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

No: DL(E)-01/5079/14-16
Licensed to post without pre-payment U(E) 28/2014-16
Rs.150

ISSN 0973-2136

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Volume XII, Issue 10, October 2016

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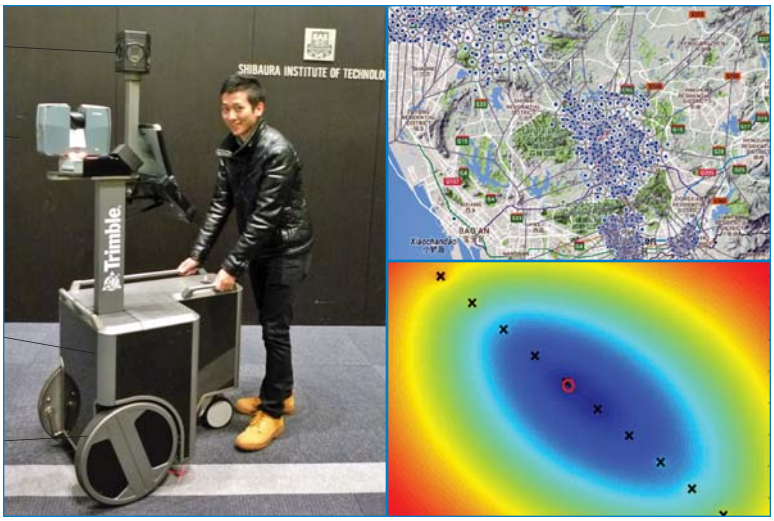

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This issue has been made possible by the support and good wishes of the following individuals and companies Andrea Lucic, Andrej Stern, Ales Blatnik, Ciro Gioia, Daniele Borio, Dinko Saric, Franc Dimc, Gianmarco Baldini, Hassan Chtouki, Karl Hafström Magnérus, Kresimir Vidovic, Marija Juric, Matej Bažec, Makoto Shiozaki, Masafumi Nakagawa, Mia Filic, Niko Gaberc, Renato Filjar, Shido Tanaka, Tatsuya Yamamoto, and Tetsuya Ohhashi; Effigis, Geomax, HiTarget, IP Solutions, Javad, Leica, Navcom, Pentax, Riegl, Spectra, Trimble and many others.

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Web www.mycoordinates.org

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

Printed and published by Sanjay Malaviya on behalf of Coordinates Media Pvt Ltd
Published at A 002 Mansara Apartments, Vasundhara Enclave, Delhi 110096, India.
Printed at Thomson Press (India) Ltd, Mathura Road, Faridabad, India

Editor Bal Krishna
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Designed at Spring Design (ajay@springdesign.in)

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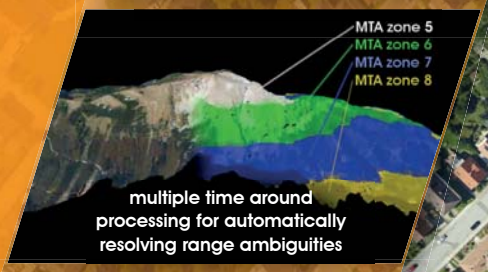
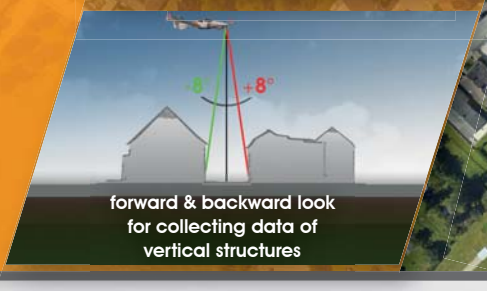


multiple time around processing for automatically resolving range ambiguities



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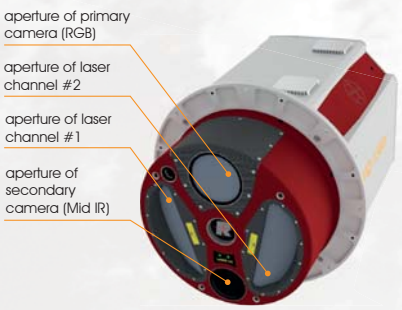

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Jammer 'Trap'

As grows the GNSS-based services,

So increases its vulnerability,

with the availability of low cost and easy available

disruptive devices like jammers.

This can have far reaching consequences

Especially, when safety-critical applications are affected.

Moreover, the usage of GNSS jammers is illegal in many countries.

The solutions could be

in developing of reliable and affordable techniques

that can detect and locate the jammers (Read page 12) .

Bal Krishna, Editor
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Anatomy of Origin-Destination Matrix derived from GNSS alternatives

Origin-Destination Matrix (ODM) has been considered a traditional tool for transport development, being established on interviews and traffic counting. Here we present a novel approach in the ODM estimation using data related to telecommunication activity, as well as the advanced methods for the ODM visual presentation and interpretation. Our approach does not only aim at assisting transport developments, but also at supporting the larger-scale urban strategic development in relation to identified socio-economic activity

The urban development strategic spatial planning heavily relies upon the identification of the patterns off socio-economic activity. A proper assessment of the socio-economic activity level requires careful spatio-temporal segmentation of the area targeted for strategic planning, and a systematic and accurate collection and analysis of the field measurements. The appropriate identification of the areas of socio-economic activity (office areas, residential areas, schools and universities, shopping m12alls, concert halls, and sport facilities, as examples) at an appropriate scale allows for strategic planning of the urban development, including expansion and modernisation of road and railway networks, public transport system, expansion of residential areas, improvement of urban infrastructure etc.

Origin-Destination Matrix (ODM) is a known measurement tool for socio-economic activities, particularly used in transport segment. An ODM is defined by spatially segmented areas of supposed socio-economic activity, and a time window suitably chosen to reflect the nature of local migrations related to the socio-economic activity. As an example, the ODM defined in the time-window 06 h – 09 h will describe the local migration related to the start of daily business, education and health activities, with majority of the population conducting migration in order to get to their offices, plants, schools, universities or health services. The intensity of migration between identified origins of migrations (mostly homes, for the (06-09) hours interval) and their destinations (areas with offices, production plants, universities, schools and hospitals) is an invaluable information for every strategic planner.

Traditional concept of the ODM estimation calls for field data collection using interviews, readings of (as numerous as possible) sensors in the field, including CCTV systems and road inductive loops, and the similar time- and effort-consuming methodologies. As the name implies, an ODM consists of matrix elements, where everyone presents the number of migrations between the *i*-th origin and the *j*-th destination. Almost all ODM estimation methods return the ODMs that estimates the spatial distribution of socio-economic activities partially, assessing only

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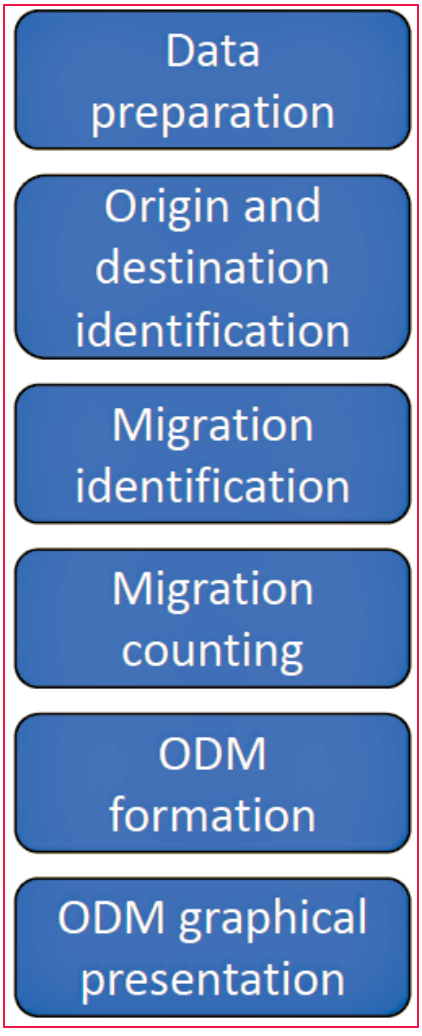

Figure 1: Algorithm for CDR-based ODM estimation

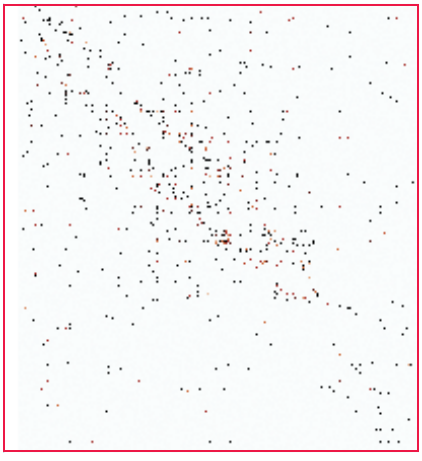

Figure 2: A graphical presentation of the O-D matrix of relative migration activity

some of the socio-economic segments, such as transport, at the considerable costs of data collection, and the sensor systems introduction and maintenance.

Here we propose a novel approach for a seamless, efficient and the more general assessment of spatially segmented socio-economic activity through utilisation of the ODMs estimated from data sets collected in mobile communication networks. The so-called Call Data Records (CDRs) are routinely collected for the billing purposes, and comprise the information on the telecommunications transactions (events) including: time of the initiation of transaction, the ID and position of the base station that served the transaction initiation. With the user IDs modified to assure the anonymity and privacy, the CDRs become invaluable source of data for the ODM estimation. While the data sets do not contain any positioning information derived or obtained from the GNSS readings, the proposed concept can be understood as the method for te ODM estimation from the GNSS alternatives.

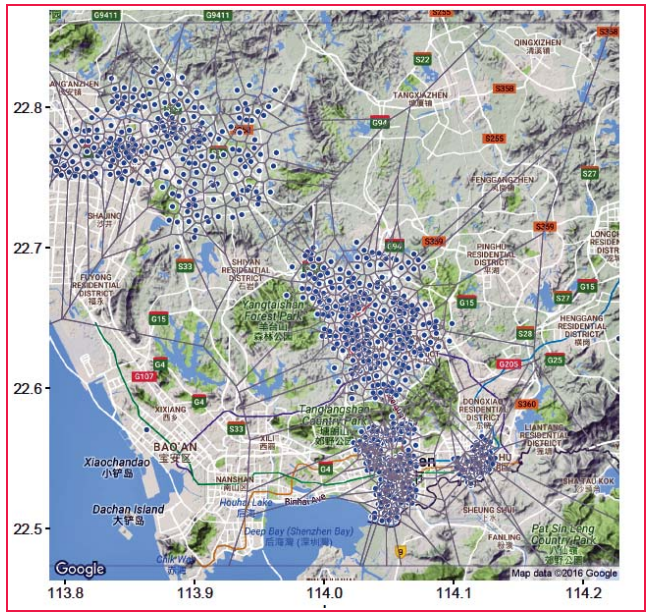

Figure 3: A Voronoi-based spatial segmentation by mobile network base stations (Shenzhen, China) on a Google Maps foundation layer

The proposed approach to the ODM estimation comprises a number of tasks, as depicted in Figure 1.

During the data preparation phase, the reduced CDRs are split into daily time-windows, determined by the known general patterns of daily socio-economic activity, but also by local traditions. Data can be split further taking into account if the day under observation was within the working week or not. The temporal segmentation into time-windows allows for statistical identification of established patterns, while at the same time attenuating insignificant and occasional anomalies through averaging.

Origin and destination identification task aims at identification of the focal points of socio-economic activity which the migrations either originates from, or destine to. The identification process is performed through utilisation of the temporal filter that identifies the areas (related to base stations) where mobile users spent large time spans.

A delicate task of the migration identification is accomplished using spatio-temporal information filtering that returns origin-destination pairs (ODP) based on the estimation distance of migration and the time spent to perform it.

After the identification of the ODPs, a simple migration counting is performed, that returns the number of migrations between every origin and destination areas (base stations) as a measure of attractiveness and intensity of the origins and destinations as the centres of socio-economic activity.

All origin-to-destination counts are then arranged into matrix form, thus creating the ODM estimate.

The number-filled ODM does not present the information in a comprehensive form. In due course we developed several methods to graphically present the ODM thus rendering it more comprehensive and revealing the evidence hidden

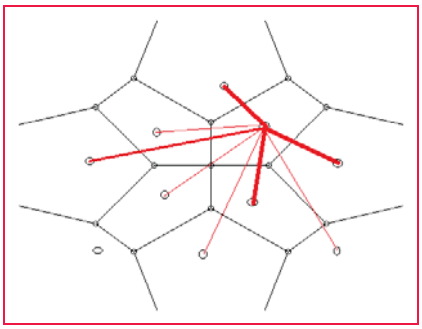

Figure 4: Sub-segmentation of the ODM

behind the plain numbers. The outcomes of the methods utilised are presented in Figures 2, 3, and 4, respectively.

Figure 2 depict a graphical presentation of an ODM map in a heat map-like manners. The presentation is achieved through normalisation of the absolute counts in the ODM with the count of the most intense migration event in the time-window under observation.

A hexagonal spatial segmentation, commonly utilised in telecommunications segment, does not represent the areas of socio-economic activity in the appropriate way, since it assumes the equally-sized spatial cells The Voronoi diagram spatial segmentation of the ODM targeted area has been selected for determination of the origin and destination areas, due to its variability in size that can be related to the density of the base station spatial distribution. In that way, the contextual information (the area's attractiveness for socio-economic activity) is more pronounced and assist in the ODM interpretation. An example of the Voronoi-based spatial segmentation is shown in Figure 3.

Finally, the expert system for the ODM estimation allows for targeted migration analysis. As an example, an ODM sub-set may be used to present the most important migration direction for a selected origin, as depicted in Figure 4.

A novel approach we utilise in the ODM estimation, graphical presentation and interpretation allows for advanced information extraction from the ODM as traditionally used tool in transport. Our approach provides:

- Improved estimation of local migrations, based on telecommunications activity data (anonymised CDRs), that encompasses much broader activity of population, including the individual mobility that is not related to conventional means of transport (cars, public transport vehicles, railways);
- Improved identification of the spatial area of socio-economic attractiveness through information sensor fusion, deployment of Voronoi-based spatial segmentation, and contextual spatio-temporal filtering of telecommunications activity data (anonymised CDRs);
- A novel ODM visual presentation the allowed for advanced ODM interpretation and inference.

James Stewart stirred the world with his 1956 movie *Anatomy of the murder*, not only because of his brilliant acting, but also for the then-controversial subject addressed. This paper is far from being expected to achieve anything similar, but its authors will be more than delighted, if the research presented rises the attention of the feasibility to use the GNSS alternatives as both the valuable source of information and reliable assistance to GNSS in transport and telecommunications segments.

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Trapping the jammer: the Slovenian experiment

This paper provides a comprehensive account of the activities jointly conducted by the European Commission Joint Research Centre, the University of Ljubljana and Agency for Communication and Services of Republic of Slovenia to characterize and ultimately mitigate the jamming threat

During the last decade, the number of applications relying on Global Navigation Satellite System (GNSS) has experienced an exponential growth. Nowadays, GNSS positioning is fundamental in different fields including avionics, Location Based Services (LBSs), road and maritime transportation. Moreover, GNSS technologies are key-enabler for several regulated and safety-critical applications, such as the Digital Tachograph (DT), the Automatic Identification System (AIS) and time distribution infrastructures. Hence, GNSS should provide reliable and continuous services. These services, however, can be easily disrupted by several interference sources including intentional attacks such as spoofing and jamming. Jamming, in particular, is the voluntary emission of powerful electromagnetic waves towards a victim GNSS receiver which will be prevented to operate [1]. Jamming can be perpetrated using low-cost portable devices called jammers. The proliferation of such devices is expected to grow along with the development of GNSS-based services. Possible solutions to address GNSS jamming include jamming detection [2] and jammer localization [3]. This paper presents the joint efforts of the European Commission Joint Research Centre (JRC), of the University of Ljubljana and of the Agency for Communication and Services of Republic of Slovenia (AKOS) towards the development of reliable and affordable techniques for jamming detection and localization. The activities performed have a strong experimental component and two extensive data collections were carried out with the ultimate goal to design effective jamming countermeasures. The principle is similar to that adopted to fine drivers not respecting speed limits: a speed trap is used to identify and fine the law transgressor. In a similar way, "jammer traps" should be developed to allow authorities to reliably identify the presence of jammers on-board vehicles and fine the jammer user. It is noted that the usage of GNSS jammers is considered illegal in most countries and the availability of reliable localization techniques will simplify the operations of authorities trying to stop this phenomenon.

The first data collection was organized in July 2015 and it was followed by a second campaign that took place in November 2015. The second campaign benefited from the experience gained during the experiments conducted in July and several additional tests were

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designed and performed to evaluate possible jammer localization approaches.

Different experiments were conducted and, in particular, the following approaches were considered:

1. *Spectrum monitoring and sentinel receivers*: a portable Rhode & Schwarz PR100 spectrum analyser was used to fingerprint the signal broadcast by jammers. A sentinel GPS receiver was also used to assess the impact of jamming on GPS devices.
2. *Software Defined Radio (SDR)-based detection*: several detection approaches were implemented using the samples provided by a low-cost TV tuner used as agile front-end operating in the GNSS bands.
3. *Receiver-based detection*: detection techniques based on the measurements provided by a GNSS receiver have been considered. This included the use of C/N_0 measurements provided by victim GPS receivers.
4. *Jammer localization using C/N_0 measurements:* two approaches for jammer localization were attempted using a single moving GPS receiver and a grid of static smartphones.

These four types of tests were performed in parallel considering two scenarios: in the first case, a static jammer was used while the detection unit was mounted on a moving vehicle. In the second scenario, the role of jammers and detection units was inverted: the jammer was installed on a moving vehicle while the detection unit was static on the road side. The two scenarios are complementary and provide insights on the effects caused by a jammer.

For jammer localization, a third scenario was also considered where a grid of Android phones was used to simultaneously collect C/N_0 measurements. This last type of tests was implemented only during the second data collection.

The two measurement campaigns took place in the proximity of the village of Črnotiče in Slovenia and provided valuable data for the evaluation of the jamming threat.

The experimental results show that low-power car jammers can be effectively detected in a road environment using commercial devices such as portable spectrum analysers

This paper provides an account of the experimental and analysis activities originated from the experiments conducted in Črnotiče. More details on specific aspects of the experiments conducted can be found in the references provided at the end of the paper.

The Slovenian campaigns

The first scenario considered during the two Slovenian campaigns is described in Figure 1. In this case, jammers were kept static whereas the detection unit was mounted on a car as schematically represented in Figure 1 b). The vehicle with the detection units moved, with an almost constant velocity, back and forth between the two way-points (A and B) shown in Figure 1 a). The tests were repeated considering different jammers (three jammers were used) and different speeds (50 and 90 km/h). The measurement units employed included a Realtek RTL2832U front-end, used to collect In-phase/Quadrature (I/Q) samples and implement experiments of type 2, a u-blox LEA-6T, GPS single frequency receiver, used to collect GNSS measurements and implements techniques of type 3 and 4. The Ljubljana Interference Monitor (LIM), a composite detection unit based on a Raspberry Pi platform, a GPS receiver and a RTL2832U front-end was also adopted for testing real-time SDR approaches.

As mentioned above, a second scenario was also performed where the detection unit was static and the jammer was mounted on a vehicle. In this case, a portable Rhode & Schwarz PR100 spectrum analyser was used to fingerprint the jamming signal.

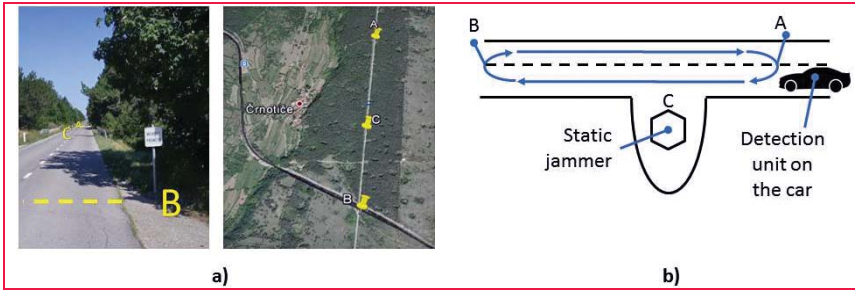

Figure 1: Jammer test performed in a remote area close to Črnotiče. a) View of the road environment selected. b) Schematic representation of the tests carried out considering a static jammer and detection units mounted on a car.

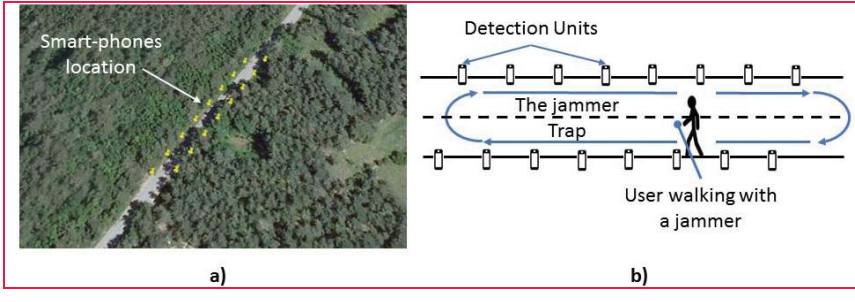

Figure 2: Smartphone-based test: a) test environment and location of the smartphones. b) schematic representation of the tests carried out considering a user walking through the smartphones with a jammer. The tests also considered the vehicular case.

The tests performed in the two scenarios provided similar results. The usage of a static jammer however allows one to establish a reference position for the jammer, and thus it allows the performance analysis of jammer localization techniques. For this reason, more emphasis is provided here to the results obtained for the first scenario.

The third scenario developed for the techniques of type 4 is illustrated in Figure 2. In this case, sixteen Android smartphones were placed over a regular grid along a straight section of the road. The location of the phones is shown in Figure 2 along with a schematic representation of the tests performed. A vehicle equipped with a jammer passed several times between the phones at different speeds. Also in this case, the test was repeated considering three different jammers and different speeds. The experiment was also repeated considering a pedestrian user slowly moving through the phones. During the experiments, the phones continuously collected C/N_0 measurements which were used for jammer localization.

Trapping the jammer

This section provides a summary of the results obtained for the different techniques tested and for the different scenarios considered.

Spectrum monitoring and sentinel receivers

The usage of portable spectrum analysers, such as the Rhode & Schwarz PR100 device, allows one to obtain a clear fingerprint of the signal broadcast by a jammer. This approach not only allows one to detect the jammer presence but it also provides specific signatures which, in principle, can be used to identify the specific jammer type. During the experiments conducted, it was possible to clearly distinguish the three jammers adopted: each device has its Radio Frequency (RF) signature with a characteristic spectral shape.

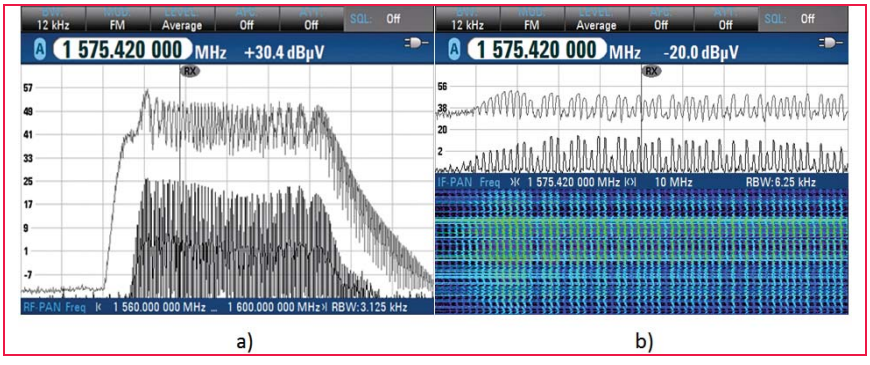

Figure 3: RF fingerprint of a wideband jammer: a) RF spectrum measured in 40 MHz bandwidth b) Spectrogram evaluated in a 10 MHz bandwidth.

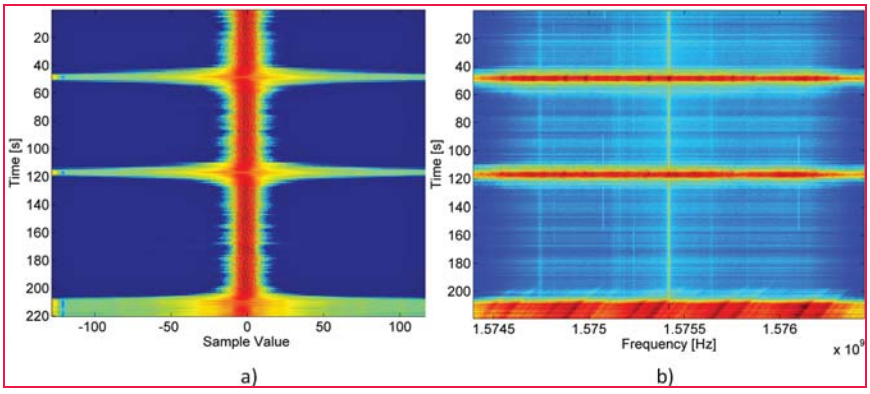

Figure 4: Time-varying histogram (a) and PSD (b) of the signal collected in the presence of a jam mer. The same jammer considered in Figure 3 is analysed.

Sample results obtained during the Slovenian campaign are shown in Figure 3 which provides the RF signature of one of the three jammers considered. The jamming signal spans a 32 MHz frequency interval which is significantly larger than the bandwidth of GPS and Galileo open signals.

The data were collected with the equipment positioned on the road side with the jammer placed on a car passing closely to the observation station. The minimum distance between jammer and spectrum analyser was about 5 m. The colour variations in the spectrogram in Figure 3 b) reflect the received power variations due to the approaching and distancing of the jammer.

SDR-based detection

The availability of the I/Q samples provided by a SDR front-end enables sophisticated detection techniques with performance similar to that achieved using a commercial spectrum analyser . In particular, I/Q samples can be used to compute metrics such as the histogram and the Power Spectral Density (PSD) of the input samples. The histogram and the PSD provide a signature of the jamming signal, and thus enable jammer identification.

The time-varying histogram and PSD obtained considering the same jammer discussed in the previous section are provided in Figure 4. When the jammer is in the close proximity of the RTL device, the jamming signal saturates the front-end and the input samples assume significant values. This fact is reflected by the multi-coloured bands present in Figure 4 a). A similar effect can be observed in PSD: when the jammer is closed to detection unit significant power is present in all the frequencies captured by the SDR front-end.

From the histogram and the PSD, it is possible to derive summary statistics which can be used for jamming detection. Metrics derived from the histogram are the signal mean, variance and kurtosis whereas metrics derived from the PSD are the total power and the spectral entropy.

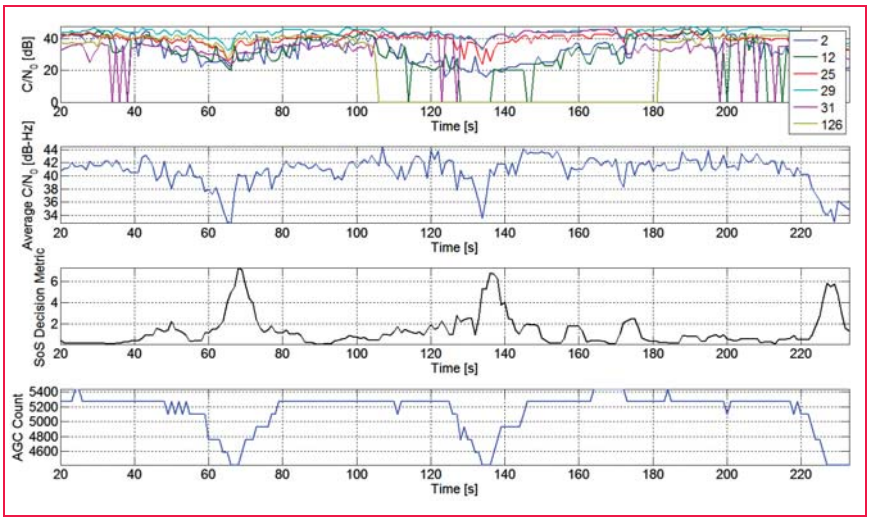

Figure 5: Sample results obtained using the measurements provided a GPS receiver in the presence of jamming. Notches and peaks are observed in the correspondence of the jammer passages.

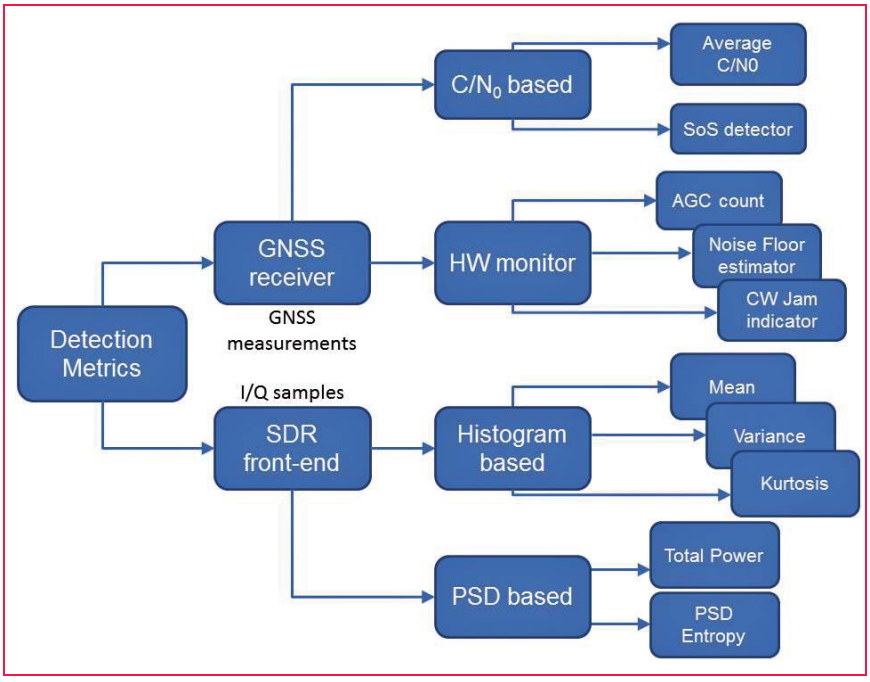

Figure 6: Detection metrics considered in this work

Receiver-based detection

GNSS receivers provide several measurements which are significantly affected by a jamming signal. C/N_0 measurements, for example, reflect the presence of interference: a significant drop in all C/N_0 values is experienced in the presence of jamming. C/N_0 values are "naturally" provided by most GNSS receivers and are, for example, directly accessible in smartphones. Thus, jamming detection can be implemented exploiting C/N_0 measurements.

In addition to C/N_0 values, several receivers provide the Automatic Gain Control (AGC) count, a noise floor estimator and dedicated interference indicators. All these measurements have been used for jamming detection.

Sample results obtained using receiver-based metrics are provided in Figure 5: the average C/N_0 reflects the reduction in performance caused by the proximity of the jammer. The Sum-of-Squares (SoS) approach suggested by [5] has also been considered: the SoS detection metric clearly reflects the jammer presence. Finally, Figure 5 shows the AGC count as a function of time: when the car with the jammer passes closely to victim receiver, the AGC count drops significantly, revealing the presence of an interference source.

A summary of all the detection metrics considered in this work, with both SDR- and receiver-based techniques is shown in Figure 6. All these techniques have been analysed and compared using the data collected during the Slovenian campaigns. A detailed analysis of these detection approaches can be found in [4].

Note that more complex approaches can be developed by combining the information provided by both SDR platforms and GPS receivers. An example is the LIM platform developed by the University of Ljubljana which integrates different sensors using the Raspberry Pi micro-computer. More details on LIM can be found in [6].

Localization technique

Finally, jammer localization techniques have been implemented using C/N_0 measurements. Two approaches, namely synthetic and crowdsourcing localization, have been considered. The two approaches are both based on the usage of C/N_0 values: in the first case, measurements are taken by the same device at different locations and at different time instants. In the second case, a grid of Android phones is used to simultaneously collect the C/N_0 measurements.

As indicated above, C/N_0 estimates are affected by the presence of interference and the C/N_0 provided by a receiver can be expressed as [7]:

$$\left.\frac{C_i}{N_0}\right|_{eff} = \frac{C_i}{N_0 + k_\alpha J} = \frac{C_i}{N_0}\,\frac{1}{1 + k_\alpha \frac{J}{N_0}} \qquad (1)$$

where C_i is the power received for the ith satellite, N_0 is noise power spectral density and J is the received jamming power. k_α is the Spectral Separation Coefficient (SSC) [7] and models the filtering effect of the receiver on the jamming signal. From Eq. (1), it emerges the C/N_0 is a function

of the received jamming power which can be related to the jammer/receiver distance using a simple path-loss model:

$$J|_{dBW} = J_{0,dBW} - 10\alpha\log_{10}(\frac{d}{d_0}) \quad (2)$$

where $J_{0,dBW}$ is the jammer reference power measured at distance d_0. α is the path loss exponent and can be assumed equal to 2 for rural open environments. d is the distance between the jammer and the victim GNSS receiver. Eq. (2) is expressed in logarithmic units. By expressing (1) in logarithmic scale and combining it with (2) it is possible to obtain a simple model valid when the jammer is in the proximity of the victim receiver. In particular,

$$\left.\frac{C_i}{N_0}\right|_{eff,dB-Hz} = \beta_i + 10\log_{10} d \quad (3)$$

where β_i is an unknown parameter which absorbs several factors such as the un-interfered C/N_0, the SSC and the transmitted jamming power. β_i can be obtained through calibration. Synthetic localization is based on (4) where C/N_0 measurements are combined in a cost function whose minimum corresponds to the location of the jammer. In particular, it is possible to consider C/N_0 measurements taken at different time instants and in different positions as equivalent to simultaneous observations from different receivers. In order to obtain more robust measurements, the average C/N_0 can be used and (4) can be rewritten as:

$$\left.\frac{C_a[n]}{N_0}\right|_{eff,dB-Hz} = \beta + 10\log_{10} d[n] = \beta + 5\log_{10}\left[(x[n]-x_{jam})^2 + (y[n]-y_{jam})^2\right] \quad (4)$$

where notation '[n]' is used to indicate quantities measured at the instant n. In particular, (x[n],y[n]) and d[n] are the receiver position and the receiver distance from the jammer at the instant n. β is the average of the β_i terms which refer to a single satellite. Using (4), it is possible to construct the cost function:

$$J(x_{jam}, y_{jam}) = \sum_{n=0}^{N-1}\left[\left.\frac{C_a[n]}{N_0}\right|_{eff,dB-Hz} - \beta - 5\log_{10}\left[(x[n]-x_{jam})^2 + (y[n]-y_{jam})^2\right]\right] \quad (5)$$

where N is the number of instants during which a jamming event is detected. The jammer position is computed minimizing (5).

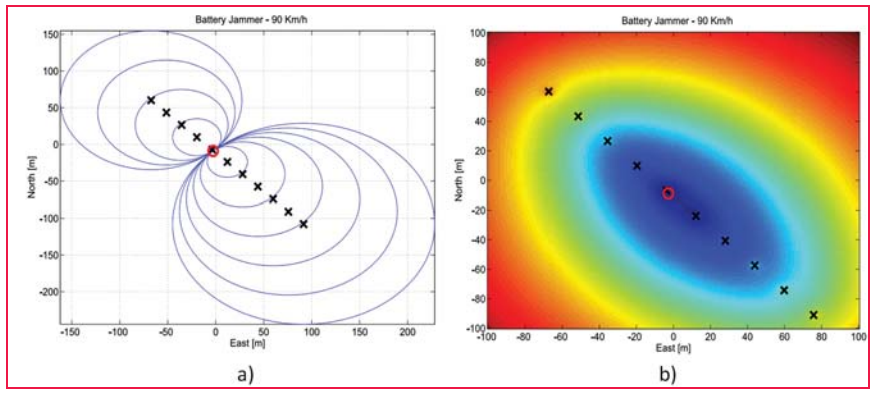

Figure 7: Jammer localization using a moving detection unit. a) Geometric interpretation of the cost function and of the estimated jammer position. b) Cost function evaluated using C/N_0 measurements collected at the points indicated by black crosses.

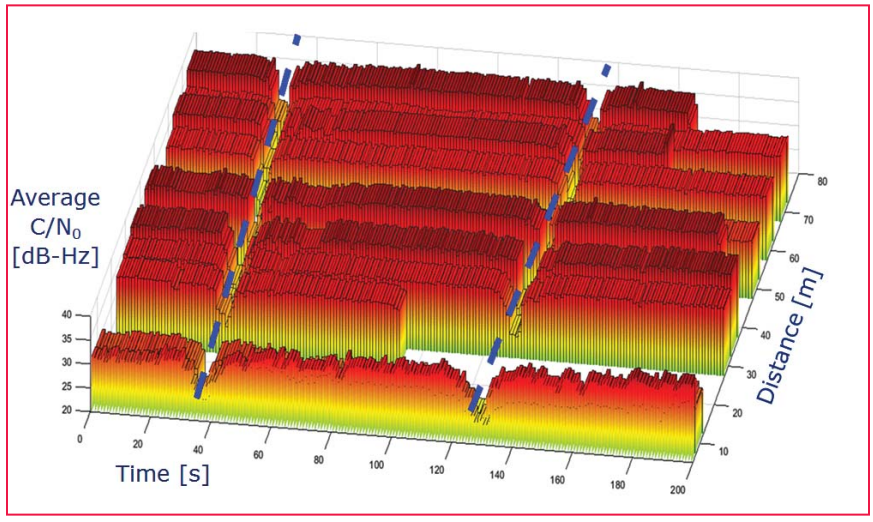

Figure 8: Average C/N_0 as a function of the receiver position (distance from the first device) and time.

Sample results obtained using the approach described above are shown in Figure 7. A geometric interpretation of the cost function and of the estimated jammer position is provided in Figure 7 a): the jammer is localized at the intersection of different circles. Each circle is centred at the location of the vehicle hosting the detection unit and its radius is defined by the average C/N_0 observed.

In Figure 7 b), the cost function is plotted with respect to the estimated jammer location expressed in a local frame centred in the true jammer position. Thus, the coordinates estimated for the jammer correspond to the actual localization error which, in this case, is less than 10 meters. This level of accuracy was consistently observed among the different tests performed.

For the crowdsourcing approach, it was not possible to use the same principle described for synthetic localization. In particular, each phone involved in the experiment was characterized by a different β. Since the calibration of all phones was not feasible, a different approach was adopted. C/N_0 measurements are first used to detect the jamming presence: jammer localization is then achieved by combining detection results from different smartphones. For localization, it was assumed that GNSS receivers are sufficiently far from the jamming source to obtain a valid position solution and sufficiently close to be affected by the jamming signal and observe a reduction in C/N_0. Jamming detection was implemented using the SoS approach mentioned above and the jammer position was finally obtained as

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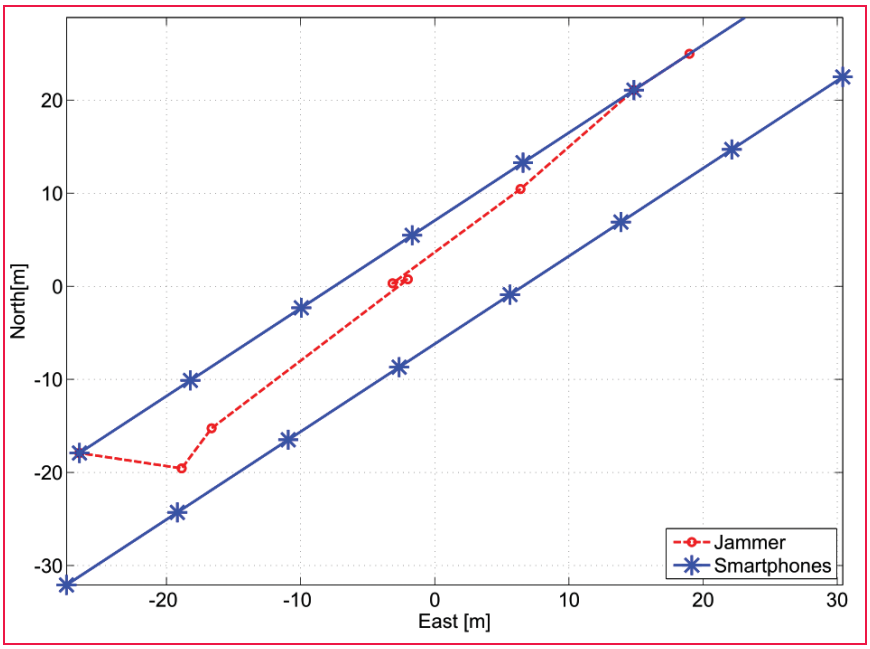

Figure 9: Estimated jammer position, obtained considering a single passage of the jammer. The positions of the jammer and of the smartphones are plotted in a local EN frame centred in the mean of the smartphone coordinates.

$$x_{jam} = \frac{1}{\#\mathcal{D}} \sum_{k \in \mathcal{D}} x_k$$
$$y_{jam} = \frac{1}{\#\mathcal{D}} \sum_{k \in \mathcal{D}} y_k \qquad (6)$$

where D is the set of receivers detecting a jammer. #D is the number of receivers detecting the jammer and (x_k, y_k) is the position of the kth receiver. The jammer location is thus identified as the centroid of the positions of the receivers which detect the jammer. If D is empty, the jammer is not detected and localization is not performed. Sample results obtained using the crowdsourcing approach are presented in Figure 8. Specifically, the average C/N_0 is provided as a function of the phone location and time. The average C/N_0 describes a "spatial wave" which clearly shows the passages of the jammer. Although few devices malfunctioned, the direction of motion and velocity of the jammer can be easily identified.

The estimated jammer positions together with the smartphones locations are shown in Figure 9. The red trajectory is the jammer trajectory obtained considering a single passage of the jammer. The positions of the jammer and of the smartphones are plotted in a local East North (EN) frame centred in the mean of the smartphone coordinates. From the figure, it emerges that the trajectory of the jammer was correctly identified even if some of the devices were not properly working during the experiment. This demonstrates the robustness of the proposed approach in the presence of malfunctions of some detection units. Additional results on the jammer localization techniques described can be found in [8].

Conclusions

This paper provides a comprehensive account of the activities jointly conducted by the European Commission JRC, the University of Ljubljana and AKOS to characterize and ultimately mitigate the jamming threat. Two unique measurement campaigns have been conducted and several experiments have been conducted to evaluate different detection and localization approaches. The experimental results show that low-power car jammers can be effectively detected in a road environment using commercial devices such as portable spectrum analysers. Effective and affordable detectors can be obtained using SDR platforms and measurements directly provided by commercial GPS receiver including smartphones. The results obtained are promising and encourage additional work towards the development of effective jammer traps.

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Shoreline protection according to Swedish environmental legislation

This paper presents the principles of shoreline protection according to the Environmental Code, implementation issues relating to the Planning and Building Act, and what the Right of Public Access means for shoreline areas

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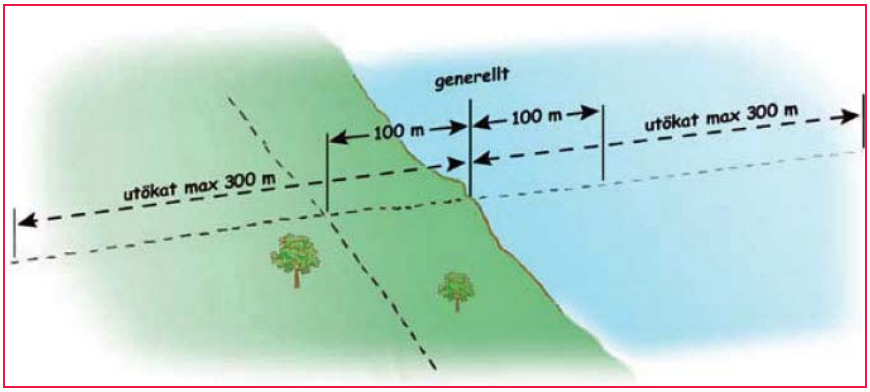
Sweden is generally associated with an attractive natural environment. A long history of settlement and use of land resources, and relatively sparse populations have led to diverse land-use practices and access traditions.

Sweden offers a great variety of winter sports. Frozen lakes, public skating areas, forests and open fields are quickly invaded by skaters and cross-country skiing enthusiasts when temperature falls below zero, and snow covers the landscape. During summer time people head into the woods to pick berries or mushrooms, hike in the mountains, go sailing or kayaking in the archipelago, or set off white-water rafting on one of Sweden's many rivers. Whether they look for peace and tranquility or a fix of adrenaline, these outdoor enjoyers all share a love for the wild life. Sweden is a major center for ecotourism and the natural splendor is the number one attraction among foreign visitors from more densely populated parts of the world. According to the County Administrative Board's guidelines, all information about Sweden's nature as a tourist destination, whether it is spread abroad, at the border or within the country, should indicate that consideration and caution are requirements when spending time in nature.



Extent of shoreline protection
Source: The County Administrative Board

The Right of Public Access, *allemansrätten*, is a unique privilege in Sweden. The origins of this right date back to the local laws and customs of the Middle Ages. It applies to everyone and is the same for Swedes and visitors from abroad. Everyone has the right to be out in the countryside. For example, one may walk freely in natural fields, travel by boat and swim in someone else's waters, and pick mushrooms and berries in the forest. The common principle is that visitors are allowed to walk across properties at a rational distance from houses, yards, gardens and fenced-in areas. This way, people can enjoy most natural spaces in Sweden, whether they are privately owned or owned by e.g. the government.

With this right comes a great responsibility to take care of nature and wildlife, and to show consideration for landowners and for everyone else that is out and about in the countryside. Basically, we can spend time in such areas as long as we do not disturb or destroy. Loud shouting, breaking tree branches, or walking in cultivated fields are consequently not permitted. As long as these principles are respected, and common sense is used at all times when judging what is or is not possible, there is no reason why everyone should not continue to enjoy these freedoms long into the future.

With a growing global population and increased pressure on natural areas for recreational purposes, the principles of the Right of Public Access are more important than ever, providing an important framework for the sustainable enjoyment of Sweden's countryside and wilderness areas.

The swedish envionmental code – shoreline protection history

The Environmental Code is one of the most comprehensive parts of the Swedish legislation. The Code contains 33 chapters including almost 500 sections. However, it is only the fundamental environmental rules that are stated in the Environmental Code. More detailed provisions are laid down in regulations issued by the Swedish government.

In addition, small land and water areas that constitute habitat to rare animal and plant species, or are otherwise particularly worthy to protect, may be designated habitat protection areas by the Government. Such designations may relate to individual areas or all the areas of a certain type in the country or part of the country. Activities or measures that are likely to damage the natural environment cannot be accepted in habitat protection areas. However, if the Government designates all areas of a certain type as habitat protection areas, it may in connection with such a decision issue rules concerning the granting of exemptions for certain activities or measures. Exemptions may only be granted in special circumstances, for example in construction of complementary building. The Government may also take the necessary measures to conserve habitat protection areas. Before such a measure is taken, the owner of the area and any holders of special rights thereto shall be notified. A decision establishing a habitat protection area will take effect immediately, even if it is appealed against.

The purpose of the Environmental Code is to promote sustainable development which will assure a healthy and sound environment for present and future generations. Such development will be based on recognition of the fact that nature is worthy of protection, and that our right to modify and exploit nature must be carried out with responsibility and wise management of natural resources.

The Environmental Code shall be applied in such a way as to ensure that:

1. Human health and the environment are protected against damage and detriment, whether caused by pollutants or other impacts;
2. Valuable natural and cultural environments are protected and preserved;
3. Biological diversity is preserved;
4. the use of land, water and the physical environment in general is such as to secure a long term good management in ecological, social, cultural and economic terms; and
5. Reuse and recycling, as well as other management of materials, raw materials and energy are promoted so that a cycle is reached.

During the early 20th century, society changed by a strong increase in urbanization. Agricultural population decreased from 80 to 35 percent of the total population between year 1900 and 1930. The industrial workers increased from 10 to 40 percent. This led to a possibility for the enjoyment of nature, and the demand for active outdoor activities increased. Some type of protection of e nature was therefore needed. Discussions on this topic were led by politicians, protection-associated related persons and spokesmen of architects of a "socially motivated nature protection".

1936, Government had written two bills regarding the possibility of enhancing public outdoor recreation. These bills discussed both the growing need for outdoor activities, and the securing of accessibility to natural areas.

The Parliament requested from the Government an investigation, which was appointed in 1937 and called "leisure inquiry". The final report was submitted in 1940, providing possibilities for swimming, both in the landscaped swimming areas and at other beaches. The report mentioned, among other things, that not only the population in urban areas had needs, but also the residents of the countryside. The debate came to a stop due to World War II, and the investigation did not lead to any legislation.

In 1947, the Building Act included the first rules about beach settlements. The County Administrative Board was thereby given (limited) authority to prohibit development in particular protected areas. The reasons for this were mainly related to the protection of nature, not to social aspects of the public's need for access to outdoor recreation, as was the case of the previous Investigation report.

Not long after this came the first legislation focused on beach areas. An Act on temporary building prohibition in certain coastal areas came into effect in 1950. The purpose was to secure access to swimming and outdoor activities for the public.

The temporary law was replaced in year 1953 by riparian law, which mainly consisted of rules from the temporary Act. In short, the County Administrative Board could thereby prescribe areas where settlements could not be established without a permit. Those beaches were protected up to a limit of 300 meters from the shoreline.

The Beach Act was valid for twelve years before it became part of the Environmental Protection Act in 1965. As a consequence, 13,700 km of the Swedish shoreline was now protected from exploitation. The average width of the shore protection was 158 meters.

This selective shore protection was taken away by the legislative change that came in 1975. A general shoreline protection for the whole of Sweden was then introduced, forbidding erection of buildings. The protected zone was determined to be 100 meters from the shoreline, and could after a decision by the County Administrative Board be extended to 300 meters in areas with particular needs for further protection. In other areas, the County Administrative Board could decide to remove the general shoreline protection where it was obviously that it was irrelevant to outdoor recreation.

Before the mentioned amendments to the Act in 1975, shoreline protection did not apply in planned areas. This limitation was then abolished, which means that shoreline protection applies for all General urban and building plan adopted from 1 July 1975. Shoreline protection could be lifted if there were particular reasons to do so. After the change in 1975, the legal rules regarding shorelines were essentially unchanged until 1994. A significant change then was that shoreline protection was not just a social but also an environmental issue.

After year 1994, the objective of shoreline protection became both securing public access to beaches and preserving good living conditions on land and in water for plants and animals. That means that some areas that were previously not of any major interest for outdoor recreation and swimming, for example streams and ponds, became subject of protection. These areas are mainly of interest for the sake of biodiversity.

Related to the amendment in 1994, the Environmental Protection Agency was commissioned to continue a paused work on shoreline protection. The idea was to have different criteria for granting exemption from the shoreline protection between different types of areas. Relaxation should e.g. be in sparsely populated areas. The Government reported in 1994 its assessment of the idea of differentiated shoreline protection and more flexible management in sparsely populated areas with plentiful lakes and streams. The areas based on analyses of certain criteria would have specified in the municipal comprehensive plan.

However, the Environmental Protection Agency's mission was recalled later in 1994, after Sweden changed governments. There was thus no differentiated shoreline.

Shoreline protection rules

Shoreline protection is regulated in Chapter 7, Sections 13 to 18, in the Swedish Environmental Code. Shoreline protection applies by the sea, lakes and watercourses. The purpose of shoreline protection is to assure public access to outdoor recreation facilities, and to maintain good living conditions for plant and animal species on land and in water.

All land and water areas are protected in a buffer zone extending up to 100 meters on either side from the shoreline. The County Administrative Board may extend this zone to a maximum of 300 meters from the shoreline, if this is necessary in order to fulfil the purposes of shoreline protection.

Such extended shoreline protection is intended to be used when the need for protection is insufficient by other nature protecting possibilities, e.g. nature reserves, "Natura 2000" areas, and similar protection that do not imply the same protection for the beaches as shoreline protection. Furthermore, the extended shoreline protection can be applied to coastal and island areas not already been developed and built upon; shallow sea

beds of importance for flora and fauna; attractive recreation areas without a regulation to prevent new constructions; peri-urban recreation areas; and ecologically sensitive areas not covered by other environmental protecting rules (Government bill 2008/09:119 p. 99).

Within shoreline protected areas it is prohibited to:

1. erect new buildings;
2. make alteration of buildings in order to serve a purpose that is significantly different from that for which they were previously used;
3. dig or make other preparations for the purpose of construction works referred to in points 1 and 2;
4. erect other structures which prevent the public from entering an area in which it would otherwise have been able to move freely or which significantly affect the living conditions of animal and plant species; or
5. take other actions which significantly affect the living conditions of animal and plant species.

The prohibitions do not apply to buildings, structures, works or measures that are necessary for the purposes of agriculture, fishing, forestry or reindeer husbandry which are not used for residential purposes and by its function needs to be located at or close to the shoreline. Furthermore, neither public roads nor railways are affected by the rules.

The Government may decide that shoreline protection should not apply to a smaller building or structure that is a complement feature to an existing main building, if the small construction is placed within 15 meters from the main building and not closer to the shoreline than 25 meters.

The County Administrative Board may in individual cases decide that shoreline protection should not apply in an area (a) where it is obvious that the area has no significance to fulfill the purpose of shoreline protection; (b) where shoreline protection concerns a small lake or a small watercourse and the importance of the area to fulfill the purpose of shoreline protection is small, or (c) that is required for a building or construction for defense purposes.

According to the Swedish Planning and Building Act, the municipality has a possibility to decide that shoreline protection should not apply within an area where the land use is regulated by a detailed development plan. Detailed development plans that gained legal force before the shoreline protection rules were introduced in year 1975 are exempted from the rules. However, if a detailed development plan is repealed, the shoreline protection rules become effective again.

Even if shoreline protection applies in an area, one may get an exemption. Such exemptions may be granted under special circumstances only. The scale of the measure or the structure, and the present and future importance of the area are taken into account. Normally, exemptions should not be granted in areas that are of particular importance with respect to nature conservation or recreation.

Exemptions must not be granted if there is any risk of unacceptable impacts on biological assets. They may, however, be granted where the site is situated on land that has already been developed, or where outdoor recreational facilities are to be built.

Certain waterfront areas in Sweden are appointed important for rural development. In these areas the chance to get an exemption is higher. The areas are pointed out in the legislation, and are often located in remote parts of Sweden. The areas are characterized by a less dens population and a lower public demand for shore areas. The purposes of this exemption are to prevent depopulation, support settlement and to facilitate local business.

If the shoreline protection should no longer apply or if an exemption is granted, it should always, as far as possible, be a free passage secured between the water and the construction.

Supervision

Chapter 26 of the Environmental Code contains rules concerning supervision, injunctions and fines. The chapter applies to the whole Environmental Code, and not only to shoreline protection. The municipalities are the supervisory authority of shoreline protection and have the mandate and responsibility to ensure that no one violates the rules.

The municipalities are authorized to issue an injunction or prohibition to ensure that the shoreline protection rules are followed. The injunction or prohibition can be combined with a penalty fine. The fine can be running, e.g. monthly or yearly, as long as the injunction or prohibition is not followed. This possibility has no time limit.

Violation of the shoreline protecting rules

Breaking the shoreline protection rules can pass for a crime against territorial protection of the nature. According to the Environmental Code, Chapter 29, Section 2, no. 2, anyone who intentionally or by negligence, within a shoreline protected area, builds or takes any other action prohibited by the rules shall be sentenced to monetary penalty or imprisonment in up to two years. This crime has a period of limitation of five years from the point in time when the crime was committed.

The number of criminal charges related to violations of territorial protection, also including other protection than shoreline protection, was during the years 2008-2013 around 40 to 60 per year (Source: The Swedish Prosecution Authority)

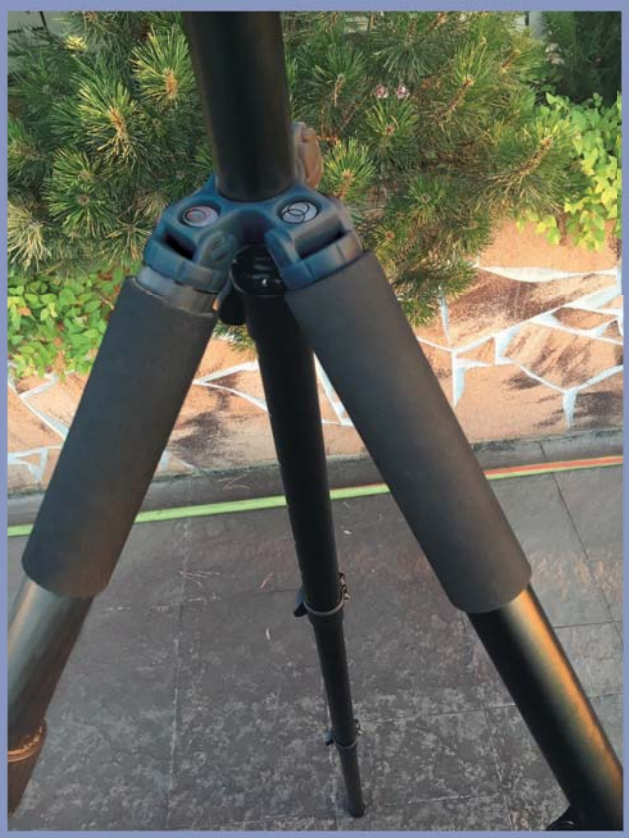
Concluding remaks

The Swedish shoreline protecting has a strong position and a long history in Sweden. This has led to the possibility for all Swedes, as well as visitors to the country, to easily access open water and the area surrounding it.

The interpretation of the authors is that shoreline protecting rules is well accepted and highly appreciated amongst most swedes and, not least, foreign visitors.

The paper was presented at FIG Working Week, Sofia, Bulgaria, 17-21 May 2015.

The first Magnetic Object Finding Olympiad (MOFO)



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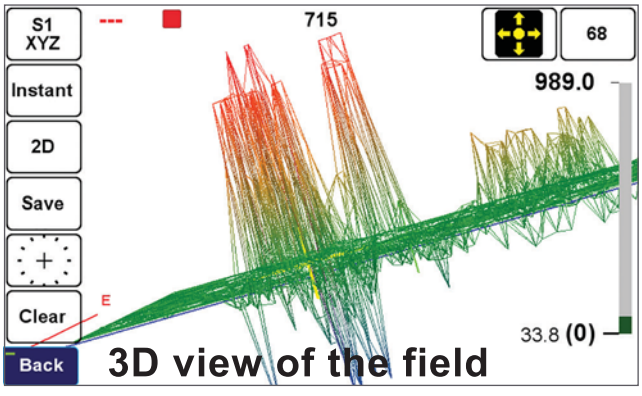
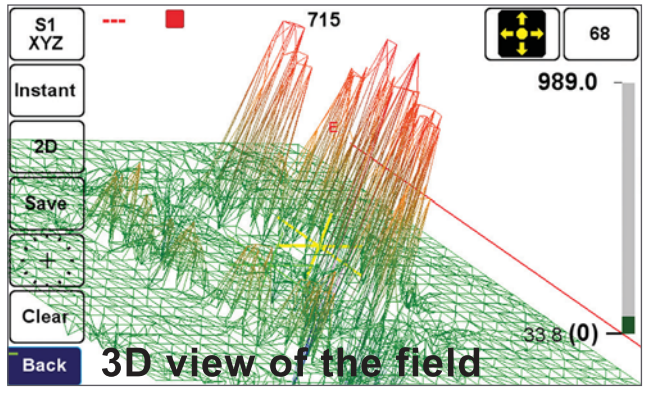
John Evers, PLS **16**/19
Matt Sibole, PLS **16**/19
Matt Johnson, PE **15**/19
Javad Ashjaee, Ph. D. **11**/19

*Shawn was first disqualified for doping, but he appealed and got reinstated by bribing Javad with a bottle of Texas BBQ sauce.

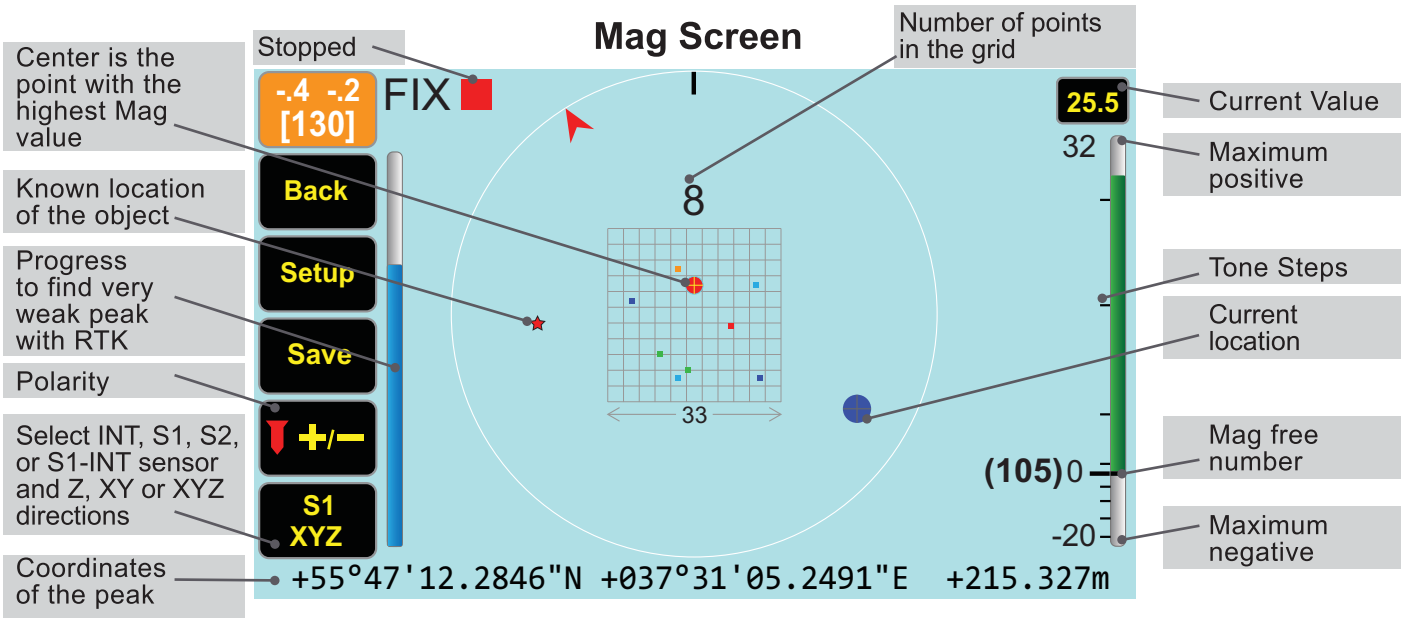
Ahead of the first Mag Objects Finding Olympiad **(MOFO),** our Michael Glutting had planted **19 mag nails,** close together, from 16d common nails to 2-3/4 inch Mag Spikes from ChrisNik, in an 18 x 12 feet land in front of our San Jose headquarters. The site had a great deal of ambient noise from a nearby freeway and construction work. Later we found that the land was also infested with several old junk nails.

Contestants were challenged to find the nails and identify their type from the signal strength.





FL



To see Mag screens you must first click the A/V hardware button and pair the TRIUMPH-LS with your J-Tip (and to the Bluetooth headset, if you want to.)

In Action screens of Collect or Stake, click the  icon to get to the Mag screen.

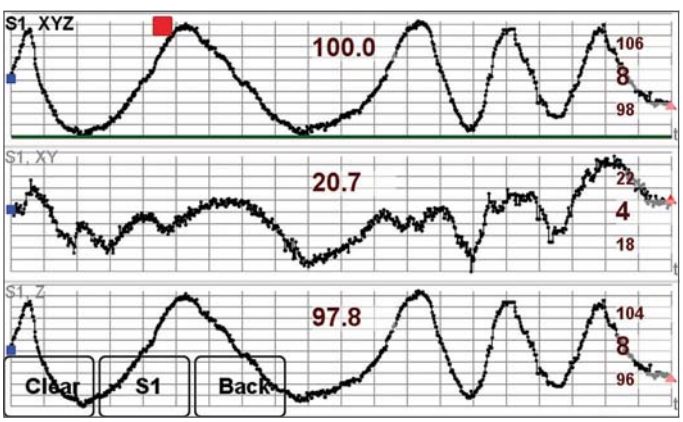
J-Tip has three search modes of "Positive", "Negative", and "Auto". The search for Positive or Negative objects is fully automatic, for all levels of magnets, and you can start search from anywhere. There is no "Gain" knob to adjust.

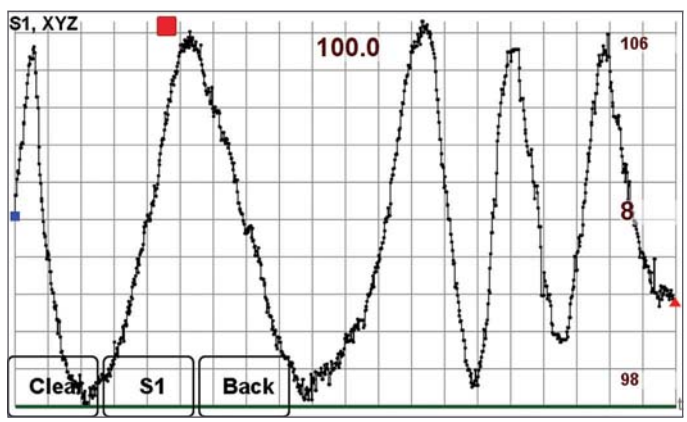
In the "Auto" mode, when you don't know the polarity of the object, you must Start/Clear scanning away from magnetic objects. This records the mag free condition of the field. Then again, the search is fully automatic. Variations from the Start condition automatically guide you to any positive or negative polarity object of any magnetic value without needing to play with any gain button or orienting the sensor in any specific direction. You can also view the positive and negative values simultaneously on the same bar which may give an indication of the shape of the object.

You can also alternate between Positive and Negative modes.

Unlike conventional magnetic detectors which sense magnetic values only in one direction, the J-Tip has three dimensional magnetic sensors. You can view magnetic values in **XY** (horizontal), **Z** (vertical), and **XYZ** (combined) directions.

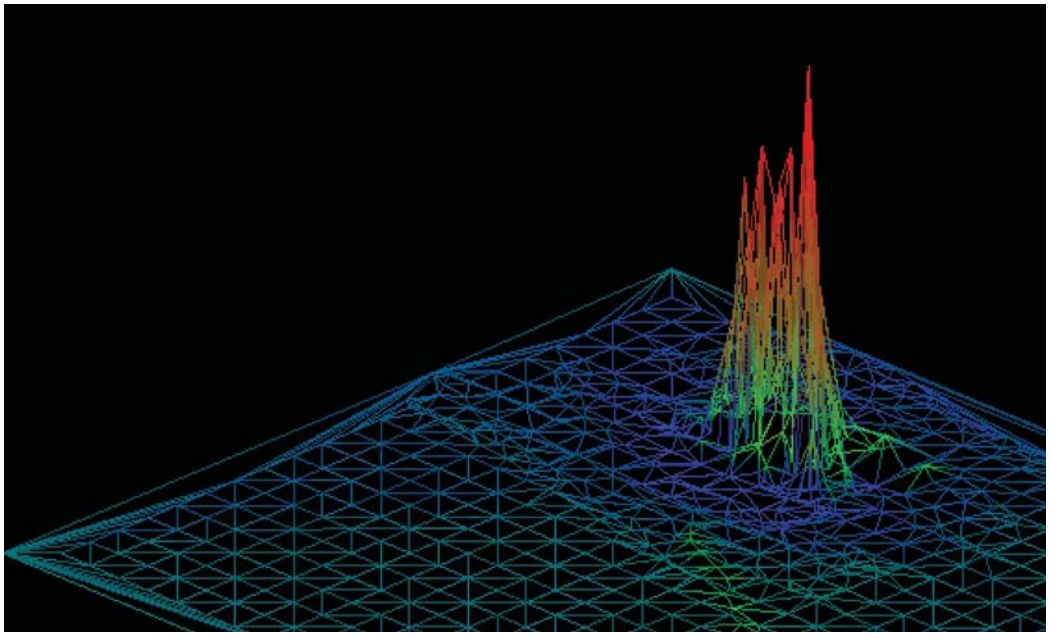
In addition to the two three-dimensional





Time view of S1 XYZ, XY, and Z components for the last 100 seconds.
Click on any graph component to see the expanded view.

3D magnetic view of the scanned field



magnetic sensors (**S1 and S2**) in the smart tip, there is also a three-dimensional magnetic sensor inside the TRIUMPH-LS (**INT**).

In addition to the audio notifications, the J-Tip shows magnetic values in "**Time View**" (always), and in "**Spatial Views**" (**Mag**, **2D**, and **3D** views) when you have RTK solutions.

You can view the 2D and 3D graphs by clicking on the top part of the Mag screen. Click the bottom part of the Mag screen to see the Time View.

Scan the area until the spread of mag values are higher than **2*** (**Start to Beep**). Audio beep rates of **2, 4, 6, 10 Hz** or **tones** are automatically assigned to magnetic values according to the weights assigned in the **Dynamic Beep** Screen and based on Min and Max mag values. There will be no tone when mag value less than **0.5*** (**No Beep <**)

When you have fixed RTK, hold the monopod vertical (within 5 degrees) to tag mag values with their coordinates. The Smart Tip scans the area 100 times per second and stores the 121 highest mag values and shows them in 11x11 cells of **3*** cm (**Digitizing Size**) wide. In Spatial Views, the **graphs are centered on the cell with the highest mag value**. Only points that fit in the 11x11 grid will be shown. The number of such points is shown above the progress bar. The "Clear" button restarts the process.

In Mag mode, pole tilts are corrected automatically and RTK is set to extrapolation mode.

When there are enough points in the 11x11 grid (a bar shows progress), it stops and you can save the point. You can also **stop** scanning and then click the "**Save**" button to save point name, the peak magnetic value and the Mag Screenshots.

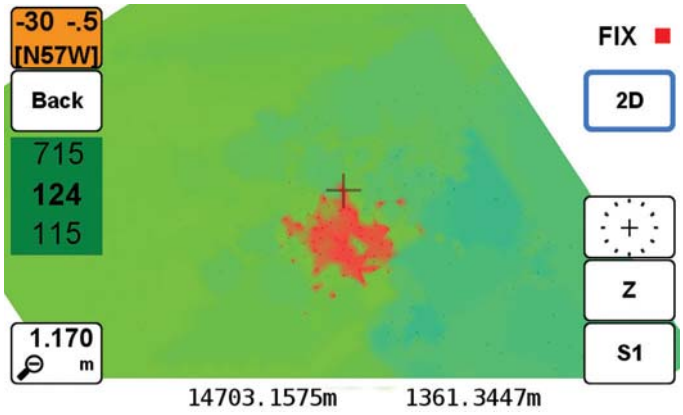
The calculated coordinates of the object is shown in the bottom of the Mag screen.

When pole is tilted less than 5 degrees, solutions will be corrected for pole tilt, otherwise points will be ignored. Time Plots show mag values at all times.

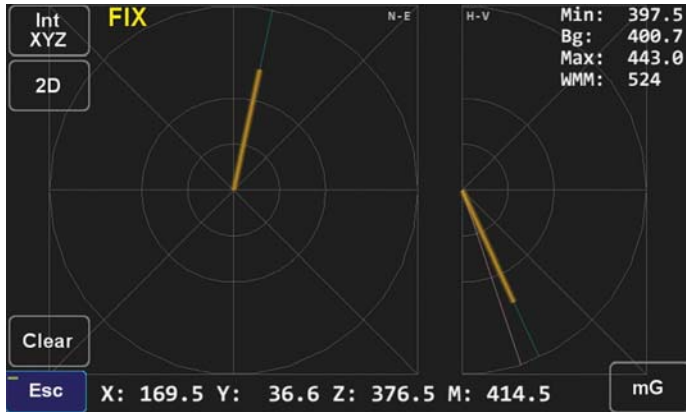
J-Tip finds the Minimum and the Maximum automatically. If you disturb the normal field scan by exposing the J-Tip to an external mag object, click the Start button.

The hardware Start and Stop buttons start/reset

***Red numbers** are the default values for their respective items (in **bold**) in Setup screen.



2D magnetic view of the field



Horizontal and vertical magnetic vector

and stop scanning. You can stop scanning, view the results in different screens and settings, and decide the next step.

You can assign gestures (like tilt and shake) for different functions. Tilt-and-back resets.

The known position of the object (entered in the Stakeout screen) is shown on the Mag, 2D and 3D screen if this option is selected.

Time graphs show the magnetic values of the selected sensors in Z, XY and XYZ directions during the past 100 seconds. It also shows the Min and Max values since the Start/Rest. Click on any of the three graph component to expand it.

The J-Tip is 48 millimeter longer than the metal tip that the monopod is graduated for. Add this to the antenna height offset when in survey mode.

When not “Paired”, the Bluetooth LED of the J-Tip blinks red. When “Paired” it is red. When Paired and Connected, it is blue. The power LED shows charge level with green, yellow, and red colors. Hold the “On/Off“ button for three seconds to turn off. Click it 3 times to unpair it from the TRIUMPH-LS.

You can set the J-Tip to turn itself off after some time of inactivity.

We keep improving the J-Tip. You can update the firmware of the J-Tip via TRIUMPH-LS similar to updating the TRIUMPH-LS.

The J-Tip advantages:

• J-Tip does not have “null” points around the peak and will not produce false alarms.

• J-Tip is fully automatic for all levels of magnets. There is even no “Gain” button to adjust.

• J-Tip senses the mag values in all directions. You don’t need to orient it differently in different searches.

• J-Tip gives a 2D and 3D view of the field condition when you have RTK and will guide you to the object. You can actually see the shape of buried object.

• J-Tip, In Time View, shows positive and negative mag values of the last 100 seconds and the Min and the Max since Start.

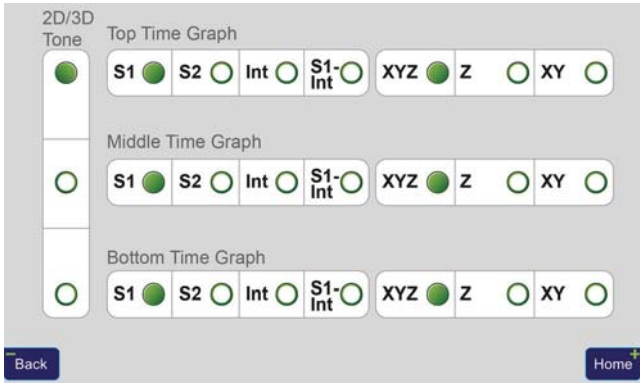
• J-Tip shows the instantaneous magnetic vector in horizontal and vertical directions.

• J-Tip works as a remote control for the TRIUMPH-LS

• J-Tip weighs 120 grams and replaces the standard pole tip. In balance, it weighs almost nothing.

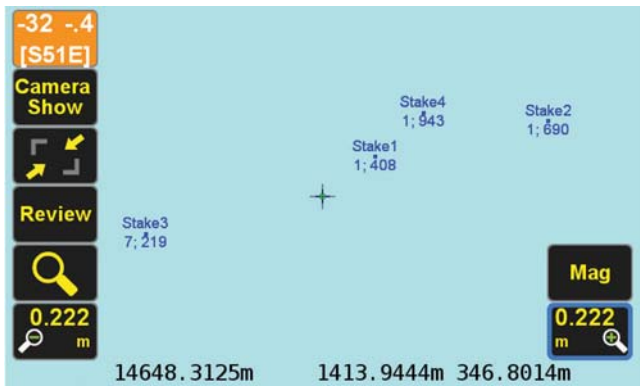
• The built in camera of the TRIUMPH-LS documents the evidence after digging.

• And... you don’t need to carry another bulky device.



Sensor and Direction selection screen allows you to select the type of mag data to be shown in Time View and in 2D/3D and Mag screens and for tones.
All values are recorded in parallel. You can stop the scan and then click to see different sensors or sensor/direction combinations. You can tune the J-Tip to your preference or for special tasks. Default values work just fine. We show flexibility in examining the internal parameters.

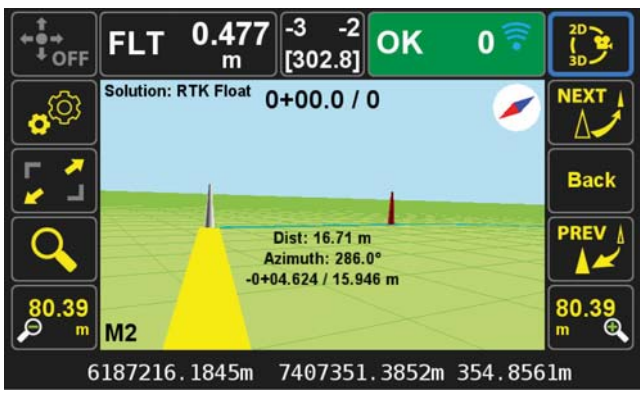
Field View

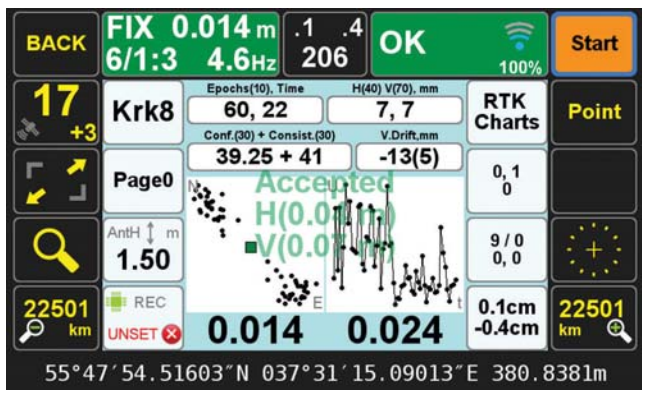


When you scan a large area, you can save all possible peak points, view them on the map and select the point with the highest peak to dig.

When you save a point, you can also save all the raw Mag sensor data for future view and research. We also plan to give you the ability to share that data with us by transferring it directly to our server for analysis and improvement.

Work Flow

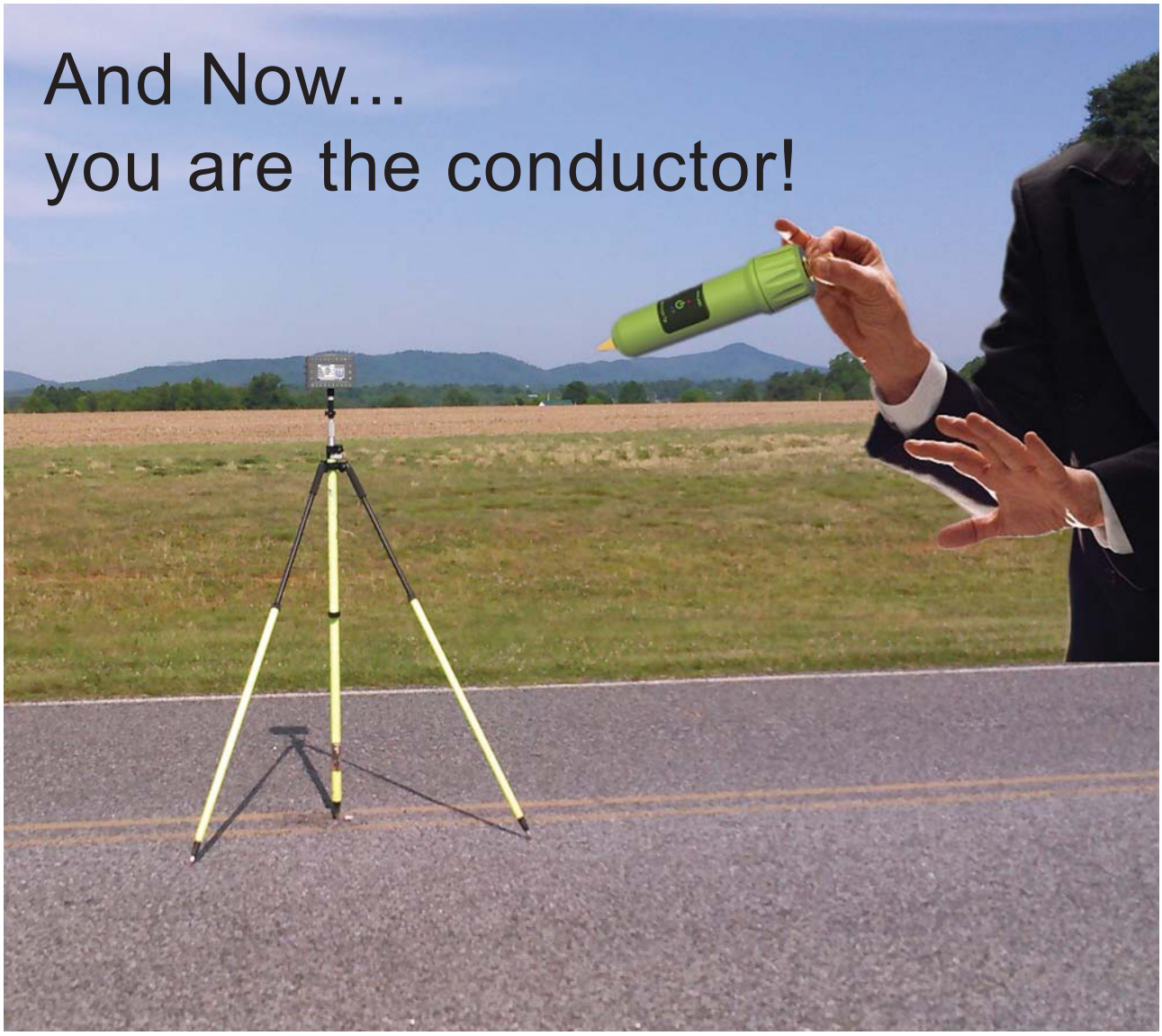




We have not only integrated a sophisticated magnetic in the TRIUMPH-LS, but we have also streamlined the whole process. First the “Stakeout” screen will guide you toward the target.
Then the “Mag” screen locates your underground target and gives you its estimate of the coordinates of the underground target and a button to save it “as staked”.
And finally in the “Collect” screen you can survey the target point which you have dug up and exposed. This is also the time to use the built in camera of the TRIUMPH-LS to photograph and fully document the evidence which you have recovered.

The addition of the J-Tip into my daily work has reduced a portion of the bulk and weight that I have come accustomed to over the years. I actually feel like I have lost a few pounds of body weight since the yellow thing isn’t hanging from my side 10 or 12 hours a day (not to mention the beating my knees took with every step). I remember my first year surveying, I was solo with a robot and my bosses orders wrote down on a map or plans and No one to carry the load but me. I have dreamed about and made it a mission to lighten the load ever since. The J-Tip will fit in my pocket and weighs less than my phone. Guy Clark has a song called “Stuff that works”. It’s the J-Tip theme song.

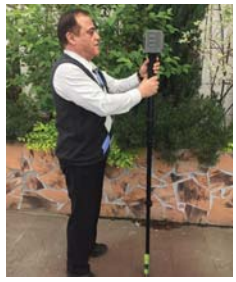
Adam Plumley, PLS

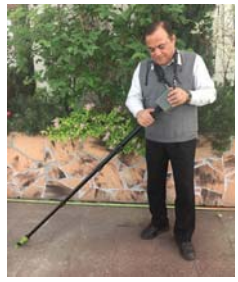


While not in magnetic locator mode, you can use the J-Tip as a remote control for the TRIUMPH-LS. Shake, move up, move down, single bang, double bang, etc. can perform different functions (like Start and Stop survey) as you assign gestures to different function.


Head-on-Shoulder


Witch-on-Broom


Tango


Baby Hold


The Cane

Monopod, 8 and 40 sec level vials, compass, Accessory hooks.

Connect legs on demand to make bipod or tripod.

+ Bipod.

+Tripod.

Monopod >>> to + Bipod >>> to + Tripod… On demand.

Rugged, Light, Compact, Easy to level.

* Detachable landing and resting pads.
* Mace leg grips (grabs concrete, asphalt, bricks and soil firmly)

Travel mode.

Inside bag.

The most stable tripod. It will never collapse, even on wet glass.

Think of it as a rugged Transformer-Pod, We call it **J-Pod.**

Point cloud acquisition and wall surface extraction using indoor MMS

In this paper, an approach to acquire 3D data with an indoor mobile mapping system in an indoor environment has been proposed

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Massive point cloud acquisition is an effective approach for 3D modeling of unknown objects in an indoor environment. Moreover, point-cloud clustering is an essential technique for modeling massive point clouds acquired with a terrestrial laser scanner or mobile laser scanner, as shown in Figure 1.

There are three clustering approaches in point-cloud clustering: model-based clustering [1], edge-based clustering [2], and region-based clustering [3]. Point-cloud data acquired in urban areas and indoor environments often include many complex features with unclear boundaries. Thus, we focused on the region-based point clustering to extract a polygon from a massive point cloud. In region-based clustering, Random Sample Consensus (RANSAC) [4] is a suitable approach for estimating surfaces. However, local workspace selection is required to improve a performance in a surface estimation from a massive point cloud. Moreover, with conventional RANSAC, it is hard to determine whether a point lies inside or outside a surface.

In this paper, we proposed an approach to acquire 3D data with an indoor mobile mapping system in an indoor environment. Moreover, we proposed a point based-rendering methodology to achieve a visualization and polygon extraction for building information modeling (BIM) from the massive point cloud. Then, we described an experiment that was conducted to acquire a massive point cloud with an indoor mobile mapping system along horizontal and perpendicular trajectories. Finally, we confirmed that our proposed methodology could achieve data acquisition for the BIM through point-based rendering and point cloud clustering from a complex indoor environment.

Methodology

Figure 2 shows our proposed methodology. It consists of: (1) viewpoint decision for point-based rendering; (2) point-based rendering; (3) normal vector clustering for surface estimation; (4) point-cloud interpolation using a rectangular template; and (5) point tracing.

Figure 1: Point cloud clustering: colored point cloud (left image) and clustered point cloud (right image)

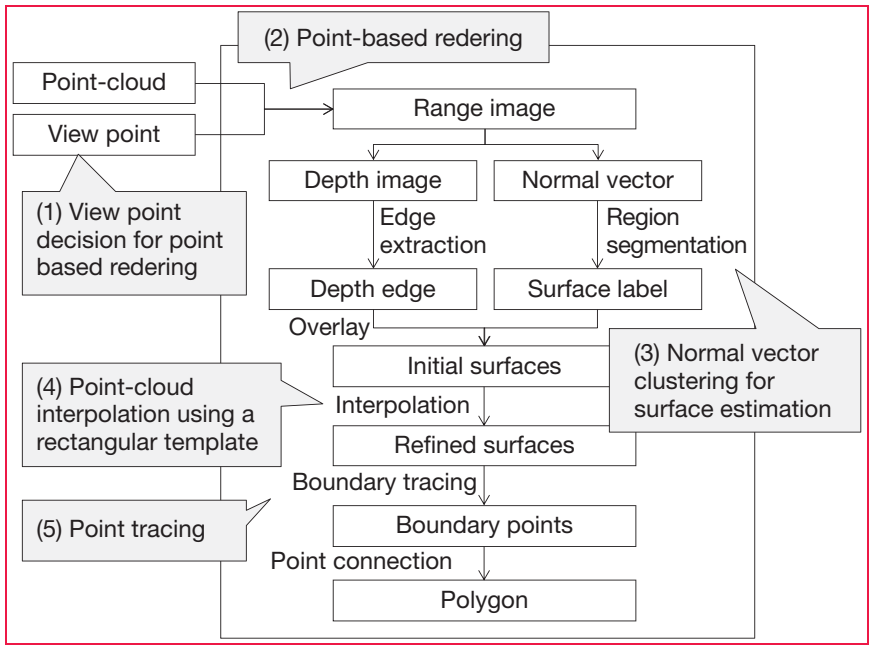

Figure 2: The five components of processing flow

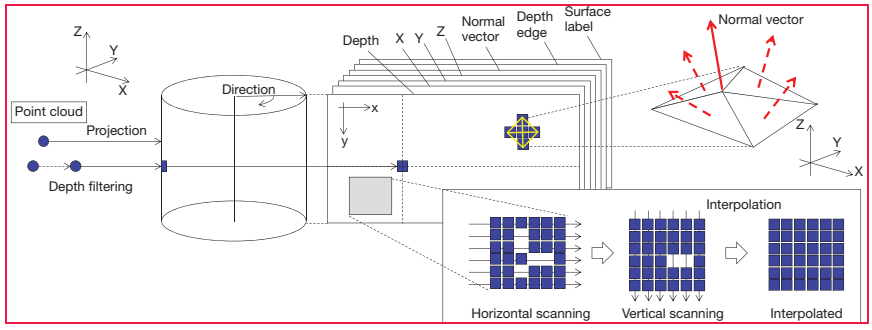

Figure 3: Point-based rendering

Viewpoint decision for point-based rendering

Viewpoints for point-based rendering are selected in point-cloud data through two steps. In the first step, an orthobinary image is generated from the point cloud to represent a rough floor surface as a viewpoint candidate. In the next step, the orthoimage is eroded with morphology processing to generate a viewpoint candidate network. Intersections on the network are selected as the viewpoints for point-based rendering.

Point-based rendering

Point-cloud visualization has two issues. The first is the near-far problem caused by distance differences between the viewpoint and the scanned points. The second is the transparency effect caused by rendering hidden points among near-side points. These effects degrade the quality of a point-cloud visualization. Splat-based ray tracing [5] is a methodology that generates a photorealistic curved surface on a panoramic view using normal vectors from point-cloud data. The long time period required for surface generation in the 3D work space is a problem. Furthermore, the curved-surface description is inefficient in representing urban and natural objects as Geographical Information System data. Thus, we have applied a point-based rendering application with a simpler filtering algorithm [6] to generate panoramic range images from a random-point cloud. The processing flow of point-based rendering is described in Figure 3.

First, the point cloud is projected from 3D space to panorama space. This transformation simplifies viewpoint translation, filtering, and point-cloud browsing. The panorama space can be represented by a spherical, hemispherical, cylindrical, or cubic model. Here, the cylindrical model is described for wall modeling. The measured point data are projected onto a cylindrical surface, and can be represented as range data. The range data can preserve measured point data such as a depth, X, Y, Z, and some processed data in the panorama space in a multilayer style. Azimuth angles and relative heights from the viewpoint to the measured points can be calculated using 3D vectors generated from the view position and the measured points. When azimuth angles and relative heights are converted to column counts and row counts in the range data with adequate spatial angle resolution, a cylindrical panorama image can be generated from the point cloud.

Second, the generated range image is filtered to generate missing points in the rendered result using distance values between the viewpoint and objects. Two types of filtering are performed in the point-based rendering. The first is a depth filtering with the overwriting of occluded points. The second is the generation of new points in the no-data spaces in the range image. New points are generated with the point tracking filter developed in this study.

Moreover, a normal vector from each point is estimated in the range image. Normal vector estimation is often applied to extract features in point-cloud processing. Generally, three points are selected in the point cloud to generate a triangle patch for normal vector estimation. Mesh generation is the basic preprocessing step in this procedure. In 2D image processing, the Delaunay division is a popular algorithm. It can also be applied to 3D point-cloud processing with millions of points [7]. However, using the Delaunay division, it is hard to generate triangle patches for more than hundreds of millions of points without a high-speed computing environment [8] [9]. Thus, we focused on our point-cloud rendering, which restricts visible point cloud data as a 2D image. A closed point detection and topology assignment can be processed as 2D image processing, as shown in the lower right image in Figure 2.

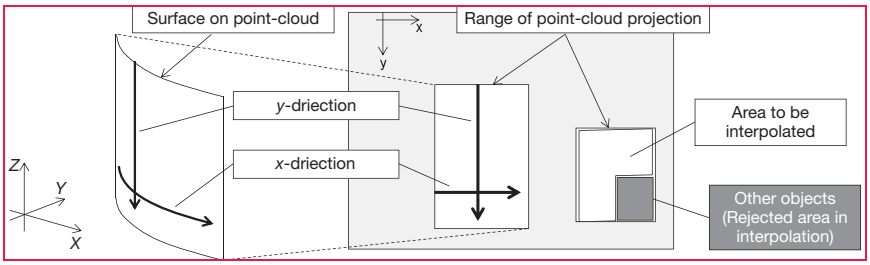

Figure 4: Point-cloud interpolation with a rectangular template in a range image

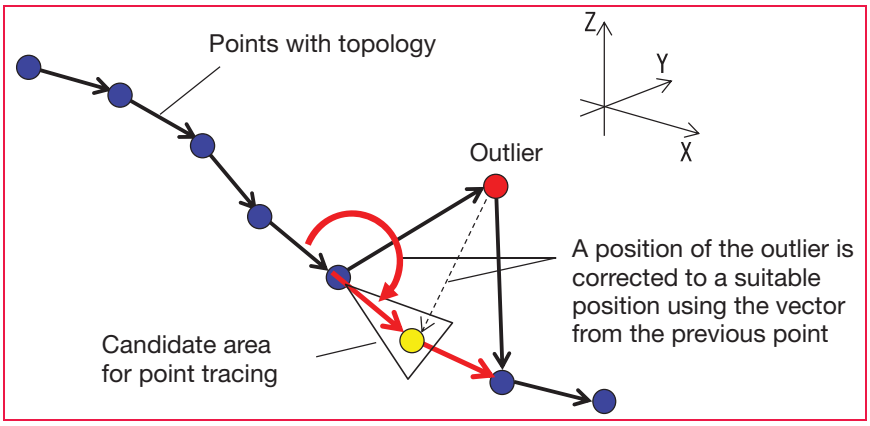

Figure 5: Point tracing

The processing flow of normal vector estimation is described below. First, a point and its neighbors in the range image are selected. Second, triangulation is applied to these points as vertexes to generate faces. Then, the normal vector on each triangle is estimated using 3D coordinate values of each point. In this research, an average value of each normal vector is used as the normal vector of a point, because we used the point cloud taken from a laser scanner that presents difficulties for measuring edges and corners clearly. These procedures are iterated to estimate the normal vectors of all points.

Normal vector clustering for surface estimation

Normal vectors of all points are grouped to detect regions in a range image as a point-cloud classification. The accuracy of point-cloud classification can be improved with several approaches such as the Mincut [10], Markov network-based [11], and fuzzy-based [12] algorithms. However, in this study, we improved the accuracy with point-cloud interpolation and point tracking. Thus, we applied multilevel slicing as a simple algorithm to classify normal vectors.

Moreover, building knowledge is used as a restriction in the normal vector and point-cloud classification. In general, walls in a room and building consist of parallel and orthogonal planes. Thus, four clusters in a horizontal direction are enough to detect walls in a general indoor environment. Although cylindrical surfaces are divided into some clusters, these surfaces can be reconstructed using surface merging. The processing flow of normal vector clustering

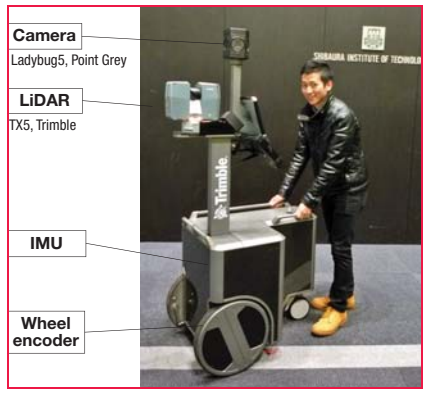

Figure 6: TIMMS

with restrictions is described below. First, stronger peaks are extracted from a histogram of normal vectors. More than one strong peak is required to detect seed points in each approximate 90° change in horizontal direction. Next, boundaries of clusters are generated from the peaks of the histograms. Then, the normal vectors and point clouds are grouped into four clusters. Finally, initial 3D surfaces are estimated from the grouped normal vectors and point cloud.

This classification detected boundaries of point clusters with the same normal vectors. The point-cloud clustering methodology for extracting the intersection of planes as ridge lines requires appropriate initial values such as curvature, fitting accuracy and distances to closed points [13]. However, our approach can extract boundaries from a point cloud without these parameters.

Figure 7: Rendered point cloud

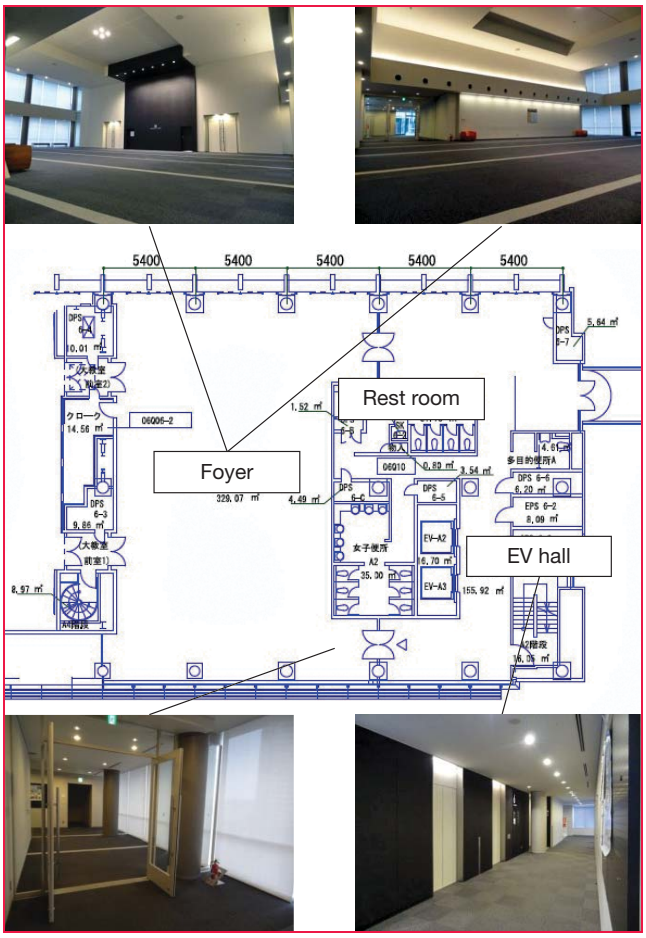

Figure 8: A part of our study area

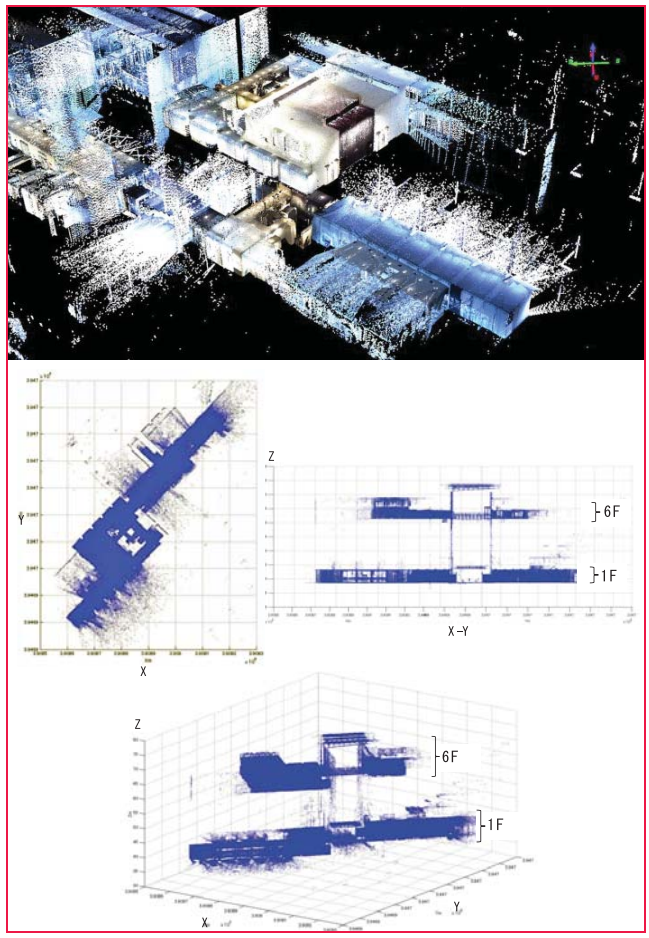

Figure 9: Acquired point cloud

Point-cloud interpolation with a template

Estimated 3D initial surfaces are refined in a point-cloud interpolation procedure. In general, it is difficult to trace the boundaries of the initial surfaces because of holes and jaggy boundaries. Therefore, point-cloud interpolation is applied as a refinement of the initial surfaces in this procedure. When flat and cylindrical surfaces are projected into a range image based on a cylindrical model, these surfaces are represented as rectangles with the following two restrictions. The first restriction is that points have the same X- and Y-coordinate values along the y-direction in the range image. The second restriction is that the points have the same Z-coordinate values along the x-direction in the range image. Based on these restrictions, point interpolation is applied along the x- and y-directions in the range image (see Figure 4). The point interpolation is as follows. First, a rectangular template is fitted to projected points in a range image. Next, missing points are detected in the rectangular template. Finally, the missing points are interpolated using neighboring points. When other objects exist in a rectangular template, the overlapped area is excluded from point interpolation.

Point tracing

Boundaries of features can be estimated from the refined surfaces in a range. Moreover, 3D polygons can be extracted with topology estimation using these boundaries in the range image. In this procedure, a point tracing is required to connect points in 3D space along the boundary, as shown in Figure 5. In general, least squares fitting and polynomial fitting are applied to extract straight and curved lines from points. When the point cloud includes noise, RANSAC is a suitable approach to estimate a feature. However, these approaches require a decision whether straight lines or curved lines are to be extracted before the fitting procedure. In this paper, we wish to extract polygons with a combination of straight and curved lines. Thus, we propose point tracing based on the region-growing approach to extract complex geometry as follows. First, a topology of points is estimated in a range image. When a polyline or polygon is drawn in a range image, continuous 3D points can be extracted. Next, a position for the next point is checked after a seed-point selection. In this step, the position is checked to find whether a possible next point exists or not within a candidate area for point tracing. The candidate area is determined using a vector from the previous point. When a point exists within the candidate area, it is connected to the previous point. Otherwise, the point is assumed to be an outlier, and the position of the point is rectified to a suitable position using the vector from the previous point. These steps are then iterated until the geometry is closed. Finally, 3D points are connected to represent a smooth 3D polygon.

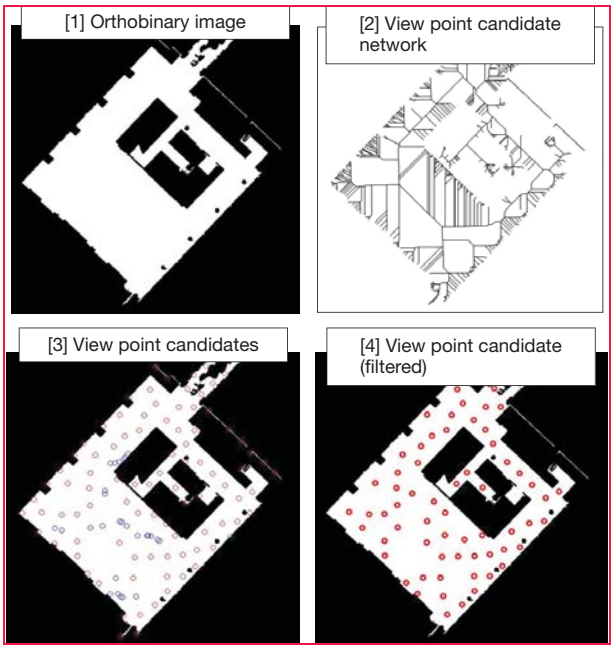

Figure 10: Viewpoint candidates

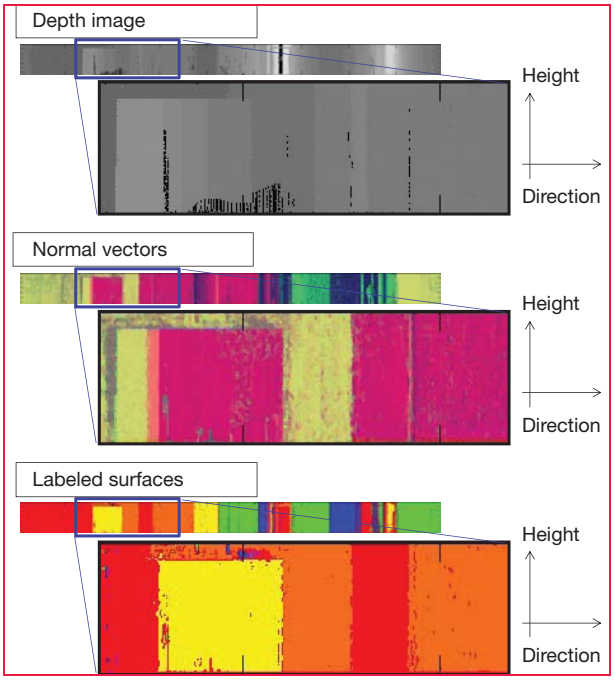

Figure 11: Results after point-based rendering and point clustering

Experiment

We used the Trimble Indoor Mobile Mapping System (TIMMS) integrated with an inertial measurement unit (IMU), a wheel encoder, a LiDAR system (TX5, Trimble), and an omnidirectional camera (Ladybug 5, Point Grey) (see Figure 6). Figure 7 shows a part of rendering results using acquired point cloud in our study. An entrance foyer consisting of a large room (21.6 m × 21.6 m width) in our university was selected as our study area (see Figure 8). The study area consisted of flat and cylindrical walls, square and cylindrical pillars, a grilled ceiling, doors with glass, and windows. These objects were representative flat and cylindrical surfaces. We acquired a 880-million color point cloud with TIMMS (see Figure 9) in our university. In the experiment, we used a 450-million color point cloud from our dataset.

In our experiment, 72 points were extracted as viewpoint candidates for point-based rendering, as shown in Figure 10. The point cloud taken from TIMMS was rendered from these viewpoints. Figure 11 shows results after point-based rendering and point clustering from a viewpoint. Figure 11 includes a depth image, a depth image, normal vectors, and initial labeled surfaces (overlay of depth edge and labeled surfaces). Each vertical axis shows height direction and each horizontal axis shows direction. Intensity values in the depth image indicate the depth from the viewpoint. Moreover, intensity values in the normal vectors and labeled surfaces indicate the horizontal direction of the point cloud. In addition, color values in the initial surfaces indicate labels of surfaces. In this experiment, spatial resolution was set as 0.2° in the horizontal direction and 2 cm in the height direction.

Figure 12 shows a rendered point cloud from a viewpoint in 3D space. The left image shows the input point cloud and the right image shows a result after polygon extraction.

Processing time for the panoramic image conversion and polygon extraction was several minutes in total for each viewpoint using an Intel core i7 2.80 GHz processor with MATLAB (single thread). Parts of the results of polygon extraction from the point cloud are shown in Figure 13. This figure includes examples of general building features, such as a flat wall and a cylindrical wall. Each row shows a result of point-cloud visualization and extracted polygon (boundaries). We have confirmed that point-cloud interpolation in a range image achieved spike noise filtering and geometry smoothing. Moreover, we have confirmed that noise such as the pedestrian was also successfully filtered from the point cloud.

Figure 14 shows integrated results for polygon extraction from 72 viewpoints. Our approach extracted 980 polygons from the point cloud fully automatically. As shown in Figure 14, some polygons that were extracted were failures. Our investigation showed that these failures were caused by LiDAR measurement noise, such as light reflection errors and moving object measurement. Although noise was almost eliminated, the remained noise in the range image affected the point-cloud interpolation.

Summary

We have proposed a method for panoramic rendering-based polygon extraction from indoor mobile LiDAR data. Our aim was to improve region-based point cloud cluster modeling after point-cloud registration.

First, we proposed an approach to acquire 3D data with an indoor mobile mapping system in an indoor environment. Moreover, we proposed a point based-rendering and clustering methodology to achieve a visualization and polygon extraction for building information modeling (BIM) from the massive point cloud. Our proposed methodology consisted of the viewpoint decision for point-based rendering, the

point-based rendering, the normal vector clustering for surface estimation, the point-cloud interpolation with a rectangular template, and point tracing. Then, we described an experiment that was conducted to acquire a massive point cloud with the TIMMS along horizontal and perpendicular trajectories in an indoor environment that included flat and cylindrical surfaces. Finally, we confirmed that our proposed methodology could achieve data acquisition for the BIM through point-based rendering and point cloud clustering from a complex indoor environment.

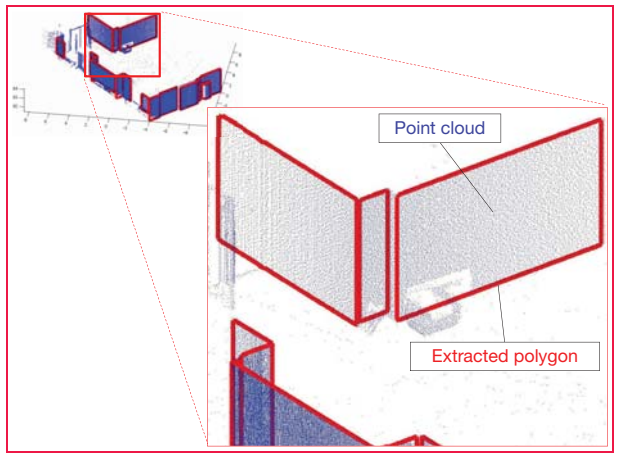

Figure 12: Point cloud and polygon extraction result

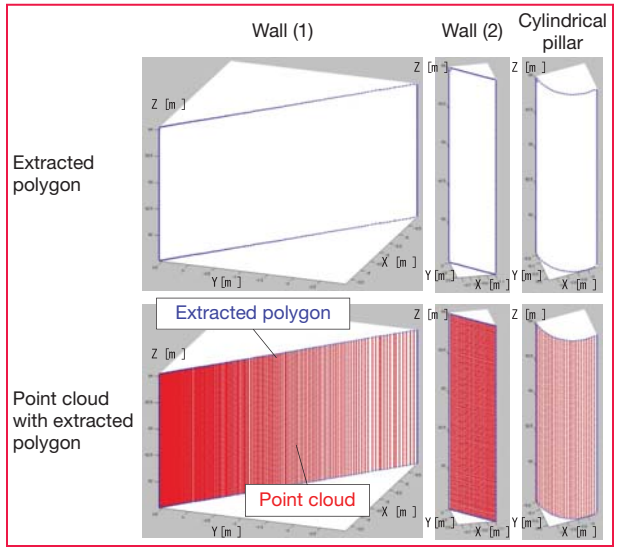

Figure 13: Parts of results of polygon extraction from point cloud

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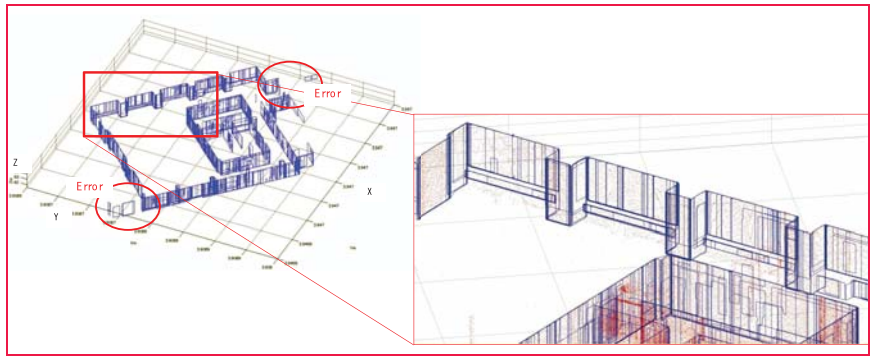

Figure 14: Integrated results in polygon extraction from 72 viewpoints

Public policy of the fight against insalubrious housing: the Moroccan Experience

The Moroccan experience in the fight against insalubrious housing is instructive; several recipes have been tested to contain this scourge that is related to human groups

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The insalubrious housing development is a global phenomenon,and one of the main issues that concerns the international community and local governments due to its continuous growth since the end of the last century and the complexity of its economic and social dimensions. Moreover, the UN Habitat underscored the dangers arising from this phenomenon especially in the southern countries where the number of shanty dwellers is likely to jump from 1 billion today to 2 billion by the year 2030[1].

Morocco that does not escape from this phenomenon,knew at the beginning of the last century, as a result of the population growth, rural emigration and emergence of some urban spaces, the first hard cores of shanties that have appeared, particularly in the large cities. This type of habitat that becomes a lasting phenomenon[2], takes many forms (shanty towns, illegal or unauthorized housing and old fabric), their common denominator being the disfigurement of the urban landscape and the insalubrity threatening the health and safety of the people who live in.

Aware of the importance of combating this phenomenon, the government has made from the fight against insalubrious housing, since the sixties, one of the priorities of the action in terms of housing. These efforts are continuing until the present time in order to achieve the 7.D target of the Millennium Development Goals[3], this target is to "succeed, by 2020, a significant improvement in lives of at least 100 million shanty dwellers "including the indicator" Proportion of population with access to the security of the housing tenure. "

In order to meet this challenge, this country has initiated a public policy designed to improve the housing conditions and ensure the access of the households living in precarious situations to decent housing. Nowadays, it occupies the 2nd position among 20 countries of the South that have expended considerable efforts, and have thereby earned the recognition of the international community for the fruitful results.

The development of this study on the insalubrious housing phenomenon in Morocco needs to take a preliminary insight into the concept of the insalubrity and its forms, in order to understand the terminology and unify the representations that can be made by each other, according to the specific circumstances of each country.

Insalubrious housing forms

When we approach the insalubrity, we encounter a difficulty in understanding this concept and in defining its contours[4]. If salubrity is considered as a healthy state of an environment favorable to health, insalubrity is that of a hostile environment which is dangerous for health.

Insalubrity is the subject of many definitions depending on the cultural context in which it occurs, but it

is always attached to the hygienic conditions and takes usually three forms: the shantytown, the illegal or clandestine habitat and the old fabrics.

Shanty town

A shanty town is a set of shacks serving as shelters built with an assortment of light reclaimed materials (iron sheets, wood, etc.) on land that is devoid of basic infrastructures (drain systems, drinking water adduction, power-network, etc.). In certain cases, we note the beginning of an entrenchment process, affecting the walls, in particular, and sometimes extending to roofing structures. Occupancy rate in shanties is very dense, with lots being narrow and public space often reduced to mere footpaths.

The illegal or unauthorized housing

It is anarchic habitat, uncontrolled during and after construction, usually made without any respect of technical, architectural or urbanistic rules. These constructions are sometimes spread even over risk areas, on a cliff on or near to landfills, not thus respecting any condition of salubrious habitat.

The old fabrics

It is basically the housing threatened with ruin in the medinas[5] and old fabrics, where the risk of collapse is high. This risk is growing with the degree of cohabitation and over-occupation that are present in a generalized way,but differentially according to the situation of each Medina. The degree of insalubrity and degradation in these areas varies from one case to another within the sectors of each of the medinas; "Insalubrity touches islets or whole sectors of almost all the old medinas"[6]

For developing this topic, we will study first, the evolution of the intervention strategies for insalubrious housing reduction during the period 1950-2003 (1st part) and then the program "cities without shanties" as a new approach to fight against insalubrious housing(2nd part).

Evolution of intervention strategies for the insalubrious housing reduction during the period 1950-2003: Aspects, objectives and results

Since the early years of the independence[7], the successive governments have tried to address insalubrious housing and especially the shanty towns, many programs have been developed and launched over the years to overcome this scourge, but without any big success. These interventions are motivated by all political,security and social reasons, and can be divided into three operating modes:

- *Resettlement*: This consists in allocating to recipients developed land lots[8]. These lots are built by the recipients themselves who receive assistance in the process, in the framework of integral or progressive land-lot equipment programs. The ultimate goal is the complete transfer of the population occupying the original site and the total destruction of the shacks.
- *Re-housing*: This consists in awarding social housing units[9] to shanty dwellers who have previously been the subject of a census and in certain cases also, to re-house household dwellers whose homes are targeted by de-densification operations, in the framework of "re-structuring/overhaul programs.
- *Restructuring*: This mode is intended to endow large and medium sized shanties –which may readily be integrated into the urban fabric—with such necessary infrastructures (as sanitation systems, roads, drinking water adduction, and power networks) as would allow them to regulate their situation in terms of land-registry and urban planning. The cost is borne jointly between the State or the community and recipients[10].

A quick review of the evolution of the insalubrious housing reduction policies reveals several successive phases in which one of the above types of intervention was favored:

Prior to 1980, welfare state and hygienist approach

During the period (1950-1970) there was the resettlement policy that dominated with the proliferation of summary subdivisions designed according to a so-called urban network"wholesome housing network". Public interventions proceeded from an hygienist urban vision inherited from colonization, which consists of, firstly,the demolition policy of settlements and displacement of households above the aforementioned homes network, and secondly the improvement of the equipment inside irregular settlements(water supply and the opening of roads following the alignments).

That period was characterized by a strong state intervention in the housing, the financial and operational involvement of the public sector, the time and the cost concerns and significant achievements to counteract the shanty towns' expansion.

During the period 70-80, the projects funding still relied on the general budget of the State with a political will to restructure the largest shanty towns (number inhabitants>4000 persons). Meanwhile, the state has opted for a new action program to fight against shanty towns: it is the progressive equipment areas; land lots allocated to shanty dwellers are summarily equipped and they will be connected to electricity, and roadways will be gradually paved according to the financial capacity of households over three years to eleven. These formulas were all abandoned because of the lack of concrete achievements.

A new approach was then adopted which consisted in the implementation of urban development projects (PDU[11]). This entailed the undertaking of integrated operations centered on in-situ restructuring of shanties[12]. This program includes a technical assistance and loans 'in kind' for the concerned people "building materials loans " and the creation of business parks and the achievement of public facilities and services at the city level to allow them to find jobs enabling them to meet the loans deadlines . The occupants of the demolished shacks will be assigned to a projected wholesome network

This strategy contributed to the adoption of new practices as: the participation of the

recipients in the process; the simplification of urban development norms and equipment standards; the streamlining of procedures underlining building permits; the coordination of different partners.

Due to the lack in recovery of funds spent by the State for recipients, and for supporting this policy, the national fund for the purchase of land and equipment was created in 1973 to receive the pre-financing of recipients in the housing projects and regional establishments of planning and construction in 1974 in the seven economic regions whose mission is to develop the real estate by carrying out the subdivisions and housing constructions with extra budgetary funds[13].

Alongside these achievements, informal construction benefited from the "laissez faire policy(French)" of the administration, which have accelerated the production of illegal housing and the aggravation of social problems, thus urbanization continues with two sides; the first is characteristic of the city centers "European" and the regulatory areas mainly occupied by middle and upper classes that have a reasonable coverage by public services; The second is characteristic of the popular housing areas, gathering the densely populated medinas and informal extensions, where the access problems to basic services are very serious.

Therefore, in the early 80s, urbanization in Morocco; effervescent and chaotic, caused that the economic capital had been the scene of urban riots that reminded the politicians of the existence of shanty towns and the dangers of their proliferation, hence the urbanism has ceased to be a technical question and become, above all, a political issue handled for several years following a security logic.

's 80: withdrawal of the state and the creation of specialized agencies

These years were marked by the setting up of institutional mechanisms to strengthen the role of the state in the fight against insalubrious housing: the National Anti-Insalubrious Housing Agency created in 1984, the National equipment and construction company and another institution "Attacharouk" created in 1987 will intervene by delegated mastery of works. The first urbanism agency was created in 1983 in Casablanca; the most affected city by this phenomenon, to supervise its spatial extension.

The 80's decade was marked by the withdrawal of the state that has substituted its role as a provider by the role of a regulator in terms of housing, as well as by a readjustment of the authority interventions based on specialized programs sponsored by the government agencies (newly created institutions) and the territorialcollectivities[14].

Various restructuring programs are led on shanty towns to integrate them to the urban context. The restructuring aims at keeping people on site by introducing on the urban level the necessary adjustments. These projects are carried out with financial support from USAID, it was

expected that the primary infrastructure would be financed by municipal budgets, and expenditures for the purchase of land, the costs of studies and the support infrastructure in site will be funded by the "HG002"[15] loan. These expenses should be reimbursed by the revenue collected from the recipients. As for socioeconomic facilities, they will be financed by the budgets of the various concerned ministries.

The shanty town-curbing strategy consisted essentially in equipping land lots and putting them at the disposal of the households concerned. It was undertaken through operations which integrated sites evenly for the purpose of guaranteeing social mingling and land balance. The projects consisted in developing land, equipping it fully with basic infrastructures, and endowing it with such common areas as would host sundry community activities.

's 90: diversity of intervention modes and introduction of social housing

In 1992, the census led on shanty towns by the Habitat delegations revealed the existence of nearly 1,000 shantytownssheltering160.307 households, about 850,000 people. In 1982, the number of shanty town dwellers was about 1,117,000 people (204,000 households). This regression of shanty town households (-44,000 households in 10 years) resulted from the efforts of the State and its components, "this effort is measured, during the 1982-1992 period by the delivery by the department of Habitat of nearly 134,000 shanty town curbing units with 63,500 curbing land lots, 59,500 restructuring land lots and 11,000 rehousing units."[16]

The policy of shanty town "resettlement" has enabled the public institutions to take advantage in this time of the signs of gratitude and international recognition. Taza (a small town) was even, through this program, declared a "city without shanties"[17]. Even so, this phenomenon continues to disfigure the urban landscape in Morocco which will persuade the government to test other solutions.

A national program of social housing called "200,000 housings program" was launched in partnership with the private sector, which benefited from tax incentives and administrative flexibility for the construction and sale of apartments of 200,000 DH, which allow to build 180,000 units, 77% of which are purchased by low-income households[18], but this program had been without big success.

At the end of the ninety, the Habitat department was called, in the agenda of shanty towns curbing(PARHI[19]), to define the most appropriate intervention methods to the savings opportunities of households with limited resources, to develop new mechanisms of action,especially through the promotion of land policy, the development of new synergies in the fight against insalubrious housing and the promotion of institutional arrangements for the completion of projects, thus directly involve other stakeholders (territorial collectivities, specialized institutions, urbanism agencies, water and sanitation boards, concerned populations, ...)

Despite these efforts, the urban crisis and the informal production of housing are steadily worsened; our cities continue to host the shanty towns in all their forms. In the early 3rd millennium, the statistics showed that the "anarchic housing groups" that lack the basic equipment involve 540,000 households, the shanty towns and scattered shacks involve 370,000 households; the housing threatening ruin 90,000 households, the total housing deficit including the needs of the de-cohabitation was estimated at nearly 1.240.000 units[20].

To Face this alarming situation, the state began to explore new approaches to deal with the results of previous achievements, largely insufficient in front of the upsurge in many cities of precarious housing in all its forms, and the persistence of large and medium shanty towns in the heart of major cities (Casablanca, Rabat, Tangier, ...); This problem has led to the establishment of a new strategy of action which will be discussed in the second part.

New approach of insalubrious housing curbing: cities without shanties program (VSB)

To reduce the growing needs and housing deficits, and to combat the problem of insalubrious housing, the state has set up a multifaceted action strategy. This is the case of the VSB program supported by the accompanying measures, from the massive and diverse production of social housing as a component of urban and social integration of poor who access the property, to other components including the establishment of urban hubs, new towns, new areas of urbanization, mobilization of public land, the treatment of housing threatening ruin and the creation of the guarantee fund to support the request oriented to social housing.

In 2004, the VSB program was launched to eradicate all shanty towns about 362,237 households (number updated as the program is taking place) in 85 cities and urban centers with an investment of about 25 billion DH, which include a state subsidy of 10 billion DH[21].

The accomplishment of this program is based on the city as a programming unit, a conventional framework fixing the shared responsibilities between the state and local governments and the achievement deadline, and increased prevention housing offer.

This program is a part of a new approach that breaks with the past government intervention, this intervention now is global (at the city level), it replaces the conventional process based on project, in order to find a lasting solution to the problem of precarious housing.

Another feature of this project is its large scale since it concerns all the shanty towns in the urban areas. For its best implementation, the program focuses on the production of the shanty town curbing units to be accompanied by the demolition of corresponding shacks.

Implementation instruments:

Mobilization of public land

The land question is crucial in the implementation of this program because the curbing projects of insalubrious housing and the promotion of social housing area big consumers of the urban land. Between 2003 and 2009, public land has been substantially mobilized, opening as much as 9,000 hectares for urban planning and development. The land thus opened was meant for a dual purpose: controlling shanty-sprawl and preventing insalubrious housing, as well as creating wholly new business parks and new towns[22].

Indeed, the mobilization of public land has served to encourage the private sector to invest in the construction of social housing, in a public-private partnership framework and to expand the public land supply of developed land lots, for the operators and households.

Program funding

An investment of approximately 17.118MDH was mobilized to 2010, being the overall cost of the program realization, 35% of which is generated by the integrated nature of the planned operations so funded by other resources (selling products of the equalization lots, shops ...). The remainder of the project cost is provided by contributions given by recipient households (own funds and / or debt) and state subsidies.

In 2002 a"housing solidarity fund "was set upto support this program, credited essentially by a tax on cement which was instituted in the same year[23], has seen the scope of its utilization widened to cover operations pertaining to social housing and to programs designed to reduce insalubrious housing.

Legal framework for action

To make the interventions of the actors involved efficient, a conventional partnership framework has been established between them defining operations planning, financing and implementation with clear responsibilities of each stakeholder.

This approach is reflected by the establishment of two important documents:

Cities without shanties contract: It is a contractual document between the State and local collectivities, specifying the commitments (roles and responsibilities) of the different parties concerned in the process of the implementation of projects aimed at reducing the sprawl of shanties within the same city. It also provides technical and financial data relating to land base and the consistency of the operating modes.

Funding agreement: It is a technical and operational document which defines funding terms and implementation modalities of the Local Shanty-reduction Program, with terms of reference outlined in the VSB Contract

Program governance

In order to ensure that contractual commitments are actually implemented, some coordination and follow up governance entities have been set up: The National Follow-up Committee chaired by the head of government, the regional coordination committee chaired by the Wali of the region and the Provincial identification and implementation Committee chaired by the Governor of the prefecture or province.

These committees issue periodic status/progress reports of the program and the project implementation.

Partners and operators

The institutional framework set up to ensure the implementation of the VSB program includes partners and public and private operators.

The partners in this program are the central authorities represented by the ministries of interior, finance, housing, to a lesser extent, other ministries according to the nature of public facilities to achieve, regional and provincial authorities and territorial collectivities.

The public masters of works are the Holding Company "AL OMRANE"[24], the public group CDG[25] and some territorial collectivities. The participation of private developers in re-housing projects is ensured by calls for expression of interest and through incentives (land, financial, fiscal ...)

Social follow-through of households

Social follow-through of households to be transferred is crucial as far as securing their adherence to the program and facilitating their smooth integration in new host areas concerned. Broadly speaking, the approach aims to foster information flow and to facilitate access to and appropriation of the projects by the populations concerned, especially in difficult districts. Follow-through consists of a number of actions designed to enhance proximity, hearing, animation, and intermediation in such a way as to ensure that the spatial projects really match and bring about social improvement and also to identify exclusion risks for the most vulnerable people.

Social Follow-through Cells which are present on the site receive and listen to the concerned populations and help them to express their complaints and needs for transmitting them back to the technical staff to assist them in finding the appropriate solutions to their situations.

VSB Program: contribution of the social housing and appreciation.

Among the accompanying measures of the VSB program, the establishment of a legal framework to encourage the social housing offer and to support the demand, which helped to meet substantial needs and to avoid the multiplication of the clandestine housing applicants.

Housing offer diversification and support for the demand

The overall housing deficit in 2002 was around 1.24 million units, which pushed the government to adopt a 2003-2010

action plan to increase the production rate to 100,000 social housing per year, to gradually eradicate insalubrious housing. To avoid the pitfalls of the past, the government has opted for a simultaneous action on both the elements of supply and those of demand.

Diversification of social housing products:

The state has created in 2008 a new housing product with a low real estate value for the benefit of the needy families. This type of habitat is made up of apartments of 50 to 60m² marketed 140.000DH likely to constitute a competing product to the shacks that are sold at the same price in the big cities, and its area does not usually exceed 12 m².[26]

This product is completely tax-free for the benefit of developers who are the partners of the state in achieving the construction projects with a minimum of 500 apartments in urban and / or 100 apartment in rural areas over a maximum period of 5 years while respecting regulatory and planning provisions. These programs benefit from the public land for the cost price.

These apartments are designed for people receiving an income less than or equal to twice the minimum wage being4000DH. Are eligible shanty dwellers, residents of homes threatened with ruin and uniform wearers.

The old program of the social housing in 200.000DH was revived in 2010 by a new formula of apartments in 250.000DH following the rising cost of the building materials and land; it was planned incentive measures in favor of the developers and acquirers to encourage the construction operations and increase the purchasing power of the poor families:

- The period of application is 2010-2020 to provide sponsors visibility over the future of investment and give households the time for mobilizing the acquisition cost which shall not exceed 250.000DH;
- The VAT amount is offered to purchasers as a direct state subsidy on the condition that they do not own any housing and they use it as their main home for a minimum of 4 years;
- Specifications relating to social housing that include the provisions ensuring the quality and safety of buildings;
- Promoters are exempt from any taxes pursuant to an agreement to be concluded with the State coupled with specifications for the production of at least 500 social housing over a maximum period of 5 years;

This diversification of the social housing offer due to the incentives granted by the Government, has facilitated the access to these products at a fairly large population.

Support for demand

* Lower interest rates and longer repayment duration.

The Excess of liquidity characterizing the banking system since 1999 has increased the competition among banks to capture the mortgage market[27]. The low interest rates, combined with the non-requirement of personal contribution and the lengthening of the loan term up to 25 years, increased the household borrowing capacity, allowing them to continue to feed the demand despite the rising property prices.

* The Guarantee Fund Institution

The Governments and the partner banks have concluded in December 2003, an agreement for the creation of two guarantee funds FOGARIM and FOGALOGE. These funds have been created to replace the drawback system of interest, which concern only the population with a regular income and thus exclude a large part of the population not eligible to the bank credit because of the irregularity of its revenues. The FOGARIM is designed for people with low and irregular incomes in order to buy a home not exceeding 250,000 DH. For this reason, the Central Guarantee Fund was endowed with a budget of 600 million DH, funded by the Housing Solidarity Fund. Regarding to the fund FOGALOGE, it aims the coverage of the bank loans to the public sector employees for the purchase or construction of the social housing[28].

Appreciation of the VSB program

This program is seen as a clever idea which is a result of a political will and a voluntarist vision,which allowed during the period 2004-2012, the declaration of 45 cities without shanties among the 85 concerned cities, being 200,666 households benefited from these curbing projects. However, this policy also raises reservations.

Advantages

This traversable policy is innovative compared to earlier policies distinguished by:

- A very strong involvement of the private sector;
- Social Follow-through of Households and their contribution for improving the conditions of implementation of the curbing projects;
- The flexibility that allowed, through a margin of flexibility left to the initiative of decision makers and operators, the policy changes and corrections based on the local contexts;
- The financial resources availability and the multitude of funding sources (subsidies, guarantee funds for low-income families, bank loans, equalization products, international financial organizations, advances of recipients) which allowed the program to succeed;
- A large prior consultation on the opportunity of the program;
- A positive achievements; the living conditions of the recipients have significantly improved the access to property, basic services (water, electricity, ...) and public facilities.

Constraints

Despite the shown goodwill and the concrete actions on the field, some constraints persist:

- The complexity of the land

management due to the unavailability or the high cost of some public lands targeted by these operations, burdensome and slow clean up procedures of land, the inadequacy of the lands designed to house the shanty dwellers or their incompatibility to the planning documents ...;

- The households transfer difficulties and their limited financial resources;
- Insufficient data control on the recipient due to the lack of a national database of households that have already benefited from the program, the relatively unknown saving capacity of households and their expectations from the program and the development of new informal settlements outside the control;
- No honoring of financial commitments and the relative inaccuracy of the contracts content and responsibilities of each partner;
- Insufficient adherence of territorial collectivities due to their limited means, the political one-upmanship and the reconsideration of the process established by the Ministry of Housing;
- A lack of widespread Social Follow-through of all projects of shanties curbing or its insufficiency which sometimes becomes a source of project blocking or delaying.

Conclusion

The Moroccan experience in the fight against insalubrious housing is instructive; several recipes have been tested to contain this scourge that is related to human groups. Its expansion is favored certainly by poverty and the difficult economic conditions, but other social and behavioral factors are catalysts. It is now necessary to make an ex-post evaluation of all these public policies in order to draw the relevant conclusions and to rectify the situation in the light of the recommendations. The relative success in stemming this phenomenon can also be explained by the limited state intervention and its simplistic approach; the Moroccan model should be improved. First, given the current competence dilution, institutional backing of this phenomenon must be revisited in order to strengthen the attributions and the technical, legal and financial means of the organization in charge of this project, which must be attached to the highest authorities so as to give a binding nature and executory force to its decisions.

Then, no doubt that the upstream action for preventing is better perceived than the downstream action of curing, the rural world is an endless source of potential migrants to the city. If we succeed in fixing them on their land, huge success will be realized,that is to say, the state is expected to further expand the experience of emerging rural centers as complete living areas.

Finally, so far the approach is not adapted to contexts and behavioral aspects involved, hence there is a great need to initiate sociological studies to probe the social heritage and people unconsciousness and so

as to draw necessary conclusions for future public action.

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[2] Fathallah Debbi, the problem of insalubrious housing in Morocco, in Al Maouil- Journal, Rabat, June 1999, p12.

[3] The Millennium Development Goals are general objectives adopted by UN member States in 2000 that apply to the whole world. The Millennium Declaration contains eight goals, from which 18 targets were established. The Goal 7, Target 11, meets one of the most pressing challenges of the Millennium.

[4] RHARBI L. & H. Dinia, Insalubrity in the urban built: attempt of approach, Notebooks of the National Anti-Insalubrious Housing Agency, Almaouil journal, June 1991.

[5] The medinas are the older areas of a city or the first cores that were born there.

[6] DEBBI Fathallah: the problem of insalubrious housing in Morocco; the notebooks of the National Anti-Insalubrious Housing Agency, 1991-1997 edition p: 17.

[7] Morocco was colonized by France since 1912, it became independent since 1956.

[8] Its area is between 64 and 70 sqm for single-family lots and 80 m² for the twin-family lots - program cities without shanties-

[9] The area of the house is less than or equal to 60 sqm with a total real estate value not exceeding 120,000 dirhams, one third of which is supported by the State.

[10] The aid of the State (50% of the cost) is for the equipment in roads and sanitation system. The drinking water supply and electrification are borne by the beneficiaries with a contribution, if any, of the local community- program cities without shanties-

[11] French : plan de développement urbain

[12] Examples: Douar Doum in Rabat (21000 inhabitants / 18 ha), Saknia Kenitra (38000 inhabitants / ha 48, BorjMy Omar Meknes (45000/159 ha); these districts are restructured with financial support of IBRD.

[13] Tahar Berrada, Assessment of the main forms of public intervention in the fight against insalubrious housing, AlMaouil journal, June 1991, Rabat, p 24-32.

[14] DryefM'hamed, urbanization and urbanism law in Morocco, National Scientific Research Centre, Edition la Porte, Paris, 1993, p 266.

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of the Workshop held on March 20 and 21, 2001, Rabat, pp16-22.

[17] Morocco received the Honor Award in 1995 granted by the UNCHS.

[18] Ministry of Housing, Social Housing Report, 2010.

[19] Shanties curbing agenda (French: programme d'action de résorption de l'habitat insalubre).

[20] M. H. Alami, Urban management and access to basic services, 2005, p.222.

[21] National report on shanty-towns curbing: the moroccan experience, Ministry of Housing, urban Planning and City Policy, p.14.

[22] National report on shanty-towns curbing: the moroccan experience, Ministry of Housing, urban Planning and City Policy, p.16.

[23] The value of this tax is (3 cents / kg) by the finance law of 2012.

[24] This public limited company was founded in 2004 after the merger of public housing operators, today it comprises 14 subsidiaries covering Morocco.

[25] Written in French : caisse de dépot et de gestion.

[26] Ministry of Housing and Holding Al Omrane, report on social housing for 140,000 DH, 2008.

[27] Ministry of Finance, study on the new housing strategy in Morocco, 2008, p.5.

[28] To gain access to this fund, the annual income of the public servant shall be less than 72,000 dirhams and the overall acquisition cost of housing should not exceed 400,000 dirhams. Funding quotas can cover up to 100% of the overall cost of housing. The maximum repaymenttermcan go up to 25 years.

The paper was presented at FIG Working Week, Sofia, Bulgaria, 17-21 May 2015.

Strategic Noise Mapping for the German Federal Railway Authority

Commissioned by the German Federal Railway Authority, and under the direction of Disy Informationssysteme GmbH, the consortium of firms Disy, Pöyry and SoundPLAN are performing strategic environmental noise mapping of German rail lines up to mid-2017. By this point in time, according to EU guidelines, the third round of strategic noise mapping must be completed, not only for the main rail lines but also EU-wide for all carriageways. This major project involves not only the calculation of noise levels, but also a complex data management system to check, clean and homogenise huge quantities of data as the basis for the sound propagation calculations. The country-wide noise maps resulting from this project are the basis for noise action planning. Heterogeneous output data requires complex data management

A particular challenge relates to the almost unimaginable size and heterogeneity of the data that has to be processed. This data not only comes from different sources, it comes in different formats, levels of quality and spatial layouts. These must be reconciled and verified against one another so that in the end the noise map can be calculated. *www.disy.net*

GZC chooses SuperPad

Supergeo has announced that the multifunctional mobile GIS software, SuperPad, has been recently selected by the Slovenian geodetic consulting firm, Geodetski zavod Celje, d.o.o. (shortened as GZC) as the tool to collect and processing geospatial data. *www.supergeotek.com*

The French Ministry of Defense chooses Global Mapper

Blue Marble Geographics and Alain Olivier Geomatique, Blue Marble's partner based in France, have announced that the French Military of Defense (Ministère de la Défense) has signed a three-year agreement to deploy Global Mapper throughout all of branches of the country's armed forces. This enterprise license provides unlimited access to Global Mapper's powerful geospatial data processing and analysis functionality for all frontline and support defense personnel. *www.bluemarblegeo.com*

Bentley OpenRoads ConceptStation

Bentley Systems has announced OpenRoads ConceptStation, a conceptual modeling application that empowers highway engineering professionals to quickly create conceptual road and bridge models in a matter of hours – not days. It enables rapid and iterative conceptual and preliminary design, leveraging contextual information obtained through point clouds, reality meshes, GIS, and other sources.

It combines engineering drawing tools and project costs to facilitate better decision making in the conceptual design phase of a project.

GIS tech to track tax defaulters

Proposed as smart city, administration of Dharmshala, Himachal Pradesh, India has warned violators to shun illicit practices. The hill town will undergo survey based on GIS for property tax and violations in constructions made by the residents of this region. Corporation has urged the residents to contribute in the development of the town as smart city. *http://timesofindia.indiatimes.com*

PCI Geomatics and PrecisionHawk partnership

PCI Geomatics has announced that it has entered into a long term partnership with PrecisionHawk, a leader in the commercial Unmanned Aerial Systems (UAS) industry, to deliver improved data analytics to its customers. *www.pcigeomatics.com*

Industry to build ISRO's two spare navigation satellites

ISRO is finalising plans to get two spare navigation satellites of its IRNSS fleet built by industry in the next two years. It will handhold industry for the first project and build it by March 2017. The second one will be built entirely by industry, according to Mr. M. Annadurai, Director of ISRO Satellite Centre. Both will be 1,400-kg spares kept ready on ground.

"We plan to have a consortium of industry to do the two navigation satellites. The rest of the seven navigation satellites are in orbit," he said. ISRO will lend its infrastructure and expertise while industries bring on the hardware for the satellites that will back up the Indian regional navigation spacecraft, sometimes called the 'Indian GPS'. Expressions of interest were called in June and ISRO is discussing the nitty-gritty of risks, price and profit sharing with prospective partners.

Dr. Annadurai said ISRO plans to go to the next level and issue the request for proposal — the technical bid — "in weeks" to interested companies from both, public and private sectors. *www.thehindu.com*

November's Galileo satellites arrive at Europe's spaceport

A transatlantic flight delivered four Galileo satellites to French Guiana in preparation for a shared launch this November by Ariane 5. Each satellite was placed into protective containers before leaving the cleanroom environment of the test facility. These containers incorporate sophisticated environmental control, satellite monitoring systems and shock absorbers.

Pinpoint navigation in Israel

The precision of GPS systems in Israel is expected to improve dramatically from an accuracy of ten meters to only one meter, after an European Geostationary Navigation Overlay Service (EGNOS) navigational station was stationed in the Technion Israel Institute of Technology this week. The new station is designed to benefit aviation in Israel, where airspace is among the most congested in the Middle East, and it will also improve the navigation app used by many drivers. The system which has been deployed at 50 stations around the world, consists of three satellites and a network of ground stations. The station's satellites broadcast signals enabling users to receive precise locations in real time. Placing the stations is part of cooperation between the European Space Agency (ESA), the Technion Faculty of Civil and Environmental Engineering Mapping and Geo-Information Department, and Israel Aerospace Industries Ltd.'s (IAI) MLM division. *www.globes.co.il*

Russian jamming up the works with POLE-21

In a story posted at *Sputnik News*, Russia has now developed a system that can block enemy electronics.The report states that an integrated jamming system to screen strategic facilities from cruise missiles, smart bombs and drones using GPS, GLONASS, Galileo and Beidou global positioning systems for homing, has entered service with the Russian armed forces. Dubbed as POLE-21, the system consists of jamming modules installed on mobile phone towers that operate as a single whole to cover entire areas, making them impregnable to satellite navigation systems. In addition to be being powered by a tower's circuit, the Pole-21 modules also use their GSM antennas as a backup channel for signal control and transmission. *www.satnews.com*

Putin orders to ensure long-term government support for civil ship building

Russian President Vladimir Putin has asked the government to ensure a long-lasting state support for civil ship building, according to the Kremlin press service. He ordered to extend the term of giving subsidies to Russian companies to compensate part of their expenses on paying interests on loans for buying ships as well as lease payments. Putin has also tasked the Russian government to elaborate a plan on installation of satellite navigation equipment based on Glonass system on Russian vessels, a document published on the Kremlin website said. "With a view to ensuring the safety of navigation, to develop a comprehensive plan for promotion of the use of electronic navigation charts for inland waters and installation of satellite navigation equipment based on Glonass system for inland and mixed (river — sea) navigation vessels," the list of instructions issued by the president following the State Council meeting devoted to development of inland waterways said. *https://sputniknews.com*

EGNOS-Africa joint programme

The 26th of July 2016 marked the beginning of cooperation between ECCAS and the Joint Programme Office (EGNOS in AFRICA Support Programme -Joint Programme Office), "JPO", by signing the Memorandum of Cooperation; ECCAS represented by its Secretary General His Excellency Ambassador Ahmad Allam -Mi, and JPO represented by its Director, Mr Ladislaus Matindi. The signed Memorandum of Cooperation will guide the collaboration between the two organizations in the field of satellite navigation, specifically on the potential implementation and operation of GNSS / EGNOS in ECCAS member States and its applications in all sectors (aviation, maritime, rail, road, agriculture, land management, etc.).

JPO has notably developed a roadmap for the implementation of EGNOS in Africa for the benefit of all stakeholders including the States. In 2016, the JPO enters a second operational phase under the 'Support EGNOS in Africa Programme' which is co-financed by the EU with a contribution of ASECNA. *www.aviation-africa.eu*

Dr. Dorota Grejner-Brzezinska receives Kepler award

The Institute of Navigation's (ION) Satellite Division presented Dr. Dorota Grejner-Brzezinska with its Johannes Kepler Award September 16, 2016 at the ION GNSS+ Conference (Portland, Oregon) for her outstanding contributions in advancing high-accuracy GNSS/INS integrated systems, educating future navigation leaders, and for strengthening the ties between satellite navigation and geodesy. www.ion.org

Pakistan to launch remote sensing satellite in 2018

Pakistan Space and Upper Atmosphere Research Commission (SUPARCO) is set to launch the country's first remote-sensing satellite in March 2018. Pakistani President Mamnoon Hussain said that ultimate aim of launching the remote sensing satellite will be giving a boost to the national development activities.

ISRO sanctions Rs. 36 lakh to CGIPS

Indian Space Research Organisation (ISRO) has sanctioned Rs.36 lakh to the Centre for Geoinformatics and Planetary Studies (CGIPS), Periyar University, to carry out research on lunar and martian surfaces. The ISRO has sanctioned the research project to S. Anbazhagan, Director for the Centre under its Announcement Opportunity (AO) programme, coordinated by the Space Application Centre, Ahmedabad, according to C. Swaminathan, Vice Chancellor of the University.

The Centre will utilise the funds for analysing data of Chandrayaan-1 and Mangalyan satellites to understand the geological activities of lunar and martian surfaces. Prof. Anbazhagan, Principal Investigator of the projects, has said that the surfaces of the Mars preserve evidence for hydrological activity in the form of valley networks and outflow channels. *www.thehindu.com*

Tanzania will use drones to aid in mapping, prevent clashes over land

Tanzania's government is set to deploy drones to speed up land mapping in rural areas in a bid to halt frequent, sometimes deadly clashes between farmers and cattle herders over land and scarce water resources. In 2014, local media reported repeated outbreaks of fighting over land in Tanzania's northern Manyara region, resulting in several deaths. Aided by drones, more than 300,000 title deeds are expected to be issued in Ulanga, Kilombero and Malinyi districts in eastern Morogoro, under a project by the World Bank and a local parastatal, the Commission for Science and Technology (COSTECH). The titles are expected to be issued within a year of successfully using the new technology. *www.voanews.com*

FARO VectorRI Imaging Laser Radar

FARO® has announced the launch of the FARO VectorRI Imaging Laser Radar, an ultra-high speed, large-volume, non-contact 3D measurement solution with high-resolution 3D imaging and projection guidance for manual and automated manufacturing processes. This product introduces a new class of LIDAR with High Speed Imaging (HSI) technology. HSI combines ultra-high speed 3D scanning and ranging with high-resolution 3D imaging and projection. It is the world's first and only LIDAR with HSI technology delivering performance improvements over traditional LIDAR solutions, with high speed distance measurement, high speed beam steering, image-contrast functionality and projection guidance capabilities. *www.faro.com*

SimActive brings picture-in-picture 3d viewing with version 6.5

SimActive Inc. has announced Correlator3D™ version 6.5 with a new picture-in-picture (PiP) feature. The PiP brings a 3D rendered view of projects through an inset window, visible at all times to streamline processing and editing. The PiP allows a 3D visual assessment of data and results throughout the entire production workflow, including real-time modifications displayed during DEM editing. www.simactive.com

DAT/EM Systems releases software Version 7.3

DAT/EM Systems International has announced the release of the 7.3 edition of DAT/EM software products. Updated products include Summit Evolution™ 3D photogrammetric workstation, LandScape™ 3D point cloud viewing and editing software as well as Capture™, which links Summit Evolution and LandScape products to third party programs including ArcGIS® and ArcGIS Pro, AutoCAD®, Global Mapper® and MicroStation®. *www.datem.com/*

Certification Center Svyaz-Certificate relies on R&S SMBV100A GNSS

The Certification Center Svyaz-Certificate in Russia exclusively uses the GNSS simulator in the R&S SMBV100A vector signal generator for the new performance tests on ERA-Glonass emergency call systems in line with the Russian GOST R 55534 specification. The R&S SMBV100A is already used in the conformance test solution consisting of an R&S CMW500 wideband radio communication tester, GNSS simulator and the associated application software.

During performance testing, it is verified whether the GNSS receiver of an ERA-Glonass emergency call system fulfills the accuracy requirements in line with the specification. In case of an emergency, the IVS should not only correctly transmit position data according to a specified protocol to the public safety answering point (PSAP), but position data must also be accurate so that the first responder can locate the accident vehicle quickly. Performance tests are now a part of the certification, in addition to the existing conformance tests. *www.rohde-schwarz.com/*

Bluvision selected as Waze Beacons Partner to Power Tunnel Navigation

Bluvision were selected as the hardware partner for enabling tunnel navigation capabilities by Waze. Waze, the free, real time, crowdsourced traffic and navigation app powered by drivers, has developed a viable solution that addresses 'tunnel blindness' in the absence of GPS. Bluvision's Bluetooth sensor beacons - BEEKS Plus with extended battery life that can exceed 6-years, along with Waze innovative software - is the perfect solution to the challenges with tunnel navigation and accuracy in ETA. *www.bluvision.com*

Xiaomi's Mi Rabbit is a Compact Tracking Device

Xiaomi's Mijia ecosystem has yet another new product in the form a small tracking device called the Mi Rabbit. It is basically a compact tracking device that can be carried around in a pocket.

The device seems to be primarily aimed at children to help their family members track their movements on the go. That said, this device may be of use for ladies too, keeping in mind women safety. The Mi Rabbit apparently utilizes GPS and GLONASS positioning system to locate the user carrying the device with an accuracy of up to 5 meters. *http://techpp.com*

Digpro launches mobile application

Digpro, the major innovator in the field of Geographic IT, is now launching a mobile application for its network information system (NIS). With dpWebmap meets Digpro network operators' strong demand for mobility and flexibility in their daily work with the management of different networks out in the field.

Now launched dpWebmap, a mobile application that makes network data available in an effective and accessible manner. With dpWebmap the network operators will efficient their communication with external resources in a simple and user-friendly way, and can visualize the correct information in real time to technicians in the field. *www.digpro.com*

IFEN NCS TITAN GNSS Simulator

IFEN GmbH has announced the launch of its new NCS TITAN GNSS Simulator. With up to 256 channels (and 1024 multipath channels) and up to 4 RF outputs per chassis, the extra complexity and cost of using multiple signal generators is avoided, improving reliability without compromising on functionality.

The innovative design of the NCS TITAN allows users configure channels for any GNSS signals and allocate those channels to any of the RF outputs fitted. This flexibility enables the same Simulator hardware to be used for an extensive range of tests, for all types of GNSS applications. The NCS TITAN sets new standards in the field of GNSS Simulation, in terms of fidelity, accuracy, dynamics, iteration rates and reliability. The Simulator has been developed in cooperation with WORK Microwave GmbH, Germany. *www.ifen.com*

SMC to procure two additional GPS III satellites

The Space and Missile Systems Center awarded a contract option to Lockheed Martin Space Systems Company to procure two additional GPS III satellites. The contract option procures long lead and production hardware to produce space vehicles 9 and 10 for the next generation of GPS satellites being built by Lockheed Martin. The government expects to compete future purchases of GPS III satellites, beginning with GPS III SV 11. This competition will maintain the current technical baseline of GPS III and will add additional hosted payloads to increase system accuracy, search and rescue capability, and universal S-band compatibility.

NovAtel announces New VEXXIS Family of GNSS Antennas

NovAtel has introduced its new VEXXIS series of GNSS antennas. The VEXXIS series includes two lines of antennas, the new GNSS-800 series and the GNSS-500 series introduced earlier this year.

The VEXXIS GNSS-800 is designed with the aim to provide exceptional tracking performance previously unachievable in a small form factor. According to NovAtel, the patented multi-point feeding network and radiation pattern optimisation technology delivers stable phase centre and enhanced multipath rejection as well as exceptional low elevation satellite tracking while achieving high peak zenith gain.

The VEXXIS GNSS-500 series of antennas were designed with a low profile, aerodynamic enclosure, making it very suitable for ground vehicles in applications such as agriculture, machine control and mobile mapping.

Handheld ALGIZ 10X Ultra-rugged Tablet

Handheld Group has announced a major upgrade to its popular Algiz 10X ultra-rugged tablet computer with new and improved screen technology and improved GPS/GLONASS functionality. The new version of the Algiz 10X has a 10.1" HD projective capacitive touchscreen that is ultra-bright and built for outdoor use. The 10-point touchscreen offers the ability to operate in both glove mode and rain mode, allowing outdoor users to operate seamlessly in any weather. It also comes with an optional active capacitive stylus to maximize ease of use. *www.handheldgroup.com*

Fugro's Oceanstar manoeuvring system enhances vessel safety

Fugro has introduced a service to its range of satellite positioning systems. Oceanstar is an onboard decision support system that has been developed to improve navigational safety and reduce the operating costs of commercial vessels such as cruise ships, container ships, ferries, ro-ro vessels, bulk carriers and tankers. The decision support system incorporates approved and 'Wheel Mark' certified functions such as differential GNSS (DGNSS), speed and distance measurement device (SDMD), transmitting heading device (THD) and rate of turn indicator (ROT). The system can be tailored to particular requirements and market environments to ensure a cost effective, fit-for-purpose solution.

Telit Expands Sensor-to-Cloud Solutions

Telit has announced the commercial availability of its BlueMod+S42 Bluetooth 4.2 module, and two variants of the popular SL869 single and multi-standard positioning module family, the SL869-V3 and the SL869-ADR. The BlueMod+S42 complies with the Bluetooth SIG v4.2 standard, which features critical upgrades, making Bluetooth low energy (BLE) applications faster, and more secure. The SL869-V3 and SL869-ADR are multi-constellation Global Navigation Satellite System (GNSS) receiver modules, each capable of tracking and using up to three constellations simultaneously to produce positioning, velocity and time information.

Clarion to use Furuno's GPS Receiver

Furuno's GV-86 GPS receiver chip with its dead-reckoning DR/GNSS module will

be integrated into Clarion's NXR16 car navigation systems for the auto-leasing and car rental industries. The GV-86 features a dead-reckoning-enabled GNSS receiver, which receives concurrent GPS, SBAS, and QZSS satellite signals. The dead-reckoning capability allows the unit to provide positioning while receiving multiple GNSS signals in such harsh environments as tunnels, urban canyons and underground parking, the company said.

KB Radar develops UAV-based SATCOM, navigation jammers

Belarus' KB Radar Design Bureau has developed satellite communications and navigation jamming systems that can be mounted on tactical-level unmanned aerial vehicles (UAVs). The Touman-2 has been designed to jam the downlink and transmission signals for equipment that uses Inmarsat, Thuraya, and Iridium satellite communications infrastructure, while the Touman-2.2 is intended to interfere with GPS, GLONASS, and Galileo satellite navigation systems. The Touman-2 jammer can operate in two modes - barrage and spot - and can be used in conjunction with ground-based apparatus to enhance its effect. *www.janes.com*

McMurdo launches emergency beacons with GPS, GLONASS, Galileo

Emergency preparedness company McMurdo has launched a new family of Emergency Position Indicating Radio Beacons (EPIRBs) that will accelerate the search-and-rescue process by combining multiple frequencies – including GNSS – into a single EPIRB product. The McMurdo SmartFind and Kannad SafePro EPIRBs are distress beacons that can support each of the four frequencies used in the search-and-rescue process: GNSS for location positioning, 406 MHz and 121.5 MHz for beacon transmission, and Automatic Identification System (AIS) for localized connectivity.

The multiple-frequency capability will ensure faster detection, superior positioning accuracy, greater signal reliability and, ultimately, accelerated rescue of people or vessels in distress, the company said.

Harxon releases GNSS Beacon Antenna

Harxon has released a utility beacon antenna HX-CS7615A to professionally solve marine satellite positing issues. The device supports GPS L1/L2, GLONASS L1/L2 BDS B1/B2/B3 and Beacon frequencies (282.6～326kHz), which greatly overcomes the defects of long-distance transmission limits. In addition, combining this range of frequencies in one antenna makes this device much more cost effective. The multi-path rejection board designed inside significantly eliminates measurement errors. The phase center of this antenna remains constant as the azimuth and elevation angle of the satellites change.

Carlson releases BRx6

The all-new Carlson BRx6 is a multi-GNSS, multi-frequency smart antenna released by Carlson Software Inc. Each BRx6 contains a multi-constellation, multi-band 372-channel GNSS receiver, Athena© RTK technology and an integrated Atlas© L-band receiver.

In addition, the BRx6 contains electronic sensors that measure tilt, direction (electronic compass) and acceleration, fully supporting SurvCE's advanced features like LDL (Live Digital Level or e-bubble), leveling tolerance, auto by level, tilted pole correction and advanced stakeout features. SurvCE contains sophisticated checks for compass and acceleration anomalies to ensure accuracy.

SLX-1 Multi-application CORS GNSS Receiver by Satlab

Satlab Geosolutions AB, announced its multi-purpose multi-frequency SLX-1 GNSS receiver. It is designed to function as a CORS receiver and a mobile sensor suitable for any application where a rugged multi-application GNSS receiver is required.

Based on embedded Linux operating system, the SLX-1 is a true multi-user and multi-tasking solution. The base CORS design is ideal for long unattended and continuous operation. The receiver tracks GPS, GLONASS, BDS, GALILEO, QZSS and SBAS constellations and can maximize the tracking to observe all visible GNSS satellite signals, thereby providing maximum performance for accuracy and real-time measurements. *www.satlabgps.com*

Teledyne Optech lidar launched in OSIRIS-REx asteroid mission

Teledyne Optech recently announced that the OSIRIS-REx Laser Altimeter (OLA) was launched successfully from Cape Canaveral, USA early this month. OLA was designed by scientists and engineers from Teledyne Optech and built by MacDonald, Dettwiler and Associates (MDA). It had been installed and tested aboard the OSIRIS-REx (Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer) spacecraft.

OSIRIS-REx will reach the asteroid Bennu by 2018. Upon reaching Bennu, OLA will scan the surface to create a high-resolution 3D map of the entire asteroid, which will help scientists understand its morphology and select the best spot for OSIRIS-REx to collect a sample of its surface material. This sample will be collected in 2020 and returned to Earth in 2023. Because Bennu is a carbonaceous asteroid that has likely changed very little since the birth of the solar system, scientists hope that this mission will shed light on how the solar system developed. OLA, one of the most advanced lidar instruments ever used for such a mission, is equipped with a rapid scanning mirror and two separate lasers.

Antenova's Beltii, miniature antenna for small PCBs in GNSS devices

Antenova Ltd, manufacturer of antennas and RF antenna modules for M2M and the Internet of Things, has announced Beltii, (P/N SR4G013), a brand new embedded antenna which measures only 15.6mm x 3.3mm x 4.4mm, and operates with all global public satellite constellations.

The antenna has been cleverly designed to work over a very small ground plane on a small PCB, where it can be placed in a corner position, and does not need any ground clearance. Beltii works with

all of the world's public satellite constellations: GPS, GLONASS, BEIDOU and GALLILEO, and can add a positioning capability to any small, lightweight device. It is suitable for wearable electronics, trackers, drones, navigation devices, and sports applications. *www.antenova-m2m.com*

New Leica iCON roller– high quality and productivity

Leica Geosystems, recently released its new iCON roller, providing contractors with the solution to achieve constant and effective compaction on any work site. The new iCON roller uses on-screen visualisation to accurately show the user where completed passes have occurred and where more are needed for consistent compaction results. Through vivid colourisation and a simple-to-read window, costly reworks are avoided when pass count progress is constantly tracked.

"At Leica Geosystems, we are continuing to advance the digitisation of the construction industry," said Petter Heyerdahl, Leica Geosystems Machine Control market segment manager. "With our precise positioning and latest visualisation technology, operators are maximising productivity and increasing safety on the most challenging sites. With the new iCON roller, not only do they receive an easy-to-use solution but they can also manage all data directly in the cab of the machine."

Hexagon Safety & Infrastructure acquires GISquadrat

Hexagon Safety & Infrastructure has acquired GISquadrat GmbH of Vienna, Austria. The acquisition will enhance Hexagon's geospatial, cloud and mobile solutions for governments and utility providers in Europe. GISquadrat uses Hexagon software in a cloud environment to provide data capture and management services and applications, including task-specific field solutions for infrastructure networks and public services. *www.hexagonsafetyinfrastructure.com*

MARK YOUR CALENDAR

October 2016

Commercial UAV Expo 2016
31 October - 2 November
Las Vegas, USA
www.expouav.com

Bentley YII Conference
October 31 - November 3
London, UK
www.bentley.com

November 2016

UPINLBS 2016: Ubiquitous Positioning Indoor Navigation and Location Based Service
3 – 4 November
Shanghai, China
http://upinlbs.sjtu.edu.cn

ICG-11: International Committee on GNSS
6 - 11 November
Sochi, Russia
http://www.unoosa.org/oosa/en/ourwork/icg/icg.html

Trimble Dimension 2016
7-9 November
Las Vegas, USA
http://www.trimbledimensions.com/

INC 2016: RIN International Navigation Conference
8 - 10 November
Glasgow, Scotland
http://www.rin.org.uk/Events/4131/INC16

36th INCA International Congress
9 -11 November
Santiniketan, West Bengal, India
http://incaindia.org

FROM IMAGERY TO MAP: Digital Photogrammetric Technologies
13 - 17 of November
Agra, India
http://conf.racurs.ru/conf2016/eng/

13th International Conference on LBS
14-16 November
Vienna, Austria
http://lbs2016.org

International technical symposium on navigation and timing
15-16 Nov
Toulouse, France
http://itsnt.recherche.enac.fr/index.php

GSDI 2015 World Conference
28 November - 2 December
Taipei, Taiwan
http://gsdiassociation.org/index.php/homepage/gsdi-15-world-conference.html

December 2016

ISGNSS 2016
5 - 7 Dec
Tainan, Taiwan
http://isgnss2016.ncku.edu.tw/

IGNSS 2016
6 - 8 December
UNSW Australia
ignss2016.unsw.edu.au

United Nations/Nepal Workshop on the Applications of GNSS
12 - 16 December
Kathmandu, Nepal
http://www.unoosa.org/pdf/icg/2016/nepal-workshop/InfoNote.pdf

Navitec 2016
14 - 16 December
Noordwijk, Netherlands
http://navitec.esa.int

January 2017

Esri India User Conference
19 – 20 January
Delhi, India
http://www.esri.in/events

February 2017

17th annual International LiDAR Mapping Forum (ILMF)
13-15 February
Denver, Colorado, USA
www.lidarmap.org

March 2017

2017 GIS /CAMA Technologies Conference,
6 - 9, March
Chattanooga, Tennessee
www.urisa.org

Munich Satellite Navigation Summit 2017
14 – 16 March
Munich, Germany
www.munich-satellite-navigation-summit.org

April 2017

GISTAM 2017
27 - 28 April
Porto, Portugal
http://gistam.org

May 2017

11th Annual Baska GNSS Conference
7 - 9 May
Baska, Croatia
www.rin.org.uk

The European Navigation Conference 2017
9 – 12 May
Lausanne, Switzerland
http://enc2017.eu

July 2017

Esri User Conference
10 – 14 July
San Diego, USA
http://www.esri.com/events/user-conference/papers

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