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Abstracts

Albania

The position of Albania as a non – EU country toward GNSS education and Galileo evolution

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GNSS technology and its related applications are booming worldwide. In Europe, the development of the Galileo and EGNOS systems highlight both the increased interest towards satellite navigation and the urgent need for highly qualified personnel in this field.

The general objective of G-TRAIN is to strengthen the GNSS education in Europe, focusing on higher education. This is achieved by both coordinating and upgrading some already existing educational initiatives, and creating new opportunities for students and teachers to become networked.

A short overview of the importance of such initiatives in GNSS education in creating new job opportunities in a very new and in development market.

The main question that I propose for discussion: are the non EU countries an integrated part of the Galileo Project? Are there any job opportunities for non-EU students in this field?

Australia

GNSS Education at the University of Melbourne

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Satellite positioning and geodesy is an important part of the broader Geomatics Degree at the University of Melbourne. This presentation provides an overview of the subject including theoretical and practical aspects. The theoretical component includes the coordinate systems and reference frames, principles of satellite positioning, and various aspects of data processing. To reinforce the theoretical understanding students undertake a range of practical activities, including the manual computation of a position using observations in a RINEX file and establishing a local survey control network using GNSS (mission planning, data acquisition, processing, and network adjustment). To enhance the knowledge of local, national, and international GNSS infrastructure and services the student's field data is combined with the data from a nearby CORS network.

The objective of this presentation is to describe the way in which the subject is taught. A lot of emphasis is placed on active learning to achieve better understanding of the topic. Active learning entails participation on behalf of the students to understand non-trivial concepts through discussion and problem solving. The idea is to promote interest in the students who can continue their studies in GNSS by undertaking a research project in the final year of their undergraduate degree. This can consequently lead to postgraduate studies at Masters or PhD level. The course can be taught as a semester long subject over three months or alternatively as a two week full-time intensive course, however some prerequisites may be necessary.

Austria

GNSS positioning in support of surface soil moisture retrieval and flood delineation in near real time

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In the wake of climate change, shifts in the global water cycle are expected to have tangible implications for populations and economies worldwide in the coming 30-50 years. Soil moisture is a key parameter in the global water, energy and carbon cycles, and is accordingly an important factor in a variety

of Earth sciences, including hydrology, meteorology, climatology and agronomy. Large-scale flood maps, beyond their immediate utility in disaster management, have additionally found use in the calibration of hydraulic models. The physics underlying spaceborne microwave instruments has paved the way for the development of algorithms for surface soil moisture retrieval and flood delineation that are effectively invariant to weather conditions or the availability of incident sunlight. In contrast to soil moisture measurements at coarse spatial scales derived from existing spaceborne microwave instruments, the forthcoming GMES Sentinel-1 constellation is expected to render systematic surface soil moisture retrieval at 1 km resolution possible for the first time from space, with potential for provision in near real time (NRT). Owing to the mission's sizable foreseen data volumes, a key ingredient to providing supporting datasets in NRT involves maintaining the platforms within an Earth-fixed orbital tube. This is achieved by leveraging accurate GNSS positioning, which in turn renders predictable lookup table (LUT) geocoding possible. With flood maps a potential application of Sentinel-1 data at its foreseen High Resolution (HR) spatial scale of 20 x 22 m over land, the NRT LUT geocoding accuracy afforded by regular GNSS localization plays an even more critical role than it does at 1 km. So-called crowdsourcing provides an outlook to a more interactive application of GNSS measurements in support of flood delineation, by enabling users on the ground to access high-resolution flood maps relevant to their location and augment them with their own observations.

Azerbaijan

Telecommunications networks: application of up-to-date equipment

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"Azercosmos" Open Joint Stock Company was established with the view of launching the telecommunication satellite into orbit and its operation as well as organization of receiving and processing of space data obtained from the satellite by the Decree of the President of the Republic of Azerbaijan.

One of the main partners of the Azercosmos is the Virginia-based Orbital Sciences Corporation which designs, builds and delivers the Azerspace/Africasat-1a commercial communications satellite of Azerbaijan into the orbit. The satellite will be based on Orbital's flight-proven Star-2 platform and will generate approximately five kilowatts of payload power for 36 active transponders.

Modern telecommunications networks use highly accurate primary reference clocks that must meet the international standards requirement for long term frequency accuracy better than 1 part in 10^{-11}.

To get this performance, atomic clocks or GNSS are used at the national ground station because there are many systems that must be accurately synchronized use GNSS as a source of accurate time. Personnel training on operation and exploitation of the satellite, manufacture of the space-qualified hardware, receiving and processing of space data are deemed as being critical for successful realization of the national space program.

Bosnia and Herzegovina

Benefit of reprocessed orbits IGS1 to geodetic reference network of Bosnia and Herzegovina

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In its effort to keep pace with contemporary developments in Europe, Geodetic administrations in Bosnia and Herzegovina organized GPS campaign to densify the EUREF network observed 1998. The campaign is called BIHREF2000, and lasted five days, when more than 20 new GPS stations were observed for the two daily sessions, and data were processed using the Bernese software. The resulting coordinates in ITRF97 and ITRF2000 were transformed into ETRS89 coordinate system. The accuracy of the coordinates was not satisfying the required accuracy of 1 cm for all three components of the position for all stations. In the meantime, the campaign CEGRN05 organized in the framework of the geodynamical project CERGOP2/Environment, when 14 stations were observed in Bosnia and Herzegovina. Among observed stations, there were 8 same stations from the BIHREF2000 campaign.

Availability of the reprocessed IGS05 precise orbits opened the door to the possibilities of the re-processing of GPS campaigns in the Bosnia and Herzegovina. The data of the GPS observations were processed using the Bernese software, version 5.0. Results were in the IGS05 reference frame. Corrections for the delays of GPS signals passing through the troposphere were estimated for every 2 hours, and their projection on the observed height of the stations was calculated using wet Neill mapping functions, but horizontal gradients were estimated for every 4 hours. It could be generally said that the accuracy of the all three components of the positions were within the 10 mm and accuracy of the processed velocities for the same stations were about 1mm/year.

So, re-processing of the campaigns resulted in the better accuracy of the realization of a geodetic reference network for Bosnia and Herzegovina, i.e. improving the accuracy of the GPS network, which is supposed to define a new B&H geodetic datum.

Bulgaria

Current participation of Bulgaria in European ad regional GNSS projects

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Union of Surveyors and Land Managers

The main aspects of the recent Bulgarian participation in the realization of European and regional GNSS projects have been outlined. The activities are related to the BULiPOS – Bulgarian segment of the EUropean POsitioning determination System (EUPOS), geodynamic investigations with respect to this project and to the Central European Regional Geodynamic Project (CERGOP). It is stressed on the most recent integration of the EUPOS network with the meteorological investigations over the territory of Europe. Information about the suggested Memorandum of Understanding between EUPOS and EUMETNET has been presented.

Croatia

Single frequency GPS positioning performance in northern Adriatic region during geomagnetic storm on 22 – 24 January 2012

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A strong Coronal Mass Ejection (CME) has brought a powerful geomagnetic storm on 22-24 January 2012. Being a part of the 24th solar cycle, it has provided an excellent experimental environment for satellite navigation performance assessment.

Here we report the results of the GPS performance assessment study in the Northern Adriatic region during the 22-24 January 2012 geomagnetic storm. Space weather conditions were examined using the various types of observables, including the Sudden Ionospheric Disturbance (SID) monitor readings collected at GNSS laboratory of Faculty of Maritime Studies in Rijeka, Croatia. Then, RINEX observables from reference stations in the region were used for a single-frequency GPS receiver performance simulation during the geomangnetic storm in question. The analysis showed noticeable effects of the geomagnetic storm, and several patterns of stationary single-frequency GPS positioning error dynamics.

These results are correlated with the lower-ionospheric dynamics data as observed by SID monitor in Rijeka, Croatia.

Croatia

Targeted professional education can improve the role of GNSS as a component of national infrastructure

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The widespread utilisation of GNSS makes a satellite navigation system a fundamental component of the national infrastrucuture, despite the fact that the very operation of GNSS systems remains the responsibility of a handful of countries. Thus, maintaining the sustainable GNSS performance becomes the task of the national authorities, as well as the GNSS operators. With the suddenly extended responsibility of national authorities, it becomes important to establish among the community of decision-makers the approporiate level of understanding of GNSS principles, vulnerabilities and risks.

Here we propose the knowledge transfer scheme necessary to establish the foundation of the understanding of satellite navigation technology at the national level, in order to successfully maintain the GNSS performance, and establish the GNSS performance monitoring, risk identitfication and correction mechanisms, thus allowing for the national infrastructure protection and supporting the economic growth through development of GNSS-based systems and services. This approach emphasises the role of GNSS experts in professional advancement of decision-makers.

Czech Republic

Development of the GNSS-based geodetic infrastructure in the Czech Republic in context of international projects

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Since the begining of nineties, the Research Institute of Geodesy, Topography and Cartography (RIGTC), Geodetic Observatory Pecny (GOP) has been involved in GNSS applications for precise positioning in geodynamic studies, for reference frame building and maintenance as well as for environmental (atmospheric) studies. Since 1993 it has been regularly contributing to the IGS by tracking data and later also by some products as a result of GOP analysis activities. In 1995 the GOP joint the EUREF Permanent Network (EPN), its EPN Local Analysis Center GOP has been operating since 1997 and the EPN Data Center GOP for Nera-real time products has been working since 2001. A systematic collaboration of GOP in the international projects on GNSS ground-based meteorology has been successfully running since 2000 (Action COST716, projects TOUGH, E-GVAP, E-GVAPII). For several years the GOP analysis center has been contributing by its products of ultra-rapid GPS and GLONASS orbits to the combined IGS product. The GNSS-based geodynamic investigations in Central Europe have been developed since 1994 (project CERGOP, CERGOP-2, now Consortium CEGRN). The Czech national system of continuously operated reference GNSS stations CZEPOS was built in 2004 – 2005 according to the EUPOS standards and, after more than 7 years of successful service, it is now being upgraded to a multi-GNSS positioning system. A collaboration within the EUPOS is going on. For 7 years the GOP has been operating the DORIS analysis center. In 2005 – 2008 the GOP participated in the international consortium established for the development of the Galileo oriented geodetic receiver (SWIRLS project, FP6 EU). Recently, the GOP joined the IGS M-GEX project (Multi GNSS Experiment) and is starting its activity within the MGM-Net (Multi-GNSS Monitoring Network) project organized by JAXA. For this purpose, the GOP observatory was equipped by the JAVAD DELTA-G3T QZSS receiver kindly provided by JAXA.

Denmark

Greenland ice sheet mass balance from GPS, GRACE and ICESat

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Many glaciers along the southeast and northwest coast of Greenland have accelerated, increasing the Greenland ice sheet's (GrIS) contribution to global sea-level rise. Here, we map elevation changes in Greenland during 2003-2009 using high-resolution Ice, Cloud and land Elevation Satellite (ICESat) laser altimeter data (Zwally, 2010) supplemented with altimeter surveys from NASA's Airborne Topographic Mapper (ATM) during 2002-2011 (Krabill, 2011). We use the measurements of elevation change to estimate catchment-wide ice volume loss (convert is to mass loss) and compare with independent

measurements from GPS and the Gravity Recovery and Climate Experiment (GRACE) satellite gravity mission, launched in March, 2002. The GRACE results provide a direct measure of mass loss averaged over the entire northwest sector, while the GPS data are used to monitor crustal uplift caused by ice mass loss close to the sites.

Egypt

Understanding of GNSS anomalies near the equatorial region: Anatolian bump signatures in ITNE-CIDR

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The Ionospheric Tomography Network of Egypt (ITNE) is a chain of passive UHF/VHF receivers, known as Coherent Ionospheric Doppler Receivers (CIDRs). The first ITNE-CIDR was installed at Helwan University (geographic latitude 29.9°, longitude 31.3°) in May 2008. Each receiver measures the Doppler shift in UHF (400 MHz) and VHF (150 MHz) signals from radio beacons on board LEO satellites. Each CIDR system is capable of tracking up to three different beacon satellites with different offsets in frequency at any given time.

This study examined more than one hundred LEO satellite passes during 2008, in which the satellite flew over the Anatolian Plateau. The study shows that bumps and ripples frequently occur at the edge of the Anatolian plateau with an ionospheric perturbation in the $\Delta(TEC)/\Delta(t)$ measurements. There are three types of perturbations: bumps (a single peak with an amplitude ≥ 0.01 TECu/sec and an ionospheric pierce point (IPP) latitudinal width of at least 1 degree), ripples (a large central peak surrounded by several smaller peaks) and waves (several comparable peaks). The majority of these perturbations occur near the edge of the Anatolian plateau.

Estonia

GNSS applications in Estonia: Estonian GNSS permanent station network

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GNSS Permanent Station Network was established in the Estonia. At the moment the network is consisting of 9 permanent stations providing GPS and GPS/GLONASS data streams. Starting 2008 we are computing weekly basis the coordinates of our permanent stations with Bernese 5.0 program.
In the paper the establishment of the Estonian GNSS permanent station network is discussed as well first results from data processing using are introduced. Moreover, the legislation issues concerning the status of the GNSS permanent station networks are briefly introduced and the foresight to future applications will be given.

Finland

Effects of GNSS jammers and potential mitigation approaches

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Reliable navigation and position determination is essential in more and more applications nowadays on land, sea, and air. Satellite positioning signals, as well as many other radio frequency signals, are however extremely susceptible to unintentional and intentional, malicious interference. In satellite navigation, in particular, recovery from interference is especially difficult since the signals are exceptionally low in power after travelling the distance of about 20000 km from the satellite to the Earth and thus particularly vulnerable.

Applications using satellite positioning for road tolling, insurance billing, or logistics have increased recently in quantity. Simultaneously, despite being illegal, intentional jamming of the related satellite navigation receivers has become temptingly easy. Affordable jammer devices can easily be purchased online or building a jammer according to widely attainable online recipes is a fairly effortless task to a professional. The increase in the amount of satellite navigation jammers is alarming, especially due to the serious damage they may cause. Jammers may cause great damage if not detected and the effects mitigated. The typical usage environment of jammers is in cars, where they transmit a jamming signal usually on the civilian L1/E1-band. The accessible GPS C/A and the upcoming civilian Galileo codes are located in the L1/E1 frequency band. Civilian in-car jammers are a severe threat to the trustworthiness of Global Navigation Satellite System (GNSS) receivers.

The jamming signal may deteriorate the position solution or induce total loss of lock of the satellite signals. Different receivers react differently to jamming - also the effect depends on the properties of the jamming signal. This presentation discusses GNSS jammers typical for in-car usage and presents some effects they cause on consumer-grade satellite navigation receivers. A few different consumer-grade, civilian receivers are used for a case study and the effects illustrated. Particular focus is given on measurement quality, percentage of signals lost, as well as positioning accuracy and availability. Potential jamming detection and mitigation methods for civilian GNSS receivers are also reviewed.

France

GNSS applications and services: Best opportunities for Europe

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The public budget must be carefully invested in R&D areas which have both a strong growth potential, and secondly, satisfy the political, societal and economic interest. The domain of GNSS applications, becoming one of the pillars of 21-century society, offers a splendid opportunity among the most promising ones!

The presentation will give an overview of opportunities from the market of GNSS applications and services. The economic and environmental benefits of GNSS will be addressed. Then the presentation will highlight the challenges coming from GNSS by, among other things, identifying the critical GNSS technologies, applications and services (multi-constellation multi-sensor receivers) to be supported and by studying the roles of Industry and Education in R&D process. It will finally present some activities performed by Galileo Services to maximizing the potential of the GNSS applications' market so as to generate, at all levels, sustainable economic growth and new jobs and to enhance citizens' wellbeing in Europe.

Some key GNSS Applications:

- Transport: safety and efficiency increase for aviation, maritime and inland waterways, rail, road transport…
- Environment protection: support to ecologic driving, waste control, Land monitoring and Land Administration…
- Health: Tracking and Tracing of medical goods, assistance to elderly/disabled people…
- Agriculture: Precision Agriculture, Livestock management…
- Mobility: Navigation, Road tolling, LBS, multi-modal transport services…
- Security and Safety: PAYD insurance, law enforcement, protection of IPRs, Customs and Freight monitoring…

Germany

The Role of EUREF in a changing GNSS landscape

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New constellations of navigation satellites are under deployment during these days and extend the

so-called Global Navigation Satellite System (GNSS) to a “System of Systems”. In the upcoming years, the GNSS community will be facing a changing landscape with new heterogeneous navigation systems (e.g. Galileo, COMPASS, QZSS), signals and frequencies. How to analyze the data of these new systems as one homogeneous system is a major challenge. What new products should be delivered to the users and how to upgrade the GNSS tracking networks without compromising products and the long-term stability are some of the questions that we will need to answer in the following years. It is clear that such a changing GNSS landscape is also relevant for the implementation of a regional reference frame, in our case the ETRS89, maintained by EUREF.

The launch of the Multi-GNSS Experiment (M-GEX) by the International GNSS Service (IGS) on February 1st, 2012 pushes the development of GNSS applications by providing global tracking data for public access. Many EUREF members contribute to M-GEX, and beyond that the EUREF Permanent Network (EPN) provides multi-GNSS data for Europe.

Furthermore, users on the ground have to choose from additional applications, such as the Precise Point Positioning – Real Time Kinematic (PPP-RTK) approach. The inclusion of observation data from nearby reference stations in GNSS processing is widely used to access the regional reference frame. PPP-RTK is considered an alternative option and it allows access to ETRS89 in real-time. The “PPP-RTK & Open Standards” Symposium in Frankfurt am Main, March 2012 summarized this promising concept and informed the large number of participants about current achievements. Services as, e.g. “EUREF-IP”, are based upon the new technology. It provides “State Space Representation (SSR)” information for precise positioning all over Europe.

For the GALILEO system experts of the European geodetic and timing community are embedded in the development of the ground-based infrastructure with the goal to formulate requirements and to provide recommendations for future services. The conclusions drawn by the geodetic working group may, on the other hand, impact an independent regional service provider like EUREF to review its existing product catalogue and, if appropriate, to update or even extend it.

Germany

Low cost GNSS applications

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Technet-Rail 2010 GmbH

Looking on the last years back the usage of mobile laser scanning has risen up in several fields. The main scope of mobile laser scanning is the detection of traffic routes such as road- and railway-networks. In November 2011 a project was realized as cooperation of RIEGL LMS GmbH, Deutsche BahnNetz AG and technet-rail 2010 GmbH near Frankfurt/Main - Germany. By using the RIEGL VMX-250 System at railcar the complete rail embankment, the rails itself and the power lines were captured. The detection covered even the neighborhood tracks. The crossed placed laser of RIEGL VMX-250 System enables the detection of thin objects even in perpendicular adjustment to track direction.

The analysis of data was realized with rail specific software of technet-rail. The programs enable exact transformation of geodetic 3D data sets into rail-coordinate system of Deutsche Bahn AG with the help of existing track data. Own measured control points are unnecessary. With wide range of rail orientated functions such as collision test, clearance- and rail based-measurements the system enables a productive instrument, designed for permanent use.

Hungary

High precision express speed data collection for the Hungarian railways

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BPMC Ltd.

The Hungarian Railways (MÁV) is one of Hungary's largest enterprises with a country wide 7200 km long railway network. Efficient asset Management has become a key issue lately for around 1 350 000 widely dispersed technical objects. For this purpose MÁV started to build its Geographic Information

System in 2008. The first phase focused on cadastre information and facility management. The second phase – described in this paper - focused on "above earth visible" railway specific assets. Because of deadline and budget restrictions there was a need to create a new methodology. The concept described below delivered expected results in a 14 month time frame.

Goal of MÁV GIS project: After having gathered cadastre data in the first phase of the GIS project, the question for MÁV in 2009 was, how to obtain data for the remaining assets, ca. 1 350 000 objects. The technical challenge - beyond lowest possible expenses - was threefold:

- large number of data to be collected in only 14 month,
- significant increase in the type of assets in the GIS system, what should be measured on spot and how, so that further work can be performed from

Hungary

Developments in the Hungarian active GNSS network

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FÖMI Satellite Geodetic Observatory

The Hungarian Active GNSS Network consists of 54 permanent stations including 19 stations of the neighboring countries. Thanks to the developments of the last few years all of the stations in Hungary are GPS/GLONASS capable plus 5 of the stations are ready to track the satellites of Galileo and COMPASS systems. On the basis of this network the users can access DGNSS corrections with sub-meter plus RTK and network RTK solutions with centimeter level accuracy. Beside that new kinds of data were also promoted. One of these is a new real-time RTCM based transformation method. New Ntrip mountpoints were set up, which contain RTCM message type 1033 in order to mitigate the effect of the so called GLONASS biases.

In the last years the number of the users of the Hungarian Active GNSS Network (GNSSnet.hu) constantly increased, now there are more than 1100 registered usernames. The biggest group of the users is the land surveyors. The second largest section is precision agriculture, where the service is used for automatic steering of tractors. Field operations on exactly the same rows can be done with 2 cm accuracy year after year, as the GNSSnet.hu provides homogenous centimeter level absolute accuracy for the whole country. There are also other fields of interest like GIS, mobile mapping, forestry, water resources management, education, etc.

Currently the main development is the establishment of a backup central data processing system, with which the availability of the services could be raised to nearly 100%. In the next years a new automatic central post-processing solution is expected and the support of the Galileo satellite system is also planned.

Israel

Using location-based social media for emergency response

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Yuval Ne'eman Workshop for Science Technology and Security, Tel Aviv University

Cyberspace and Social Media have become an integral part of life in developed countries. Nations use cyberspace to communicate with the public, disseminate information, collect government payments, and even referendum voting. Smartphones and computers enable nearly anyone to communicate from almost everywhere, and enable creating, generating and sharing of information and data, including location-based information. Recent events have shown that in an emergency, access to cyberspace has a critical role in the crisis management efforts. In some major disasters in the last decade cyberspace played a major role in search, rescue and recovery efforts. Such examples could be found in the Japan earthquake-tsunami 2011 and Haiti earthquake 2010, and in the 2011 Irene hurricane. In Japan, for example, although telephone networks were disrupted, internet access remained reliable and cyberspace was a firm base for applications and services.

As technology advances, people are increasingly more connected and connected communities

have the opportunity to be more resilient in a crisis situation. This understanding could be further utilized in future disasters to efforts. Using social networks, GNSS-based applications can support search-and-rescue teams and help them arrive faster to survivors, provide a decision support tool on prioritizing scarce rescue resources, and give online psychological support to survivors to increase overall community resilience.

The presentation will (1) provide a wide view on enablers (2)present case studies of the use of cyberspace and social networks in disaster situations (2) provide possible GNSS based social media approach for disaster recovery efforts (3)offer possible international cooperation to increase efficient use of those applications (4) present the challenges ahead and recommendation on the national level.

Japan

Future plan of Quasi-Zenith Satellite System (QZSS)

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The Quasi-Zenith Satellite System (QZSS) is a Japanese RNSS satellite system employing multiple non-geostationary orbit and geostationary orbit satellites, with which Asia-Pacific region can be covered in the service area. QZSS has positioning function and augmentation function. Concerning the positioning function, QZSS enables us to expand the positioning availability areas and extend the availability time. Concerning GPS augmentation function, we have two original augmentation signals for GPS, one is sub-meter class signal and the other is centimeter class signal.

In September 2011, the Cabinet decided the "Basic policy on the implementation of the operational QZSS project" and based on this decision, decided to accelerate the deployment of the operational QZSS as expeditiously as possible. More specifically, four satellites constellation shall be established by the late 2010s, and in the future, seven satellites constellation shall be completed to enable sustainable positioning.

The technical and application verification of the first Quasi-Zenith Satellite MICHIBIKI have been conducted. Main system capability of MICHIBIKI was confirmed to meet its specification. Using augmentation signals from MICHIBIKI, over 200 private companies have been verifying their applications.

Latvia

Latvian National height system as EVRS realization

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Latvian national height system as EVRS realization Latvian national height system is ready for re-establishment after decide long measurements and calculation works. As new zero point is choice Amsterdam Pail.

Amsterdam Pail is beginning of European Vertical Reference System (EVRS) which is gravity related and kinematic height system. European Union with INSPIRE directive and EUROCONTROL with aviation manuals encourage all geospatial data users adopt EVRS as reference surface for height data.

Modern national height system must proved best effort for all users and contact to sub-continental network for cross border geospatial programs and common maintenance of height system.

EVRS realization over Europe space is done by 1. order national levelling networks. Latvian 1. order levelling has over 100 points with EVRS heights. 16 of them form backbone of all 1.order levelling adjustment as fixed points. Adjustment gives max standard deviation of 4.40 mm against fixed points and one kilometrical square error 0.6 mm/km for all network.

Further height system distribution will be done by 2.second order network and new precise quasigeoid model of Latvia.

Latvia

Geodynamical station Riga – current situation and future prospects

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Geodynamical observatory Riga carried out optical and later photo observations of Artificial Earth Satellites since launch of the first satellite in October 4, 1957.

Regular satellite laser ranging (SLR) started in 1989 and permanent GPS receiver was installed in 1996. Now station Riga is a member of EUREF Permanent Network (EPN), International GNSS Service (IGS) and International Laser Ranging Service (ILRS) networks. This paper discusses present station state and eventual future developments including modernization of SLR and GNSS systems and adding additional geodetic measurement techniques.

Latvia

On the height component for GNSS positioning

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The accuracy of height component in GNSS positioning is most sensitive issue comparing with the positioning in plane coordinates only. On the basis of Riga city levelling network control the height component determination using GNSS technique has been examined.

Last 2nd order levelling campaign in Riga city was performed at 1975-77. Mainly negative vertical movement was discovered at several places comparing with the levelling results of 1949-54. There were no levelling networks controlled nor developed in Riga city after 1977. However, the high accuracy levelling network is still important for many civil engineering tasks and for geodetic and geophysical research as well. Application of Global Navigation Satellite Systems (GNSS) in geodesy discovers a powerful tool for the verification and validation of the historically long time ago established geodetic levelling benchmarks. Both the differential GNSS static and RTK methods appears very useful to identify the deformation of levelling networks.

However, the key issue for GNSS applied height determination is the availability of high quality geoid model. The European Space Agency (ESA) achievements in GOCE mission are very promising for the future National geoid model improvement. Acquired ground based gravimetric and GNSS/levelling data will be very useful for this purpose.

Additionally at the Institute of Geodesy and Geoinformation, University of Latvia, the digital zenith camera for vertical deflection is under development now. There is a reasonable grounds to believe that application of zenith camera will accelerate the geoid model improvement in Riga and its surroundings.

The control measuring campaign using *EUPOS® – Riga* RTK network has been carried out recently. Preliminary results has discovered a land downlift at the bank of Riga Bay and on several other places. The additional test measurements are planned for summer 2012. The results of the GNSS based control results obtained till now will be reported.

Latvia

Attractiveness of GNSS in education

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Due to rapid development of GNSS technologies we meet receivers of such kind more often and it is more common not only in scientific part, but as well as in household conditions. Nowadays GNSS devices have been become integral part of our life. Each person has had experience with receivers to measure geodetic coordinates or determine his location, for example, using possibilities of mobile phone with implemented GPS options, mobile GIS, etc.

In preparation and realization of study topics are necessary to take in consideration opinion/wishes of students. If the students are directly involved then results are better and achievements are higher. Example of FIG congress in Rome of 2012 is a one good example from a point of view of RTU. Look article "GNSS antenna offset field test in Metsähovi":
(http://www.fig.net/pub/fig2012/papers/ts07h/TS07H_kallio_koivula_et_al_5580.pdf)

GNSS is a great achievement for mankind with excellent future not only for geo-sciences with all services but as well as for whole our society, too.

Moldova

Development of GNSS permanent network in the Republic of Moldova

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Starting from 1999 a new reference system MOLDREF99 based on the ITRF97 and ETRS89 was established in Moldova. The realization of MOLDREF99 is the national GPS Network with density about 1 point per 15 sq. km. However, this density is insufficient for many geodetic applications. In order to provide real time positioning services the decision to pass from GPS "passive" Network to GNSS "active" Network in 2011 was adopted by Government of Republic of Moldova.

To provide real time position and navigation service on the territory of Moldova 10 GNSS continuously operating stations with 70 km spacing were installed in the frame of project of GNSS Permanent Network and MOLDPOS service supported by Norwegian Government.

The GNSS network will provide a geospatial infrastructure for surveying, engineering and Geographic Information System (GIS) professionals that enables high accuracy real-time kinematic (RTK) GNSS positioning without the need of separate base stations or software, significantly increasing efficiency and productivity while at the same time reducing cost over a traditionally operated system. There are two methods for positioning with GNSS: post processing with high accuracy to millimeters and Real Time Positioning: Differential GNSS (DGNSS) for sub-meter accuracy and Real-Time Kinematic (RTK) for centimeter accuracy.

A Moldavian Positioning Service (MOLDPOS)including transformation parameters database and GNSS Network monitoring will be used for large spectrum of applications (geodetic works, cadastral surveying, GIS, mapping, navigation, etc.) and will be the basis for support of scientific applications (landslide monitoring, environmental research, geohazard prediction, meteorology, etc.)

Moldova

GNSS applications in the educational system of the technical university of Moldova

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Technical University of Moldova (TUM) is the only higher education institution in the Republic of Moldova offering engineering and technological programs for almost all sectors of the national economy. The university was set up in 1964. It comprises 10 facultieswith about 18000 students and 1000 teaching staff. TUM is working actively to integrate its curriculum and syllabus in the European educational system in accordance with the Bologna declaration.

TUM started implementation of a new surveying engineering program. The new program follows the guidelines of the Bologna process and is divided into three levels, the basic level leading to Bachelor of Science degree and the advanced levels leading to Master of Science and Doctor of Science degrees in the field of Geodesy and Cadastre.

The Faculty of Cadastre, Geodesy and Construction teaching staff follow the intensive training in GIS and modern surveying technology (GNSS positioning, digital photogrammetry). The modern GIT laboratory was established including GNSS permanent station in the frame of the TEMPUS project

CD_JEP-24243 with continuation in the frame of Project 511322-TEMPUS-1-2010-SE-JPCR. „Geographic information technology for sustainable development in Eastern neighboring countries" GIDEC.

The last year TUM in cooperation with Land Relations and Cadastre Agency and Institute of Applied Research (IAF), University of Applied Sciences (HSKA) Karlsruhe, Germany started new project focused on development of a High Capacity Real-Time GNSS Positioning Service for Moldova (MOLDPOS). In the frame of this project geodetic databases were created in order to support services of national positioning system MOLDPOS based on the ETRS89 that will ensure unique and actual geospatial data for whole country territory according to international standards and INSPIRE specifications. For MOLDPOS implementation TUM intended to create a GNSS training centre at TUM for continuing education of surveyors, experts in navigation, precision agriculture, etc.

Romania

GNSS concept in the framework of the Romanian R&D program "Space and Security"

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Romanian Space Agency

The Romanian Ministry of Education and Research organizes regular competitions for R&D grants founding. One of priority domains is "Space and Security. The paper describes the objectives of the National Research Programme and the expected impact regarding the GNSS technologies development.

Romania

EGNOS extension to Eastern Europe: applications

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EGNOS (European Geostationary Navigation Overlay Service) is a Satellite Based Augmentation System (SBAS) developed by the European Space Agency under a tripartite agreement with the European Commission and the European Organization for the Safety of Air Navigation (Eurocontrol). The ownership of EGNOS was transferred to the European Commission in 2009 and since then, it has become operational as an open service. Since March 2011 the system is certified for Safety of Life applications, such as aircraft or maritime navigation or land transportation.

At the moment of writing, the EGNOS coverage area for APV-I 99% performance is limited in the eastern part of Europe; Countries from Central Europe are permanently covered (like Germany, France, etc), while Eastern European countries are only partially covered (like Poland) or not covered at all (like Moldova, Ukraine).

During 2010 and 2011, the Romanian Space Agency was involved, as a partner, in a project co-founded by the EC under the FP7 2nd call. The project's aim was to prove, through demonstrations, that it's possible and easy to extend the EGNOS services to Eastern Europe. Several static and kinematic trials took place in Poland, Romania and Ukraine by using an EGNOS similar signal generated by GMV's (the consortium leader) magicSBAS application and broadcasted over the internet. The main conclusion of the project was that EGNOS can easily be extended in this part of Europe by algorithm improvements (Romania and Poland) and by infrastructure development (Ukraine).

In January 2012 a follow-up of the EEGS project started, also co-funded through FP7. Its aim is to present the benefits of EGNOS extension to Eastern Europe in the field of aeronautics and to prepare the national civil aviation and service providers for future usage of EGNOS. Flight trials will be conducted in Poland, Romania, Moldova and Ukraine.

Sweden

SWEPOS™ Network-RTK service – establishment, status and experiences

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SWEPOS™, the Swedish network of permanent reference stations for GNSS, is in operation since 1998 and run by Lantmäteriet, National Land Survey of Sweden. Today (march 2012) the SWEPOS network consists of 250 permanent reference stations and has more than 2000 Network-RTK users. The purposes of SWEPOS are to:

- Provide L1 and L2 raw data to post-processing users.
- Provide DGNSS and RTK corrections to real-time users.
- Act as high-precision control points for Swedish GNSS users.
- Provide data for scientific studies of crustal motion.
- Monitor the integrity of the GNSS systems.

The SWEPOS Network-RTK –service was established in 2004 covering the most populated areas of Sweden and during 2009 it became a national service covering the whole country with interstation distances of 70 km. To meet the demands from the users for improved accuracy and redundancy, a decision was taken to densify the network to 35 km interstation distances and in some areas down to 10-15 km in cooperation with the Swedish Transport Administration for infrastructure projects. The plan is to establishment 40 new reference stations each year during a five year period, during 2010 and 2011 the most populated areas have been densified.

The presentation will also highlight the ongoing activities in some local projectadapted Network-RTK services developed together with the Swedish Transport Administration for infrastructure projects and the development of a Ionospheric monitoring service developed together with SP, the Technical Research Institute of Sweden.

Uzbekistan

Modification of vertical reference frame of Uzbekistan

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The optical and radiometric observation of geodetic satellites were produced in 1962-2010. The optical era in satellite geodesy came to a sudden end with the development of satellite laser ranging (SLR) and use of the Doppler technique for positioning. The SLR and Doppler measurements are used for creating of national vertical reference frame and for development of digital elevation model. The classical vertical datum is referred to the CS42 and is based upon the measurement of Baltic sea level (BSL) at tide gauges at Kronstadt at the beginning of the 1707 's. The published heights of all benchmarks, town survey marks and trigonometric beacons are given as heights above BSL. This datum is close to, but not exactly the same as the geoid. The geodetic network is not very accurate because of local geotectonic plate moving. Now, the GPS and DORIS systems offer alternative techniques to determine elevations. However, these elevations are calculated with respect to the WGS84 ellipsoid, which does not have any physical meaning, i.e., water could flow from a lower ellipsoidal height to a higher ellipsoidal height. Ellipsoidal heights refer to a geometric figure approximating the Earth and include the WGS84 and GPS receivers. Therefore, in order to establish a high precision geodetic network of Uzbekistan based on the GNSS techniques it is necessary to investigate more correctly transformation between CS42 and WGS84 systems.

Yemen

Planned DGPS system at SANAÁ international airport

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In Sana'a International Airport is currently commissioning instrument landing system (ILS) comprising the following components localizer, glide path and distance measuring equipment.

Conventional methods are expensive, and limited to a certain extent. Signals from GPS have proven to be fast, accurate and cheaper alternative to conventional methods.
Therefore, a new landing aid system based on GPS is being under consideration and DGPS system may replace the existing instrument landing system (ILS) in the future

Referring to the ICAO SARPs Annex 10 and Doc 9849, CAMA is now planning Differential GPS landing system for Sana'a International Airport.

CAMA is the sole authority who is responsible for planning, supervision and execution of DGPS system for Sana'a International Airport. This space-borne systems' accuracy, availability and reliability are subjected to numerous biases or errors. To meet the operational requirement of landing phase of the flight, augmentation system is required

CAMA is planning for ground-based augmentation system by using GPS receiver stations to verify the validity of satellite signals and calculate corrections to enhance accuracy

Since the implementation of GNSS operations requires to be considered a number of elements, CAMA will establish the GNSS team including the appropriate personnel from related areas. Moreover, we will fully coordinate with ICAO planning and implementation regional groups.

CAMA is frequently sending its staffs to abroad training in order to be able to cope with latest development regarding to GNSS.

GNSS transition planning will be done on national, regional and global basis and with close coordination with users to ensure that they are properly equipped to take advantage of new DGPS service.