Rescue) will extend its search and rescue coverage on the ground the Galileo programme is contributing a Toulouse-based test bench, and a networked trio of MEOSAR ground stations – known as Local User Terminals (LUTs) – to cover Europe, based in Svalbard in the Norwegian Arctic, Cyprus and the Canary Islands. Existing LUTs are distributed on a per country basis, but it is an advantage of MEOSAR that fewer ground stations will be needed for greater coverage.

The European Space Agency (ESA) has announced completion of tests that indicate the readiness of the European component of a modernized, GNSS satellite–aided search and rescue service known as Cospas-Sarsat.

Cospas–Sarsat is a global satellite system for rapidly detecting distress calls to be forwarded to local search and rescue authorities.

Topcon engineers track new GLONASS signal

Topcon Positioning Groups latest GNSS reference receiver has tracked a new signal from the GLONASS constellation. The GLONASS-M 55 satellite was launched in June and is equipped with an experimental payload capable of transmitting CDMA signals in the Russian GNSS system's L3 frequency band centered at 1202.025 MHz. Topcon engineers successfully tracked the signal using the NET-G5 receiver during a series of recent tests at the Topcon Technology Center in Moscow, Russia.

Russia to place GLONASS monitoring stations in China

The Russian Space Systems company shall deploy several GLONASS satellite navigation system monitoring

Rachapudi Kamakshi Memorial Gold Medal for

'Young Geospatial Scientist™ 2014'

To encourage young scientists, **Rachapudi Kamakshi Memorial Gold Medal for 'Young Geospatial Scientist™'** has been instituted by **Rachapudi Kamakshi Memorial Trust.** The award consists of a **Gold Medal, Certificate of Merit** and a **Citation Plaque** The award will be presented to the selected young researcher during the annual India Geospatial Forum, 10-12 February 2015 at Hyderabad.

Criteria for selection

Basic criteria for the award will be the research work carried out in the field of geosaptial science and technologies with innovativeness and appropriate use of scientific methodology, backed with quality write-up, social relevance and commercial acceptability of the idea and the adequate usage of geospatial technology.

Selection process

An eminent panel of jury will evaluate the nominations and interact with the nominees, if required, before selecting the awardee.

Nominations

Nominations are invited from scientists, engaged in research work in any of the areas related to Geospatial Information Science and Technology, who is not more than 35 years of age, as reckoned on 31 December 2014.

Nominations for the award should clearly state the scientific contribution supported by relevant documents. Self nominations are permitted.

The nominations are required to be submitted to Dr Hrishikesh P Samant, Associate Professor & Head, Department of Geology, St. Xavier's College, (Autonomous) Mumbai - 400 001 and also by email at hrishikesh.samant@xaviers.edu

Past awardees

2013

Mr Rishikesh Bharti, Indian Institute of Technology Bombay, receiving the 2013 award from Mr Suresh Prabhu, former Union Minister

2012

Ms Farjana Sikander Birajdar, receiving the 2012 award from Dr Shailesh Nayak, Secretary, Department of Earth Sciences, Government of India.

2011

Dr M B Rajani receiving the 2011 award from Shri M Shashidhar Reddy, Hon'ble Vice Chairman, National Disaster Management Authority

Ms Thiyam Tamphasana Devi, Indian Institute of Technology Guwahati, receiving the 2010 award from Shri Narendra Modi, Chief Minister of Gujarat

2010

The last date for receipt of the nominations is December 31, 2014

For more information visit: http://www.rachapudikamakshi.org/

stations in China for use in transport, farming, rescue operations, environment monitoring and law enforcement. The facilities may be placed in Urumqi (the administrative center of the Xinjiang-Uygur Autonomous Area) and Changchun, the capital of Jilin province. RSS and Chinese partners would cooperate in the mutual placement of positioning ground stations in Russia and China for GLONASS and China's Beidou. *http://itar-tass.com/en/*

UK eLoran now in operation to back up GPS

Technology to counter the threat of GNSS jamming is now available at Dover and along the east coast of the United Kingdom as the island nation continues to implement an enhanced Loran (eLoran) system that is setting an example for the world.

The General Lighthouse Authorities (GLAs) of the UK and Ireland has announced on October 31, 2014 the initial operational capability of UK maritime eLoran. Seven differential reference stations are now in operation to provide additional position, navigation, and timing (PNT) information to ships fitted with eLoran receivers, ensuring their safe navigate in the event of GPS failure in one of the busiest shipping regions in the world, which 200,000 vessels are expected to cross every year by 2020, according to the GLAs.

8th GPS IIF satellite launches successfully

The eighth GPS Block IIF navigation satellite launched successfully on October 29, 2014 at 1:21 p.m. EDT from Cape Canaveral Air Force Station, Florida, on board United Launch Alliance (ULA) Atlas V rocket.

Once its reaches orbit — slot 1 in the constellation's E plane — GPS IIF-8 (designated PRN03 for its pseudorandom noise code 03 will take the place of a 14-year-old GPS IIR the GPS IIR-4 satellite, which will go into reserve status in the A plane.

China's Antarctica satellite base plans spark concerns

China has disclosed plans to install a satellite facility in Antarctica, heightening concerns about militarisation of the "peaceful" continent. The Chinese Antarctic Research Expedition will build a base for the BeiDou satellite navigation system this summer, the official Xinhua news agency said. This comes as China escalates its Antarctic involvement, building its fifth station, planning an airstrip, and recently blocking marine reserves that could affect fisheries.

The Chinese icebreaker Xue Long is due to arrive in Hobart, Australia, coinciding with a post-G20 visit next week by President Xi Jinping, as Tasmania pitches for Antarctic business. *www.stuff.co.nz/*

GNSS market in Asia region exhibiting tremendous growth

According to the report "GNSS Market Outlook 2020", global GNSS market is exhibiting a tremendous growth on the back of ongoing technological advances and rising number of potential commercial and consumer applications. Moreover, with increasing availability of GNSS enabled devices and their continuously declining prices, the GNSS market growth is likely to be on fast track. With this, the GNSS market is anticipated to grow at a CAGR of more than 9% during 2014-2020.

Latest trends in Global and Chinese GNSS system industry

A new market research report by WhaTech examines the global and Chinese GNSS industry, covering the decade 2009-2019. The report "Discover latest trends in Global and Chinese GNSS system industry, 2009-2019" analyzes quantitatively the global and Chinese GNSS market of 2009-2014 by calculating the main economic parameters of each company. The data is broken down by company, country, and application. The report also estimates future market development in the coming period of 2014-2019. ◥

TomTom brings navigation technology to Acer smartphones

TomTom's NavKit has revealed a multi-year deal with Acer to bring its navigation technology to new Acer smartphones. "AcerNAV" is a turn-by-turn navigation application powered by TomTom's navigation engine, NavKit. It enables users to navigate anywhere in the world, without extra roaming charges, and the ability to download any TomTom map for free. *www.itnewsafrica.com*

u-blox Launches Indoor/Outdoor Positioning Module with 3D Sensors

u-blox' NEO-M8L module with 3D ADR technology and integrated sensors provides accurate vehicle position regardless of satellite visibility. The new NEO-M8L Automotive Dead Reckoning (ADR) module has integrated motion, direction and elevation sensors. It integrates gyro and accelerometer with ublox' GNSS platform u-blox M8 to achieve high indoor/outdoor positioning performance for road vehicle and high-accuracy navigation applications.

New navigation device by Magellan

The RoadMate RC9496T-LMB from Magellan is a 7-inch Android GPS fleet navigation device. It is fleet ready with a serial port, dash mount, and black-box cable. There is also an HD multi-touch capacitive glass display. The supplemental Magellan Fleet Manager desktop tool enables central office management of bulk software and map updates, route planning and SmartGPS Eco cloud content. *http://fleetowner.com*

Samsung announces location-based alerts service

Samsung has announced its own location-based alerts system, designed to allow businesses to send alerts to smartphones. These highly-localized messages could range from offers on products in the section of the store you are in, to directions to your seat in a stadium or theater. Called Proximity, the service is based on Bluetooth LE beacons and will work in a similar fashion to Apple's iBeacon service. *http://9to5google.com/* ◥

India plans geo-physical and geo-chemical mapping of national resources

4th meeting of Geo-science Advisory Council (GAC) was held under the Chairmanship of Union Steel and Mines Minister and Chairman, GAC Mr. Narendra Singh Tomar in New Delhi.

According to Mr. Tomar said, "India has about 8 lakh square kilometer area identified as Obvious Geological Potential (OGP). However, the geophysical and geochemical mapping has been achieved only to a limited extent. Since the field of mining is directly linked to country's growth, we must develop a time-bound action plan to complete geo-physical and geo-chemical mapping of our national resources and share this data in public domain to attract investment in mining. Emphasis of action plan should be on speed and quality." *http://pib.nic.in/*

Bentley and Trimble Advance BIM through Construction Modeling

Bentley Systems and Trimble have committed to leveraging *construction modeling* for the benefit of capital, industrial, and infrastructure project delivery. Aspects of construction modeling include modeling of temporary works, intelligent positioning, "splitting and sequencing," detailing for fabrication, workface planning, construction work packaging, and support for distributed construction – referencing and supplementing design modeling deliverables. *www.bentley.com*

PM office to oversee mapping agency in Ethiopia

A new draft law submitted to the executive branch is considering the re-establishment of the Ethiopian Mapping Agency (EMA) by altering its accountability from the Ministry of Finance and Economic Development (MoFED) directly to the Office of the Prime Minister.

The agency was originally established in 1954 as the geography and mapping institute of Ethiopia. Since then, it has passed through various organizational setups until its establishment as an autonomous agency of the government of Ethiopia. According to the proclamation, the agency has been responsible for the compilation, preparation, publication, administration and distribution of fundamental geo-information data and reporting it to MoFED. Conducting geodesy, aerial photography, satellite imagery, topographic maps, thematic maps and hydrograph are some of its responsibilities. *www.thereporterethiopia.com*

Telecom department in India wants GIS mapping of telecom towers

Telecom department of India has urged the telecom service operators in the country to put 584,000 telecom towers on GIS, for quick visual analysis to plan, manage and administer strategy that could facilitate necessary incentives. This has been a long standing demand from the Ministry of New and Renewable Energy (MNRE) and the Ministry of Environment.

With GIS mapping, the MNRE wants to gauge energy drawing patterns of telecom service operators so as they can segregate tower sites that have maximum, median and minimum diesel consumption with red, yellow and green symbols. The GIS-based system will help MNRE to effectively track and monitor operators' carbon footprint and additionally, it could assist department to recommend telcos with reduced emission levels for appropriate incentives and rebates. *http://articles.economictimes.indiatimes.com*

GIS set to increase property tax

The Ongole Municipal Corporation in Andhra Pradesh,India will conduct a survey through GIS in all the divisions in the municipal corporation to identify the houses on which additional floors have been constructed with the permission but not paying property tax. The consultancy appointed by the corporation will carry out a survey and submit a report to the municipal corporation. Based on the report, the corporation will issue notices to house owners for collection of property tax dues. *www.deccanchronicle.com* ⊿

Companies hit as DGCA bans use of drones

Several companies have had to stop using **drones** to provide services such as aerial photography after the aviation authority banned the operation of these unmanned vehicles in civilian airspace until regulations are in place.

The decision has set back plans of companies offering a variety of services using drones, including those by online retailer **Amazon**. Mumbai-based **Airpix**, with clients such as **Reliance Energy** and builders Kalpataru and Omkar Realtors, had to stop offering its flagship aerial photography service since the Directorate General of Civil Aviation issued the circular earlier this month.

The DGCA is in the process of formulating regulations and globally harmonising them for certification and operation for use of unmanned aerial systems in Indian civil airspace, the regulator said recently. *http://articles.economictimes.indiatimes.com*

Unmanned exemptions requests pile up at FAA

The number of special requests to fly unmanned aircraft commercially has surpassed 130 as firms search for a way around a federal ban on for-pay flights. The new numbers came to light the same day a court decision underscored regulators' authority to rein in the industry with restrictions unlikely to be lifted until new rules are put in place years from now.

Out of the 130 operators who have filed petitions with the Federal Aviation Administration (FAA) thus far, only seven aerial film companies have been granted exemptions from the current constraints, although "additional companies are expected to be granted exemptions soon.

Transport Canada simplifies UAS rules

During a recent announcement, Transport Canada announced two exemptions that simplify small unmanned aerial vehicle operations in Canadian airspace. Under the new exemptions, commercial use of

UAS will no longer require a special flight operations certificate or SFOC for any UAV under 2kg and certain operations with a UAV under 25kg. The department has also simplified the application process and time it takes to issue SFOCs for larger UAVs. The changes will come into effect soon and operators must check on the Transport Canada website for exemption requirements and safety conditions including maintaining visual line of sight, respecting maximum altitudes and staying clear of built-up areas. *www.auvsi.org*

A drone to detect asbestos

A drone aimed at detecting asbestos in the environment was presented in Rome, by the Italian National Research Council (CNR), along with Aermatica, manufacturer of remotely piloted aircrafts (RPA).

A hyperspectral sensor and a compact camera were integrated into the drone. During the flight the hyperspectral sensor detects the frequencies issued by the surface and identifies the specific one of asbestos, its "signature", the presence and state of deterioration that allow to establish priorities for the removal. Aci Consult organizes the overflight and mapping; the areas involved are indicated by the city Council; Aermatica collects all the data acquired by the drone and delivers it to CNR, which analyses the data and draws up the final report. All this happens with a significant lower cost compared to using aircrafts with crew. The drone is expected to start operations in Rome in the spring of 2015. *www.aermatica.com/*

FAA Official: Small Drone Rule to Be Released by End of Year

According to a Federal Aviation Administration official, after years of waiting, the agency was close to releasing a ruling that would give commercial entities greater access to fly small unmanned aerial system in the domestic airspace. The proposed ruling, which the agency has been working on over the past year, is currently being reviewed by the Office of Management and Budget, Jim Williams, manager of the FAA's UAS integration office. *www.suasnews.com* ◿

Vietnam completes spatial database on sea, islands

This is the initial result of a three-year project to monitor marine and island environmental resources using remote sensing technology which was approved in Hanoi on November 13. According to Nguyen Xuan Lam, head of the National Remote Sensing Department under the Ministry of Natural Resources and the Environment, numerous maritime studies, mapping exercises and geological surveys were conducted previously; however, none were able to give a complete overview of Vietnam's territorial waters, especially Hoang Sa and Truong Sa archipelagos. The application of remote sensing technology, far superior to conventional methods, is therefore a valuable part of research on the country's sea and island environmental resources, and is particularly useful for off-shore and inaccessible areas, Lam said. *http://english.vietnamnet.vn*

Yaogan-24 remote sensing satellite launched by China

China has recently launched a remote sensing satellite into a scheduled orbit from the Jiuquan Satellite Launch Centre in northwest China's Gansu province. The Yaogan-24 satellite was launched via a Long March-2D carrier rocket,

the 199th mission for the Long March rocket family. *http://zeenews.india.com*

Indonesia needs sea remote sensing technology

According to the Institute of National Aviation and Space (Lapan), Indonesia needs space technology of remote sensing that could draw the map of the country`s marine potentials altogether and systematically. The technology could be used to spot ridges of rock and in planning development of the marine potentials for economy and tourism, he cited. *http://www.antarabali.com*

Amazon seeks FAA permission

Amazon has asked the Federal Aviation Administration for permission to test drones outdoors and is awaiting an answer. It asked federal regulators for a limited exemption from the current ban on commercial use of drones. Its legal department assured the FAA that the testing can be done safely. Small, battery powered drones would fly no higher than 400 feet off the ground, remain within line-of-sight of the operator, and have a kill switch if something goes wrong. The application says Amazon's R&D lab in Seattle is "developing aerial vehicles that travel over 50 miles per hour, and will carry five-pound payloads, which cover 86 percent of products sold on Amazon." *www.nwnewsnetwork.org* ◿

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think out of the **box**

MobileMapper 120 and locally developed GIS software win broad market approval in Turkey

The Geomatics Group in Turkey is achieving excellent success marketing the Spectra Precision MobileMapper 120 handheld GIS mapping device running its own Mobile GIS software. Spectra Precision MobileMapper 120 uses a Windows open platform enabling it to run any Windows mobile application, including Spectra Precision applications for GIS or Survey, as well as third-party solutions that may better meet local regulations or specific customer requirements. *www.spectraprecision.com*

Leica Digicat 700 Series locator with integrated GPS

Underground service locators enable workers to locate buried utilities in order to avoid injury and damage during excavation. Following the success of its previous series of locators, Leica Geosystems has extended the range of features in its new Digicat 700 Series, providing users with greater confidence in their results due to enhanced traceability. In addition to data logging, *Bluetooth®* connectivity, depth estimation and tracing frequencies, the 700 Series is the only range of locators that offers fully integrated GPS technology. The added GPS feature helps to deliver the 'where' in locating and tracing buried utilities by easily and conveniently displaying the collected geographical data on a map. *www.leica-geosystems.com*

Directly Georeferenced Mapping From The Topodrone-100

DroneMetrex, a manufacturer of the TopoDrones introduced a revolutionary solution for Directly Georeferenced Mapping from UAVs. The difference and, at the same time, the main advantage of the solution is that it encompasses Post Processed Kinematic (PPK) principles.

An important component of PPK is a highly accurate GPS receiver on board of the TopoDrone hich independently logs the GPS coordinates of the drone for each and every photo position.

The accuracy of the photo position is also directly related to the synchronisation of the camera shutter with the GPS logging. Having that in mind, DroneMetrex specialists modified the internals of the camera and synchronised L1/L2/Glonass/BDS antenna to the nanosecond of the camera shutter to achieve highest mapping accuracy.

Indian state to launch Rs. 4,000-cr satellite imaging project

The Maharashtra Government will soon launch a Rs. 4,000-crore satellite imaging project to map all land in the State and prepare digital records of land holdings. The satellite imaging would include that of land used for agriculture, industry and also urban land. The last comprehensive land mapping exercise was undertaken 150 years ago under British rule. The project would be taken up under a centrally-funded scheme. *www.thehindubusinessline.com*

Titan multispectral airborne lidar sensor by Optech

Optech is pleased to announce the latest addition to its innovative line of airborne laser terrain mappers (ALTM), the Optech Titan, launching a new era in remote sensing. For the first time ever, multispectral active imaging of the environment can occur day or night, enabling new vertical applications and information extraction capabilities for lidar. In the past, single or dual-wavelength sensors were developed for specific market verticals and application requirements. Titan breaks away from this convention by combining three beams with separate wavelengths, increasing the information content that can be derived from the target surface and allowing surveying professionals to address many more applications using a single sensor solution.

NTLab launches GNSS RF Front-End with reduced power consumption

NTLab, a fabless microelectronic company based in Belarus, is offering

SP80 improves accuracy of mobile underground infrastructure locator

InfraRadar, an advanced mobile ground penetrating radar infrastructure locator, developed and manufactured here by GT Frontline, recently switched to the Spectra Precision SP80 GNSS receiver. As company president, Dick van der Roest said, "This was done because you cannot do a good survey without a good position, and the SP80 performs significantly better than competing systems." *www.spectraprecision.com*

Spectra Precision new solution for interior wall layout

Spectra Precision® QML800 QuickMark Layout is a new solution that automates the layout of interior points and walls. The QML800 allows drywall and interior contractors to quickly and efficiently lay out points for interior building construction.

Trimble RTX Technology for Spectra Precision GNSS Receiver

Spectra Precision has announced that its ProMark™ 700 GNSS receiver now supports Trimble® RTX™ (Real-Time eXtended) correction technology. Combining real-time data with innovative positioning and compression algorithms to deliver repeatable centimeter level positions worldwide, It utilizes an established global reference station network along with satellite orbit and clock information to compute high accuracy positions. Using the CenterPoint® RTX correction service, ProMark 700 users can typically obtain real-time 4 centimeter positioning accuracy with less than 30 minutes initialization without the use of a local base station or virtual reference station network. By using QuickStart option, this convergence time can be reduced and full accuracy can be achieved within few minutes only.

the NT1051 dual-channel multi-frequency (L1/L2/L3/L5) mutli-system (GPS/GLONASS/Galileo/BeiDou) RF front end. Manufactured in 0.18 um TSMC BiCMOS technology, it provides operability of the GNSS receiver even if interference power is 120-dB higher than the satellite signal. To allow reliable navigation in the presence of interference, NT1051 has a 1-dB compression point (on RF input) of -40 dBm. This allows stable tracking, even if the interfering signal is 120-dB higher (compared to -160 dB of typical tracking sensitivity) than the satellite signal. *http://gpsworld.com/*

Trimble Leap Submeter GNSS Device and Terrain Navigator Pro

Trimble® Leap is a Trimble RTX compatible GNSS Bluetooth device. When enabled with the ViewPoint RTX correction service, Leap delivers submeter accuracy directly to the Terrain Navigator Pro (TNP) Mobile app for iOS and Android devices. The TNP Mobile app allows users to collect markers, tracks and geo-stamped photos in the field, and then sync all the GNSS data into the Terrain Navigator Pro office software. *www.trimble.com*

iXBlue launches Marins M Series inertial Nav System

iXBlue unveiled its Marins M series inertial navigation system (INS). The series includes the Marins M3, M5 and M7 systems and is designed to address the needs of the world's most advanced navies for surface-vessel and submarine operations close to shore and in open-sea environments. The Marins M series raises the bar in performance and scalability by addressing the needs of surface ship navigation under a GPS-denied environment. For submarines, Marins M7 enables three times longer autonomous stealth navigation compared with any available system by offering drifts of less than 1 Nm/72 h.

OriginGPS launches Nano Spider GPS receiver

OriginGPS has launched Nano Spider GPS receiver. It breaks the size barrier to provide real-time positioning data

for ultra-compact applications with a 47% footprint; measuring 4x4x2.1 mm. It claims that the module is designed to support ultra-compact applications where size is at a premium, such as smart watches, wearable devices, trackers and digital cameras. Its proprietary structure is a multi-level circuit for surface mounting, built to reduce footprint size. It continuously tracks all GPS satellites in view and provides real-time positioning data in the standard industry format defined by the US National Marine Electronics Association (NMEA).

KCS launches OEM TraceME Tracking Module

KCS bv, The Netherlands, has introduced the newest OEM addition to its family of TraceME products, the TM-202LAR, a GPS/RF/GSM module intended for incorporation into products and systems used for tracking people, vehicles, and objects.

Measuring 46x21x6.5 millimeters and weighing seven grams, the low-power TM-202LAR incorporates a 48-channel CSR SiRFstar-IV GSD4e GPS L1 receiver, GPRS/GSM modem (QUAD band version) for RF connectivity up to two kilometers (1.2 miles), and a 3D magnetic compass and 3D accelerometer the operates at up to 16g. The 2.45 GHz short range radio and optional Wi-Fi extension enable localization inside buildings. With typical power consumption at 30 mA for full GPS tracking and GPRS operation, the module's advanced power-saving operation lowers power consumption down to 3μA, according to the company.

Satlab new SL600 on the Pole GNSS Survey Receiver

SatLab Geosolutions AB announced several months ago it's completely new and innovative SL600 as the planned replacement of its popular SL500 on the pole GNSS Surveying receiver. This new receiver is designed to meet the evolving needs of the surveying market and is the ideal solution for general land, marine and construction applications. At the heart of this rugged unit is an industry

leading 6G GNSS receiver capable of utilizing all 6 GNSS satellite networks (GPS, GLONASS, BeiDou, Galileo, QZSS and SBAS) providing reliable operation in the most demanding conditions.

Provides for lower current consumption (reportedly less than 100 uA) and is particularly useful in battery-operated applications, such trailer tracking.

Upgraded GPS Anti–Jam Technology by Raytheon UK

Raytheon UK launched a new enhanced version of its battlefield GPS L1/L2 anti-jam (GPS-AJ) capability. A multi-element antenna with the anti-jam processing in a single small "one-box" form factor that interfaces at the RF level, Landshield is designed to enable GPS equipment to function unimpaired against a full range of hostile jammer types including narrow band, broadband, continuous wave, pulse, swept, and spectrally matched. Primarily a military product based on a custom-built application specific integrated circuit (ASIC), the main customer market areas for Landshield is the land military vehicle arena. Despite its title, how, Raytheon says the product is not restricted to the land market and has also been developed for application for missiles and UAV/UAS platforms.

eCognition Essentials Software

eCognition® Essentials is a new software solution for geospatial and remote sensing professionals performing land cover mapping tasks using satellite imagery. It offers an intuitive image analysis solution that allows users of all levels to quickly produce high-quality, GIS-ready deliverables. www.eCognition.com

Embattled Sistema Boosts Stake in Glonass Application Maker

Russian oil-to-telecoms group Sistema has boosted its stake in a company developing consumer applications for Russia's Glonass navigation system to almost 90 percent. Before the Oct. 3 deal, Sistema had owned 60 percent of Navigation Information Systems (NIS). *www.themoscowtimes.com*

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Smart Future Cities: The Role of 3D Land and Property and Cadastral Information
2-3 February
Melbourne, Australia

The Unmanned Systems Expo
4 - 6 February
The Hague, The Netherlands
http://www.tusexpo.com

International LiDAR Mapping Forum (ILMF)
23-25 February
Denver, Colorado, USA
www.lidarmap.org/international

The International Navigation Conference
24-26 February
Manchester, UK
www.internationalnavigationconference.org.uk/

March 2015

Locate15
Brisbane, Australia
10 – 12 March
www.locateconference.com

Munich Satellite Navigation Summit 2015
24 – 26 March
Munich, Germany
www.munich-satellite-navigation-summit.org

April 2015

European Navigation Conference 2015
7 – 10 April
Bordeaux, France
http://enc-gnss2015.com/

The World Cadastre Summit, Congress & Exhibition
20-25 April
Istanbul, Turkey
http://wcadastre.org/page/45-en-home

Interexpo GEO-Siberia-2015: Open-Source Geospatial Solutions for Public Benefits
20 – 22 April
Novosibirsk, Russia
http://expo-geo.ru/event/4-Interekspo_GEO-SIBIR/

2015 Pacific PNT Conference
20 – 23 April
Honolulu, HI United States
www.ion.org/

May 2015

AUVSI's Unmanned Systems 2015
4-7 May
Atlanta, USA
http://www.auvsi.org/

RIEGL LiDAR 2015 Conferences
5 – 8 May
Hong Kong and Guangzhou, China
www.riegllidar.com/

MundoGeo Connect
May 5 to 7, 2015
Sao Paulo - Brazil
http://mundogeoconnect.com/2015/en/

Baska GNSS Conference 2015
10 - 12 May
Baska, Krk Island, Croatia
www.baskagnssconference.org

36th International Symposium on Remote Sensing of Environment
11-15 May
Berlin, Germany
http://www.isrse36.org

FIG Working Week and General Assembly
Sofia, Bulgaria
17 – 21 May
www.Figure net

GEO Business 2015
27 - 28 May
London, UK
http://geobusinessshow.com/

June 2015

HxGN LIVE Las Vegas 2015
1 – 4 June
Las Vegas, Nevada USA
http://hxgnlive.com/las.htm

TransNav 2015
17 - 19 June
Gdynia, Poland
http://transnav2015.am.gdynia.pl

July 2015

Geospatial Minds for Society
7 - 10 July
Salzburg, Austria
www.gi-forum.org

13th South East Asian Survey Congress
28 – 31 July, Singapore
www.seasc2015.org.sg

August 2015

UAV-g 2015
30 August - 2 September
Toronto, Canada
www.uav-g-2015.ca

September 2015

ION GNSS+
14-18 September
Tampa, Florida, USA
www.ion.org

INTERGEO 2015
15 – 17 September
Stuttgart, Germany
www.intergeo.de/intergeo-en/

October 2015

Commercial UAV Expo
5 - 7 October
Las Vegas, Nevada, USA
www.expouav.com

2015 IAIN World Congress
20 – 23 October
Prague, Czech Republic
www.iain2015.org

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