25 years of GNSS Researches & Applications at the Department of Engineering and Architecture and at GeoNetLab, Centre of Excellence for the Research in TeleGeomatics and Spatial Informations, University of Trieste, Italy

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R&D Activities

- Starting from 1991, 25 years of researches and applications at the Department of Engineering and Architecture and at GeoNetLab, Centre of Excellence for the Research in TeleGeomatics and Spatial Informations, University of Trieste, Italy, are presented.
- Many research and surveying activities have been performed involving different national and international research groups and interdisciplinary fields:
R&D Activities

- GNSS networks for environmental monitoring (in cooperation with ISMES and F.V.G. Civil Protection);
- Application of integrated GNSS/gravity/laser scanner/seismic/GPR techniques on Alpine glaciers and Antartctica areas (in particular DomeC), PNRA, ENEA;
R&D Activities

- Kinematic applications of GNSS (GPS+GLONASS) and SBAS/EGNOS for terrestrial, maritime and aerial applications.
- The most important funded Projects, in cooperation with national and international partners, have been: SISA Project (INTERREG IIIA Adriatic Cross Border, 2000-2006), MONITOR Project (6th EC Frame Programme – GJU), ArcheoMedSat Project (FIRB 2003), “Application of integrated GNSS/INS techniques for dynamic monitoring of cablecars” FRA Project (2013-2015), GNSS/INS integrated surveys for GNSS/GPRS/GSM modules validation.
SISA Project

Coordinator prof. Giorgio Manzoni†

Real time kinematic Applications

Integration with Laser Scanner data

ArcheoMedSat – FIRB Archeomedsat Project

GNSS/Remote Sensing/Telecommunications/WebGIS integrated technologies – new instruments for the cultural/archaeological heritage evaluation combined with historical/archaeological studies.

Itineraries, virtual time and space connections on digital devices
1 The Monitor Project: Overview

Performed by the adoption of high precision measurements techniques and by the identification of clear procedures that can be tested and then refined to drive future certifications and standardisation processes, the MONITOR Project is focused on demonstration of the use of satellite navigation in existing and new application areas, such as the Land Monitoring and Civil Engineering, the description and promotion of the added value to be brought by Galileo and EGNOS, and finally to pave the way for the acceptance of these added technologies and tools into our industry and to a wider user community.

The MONITOR Project is structured in three phases:

I. Critical analysis: that concerns the analysis of the land monitoring and civil engineering frame versus several enablers: (technology, market, standards, regulatory and legal aspects, etc..) with the final objective of the selection of the applications identified representative of certain priorities for the community addressed, elements that under deep analysis provide the selection of the Pilot Projects to be implemented.

II. Pilot Project definition and execution: that concerns the definition of a Plan to be developed for the Pilot Projects (addressing the aspects of technology, market, regulation, standardisation and training), the implementation and the analysis of the results with the respect of the short term objective identified by the Plan.

III. Results analysis: that concerns the identification of all the elements of criticalities, by a deep analysis of data results, that should be improved to guarantee that each application will reach its own objectives.

The most significant phase of the project concerns the demonstration of the use of GNSS through the selection of some applications considered representative of the areas included into the land monitoring and civil engineering community, applications experimented within the Pilot Projects, and connected to each other.
EGNOS (European Geostationary Navigation Overlay System)

Kinematic Applications

Development and application of an experimental data server hosting EGNOS and RTCM/RTK correction data for terrestrial navigation
Experimental data server hosting EGNOS and RTCM/RTK correction data for terrestrial navigation

Experimental System Architecture

NovAtel MiLLennium geodetic L1/L2 receivers

Real-time GPS-DGPS-RTK-EGNOS/INS Navigation

MMS (Mobile Mapping System)

Choke ring antenna

splitter

COM1

COM1

EGNOS messages
RTCM and RTK corrections

Data Server

TCP/IP

VPN

Internet

TCP/IP

User Platform

Integration of the user terminal with other sensors

P.C.S. (POS Computer System)
Client/Server Application

- The implementation of the **EGNOS Message Server** (EMS) and the opportunities offered by the SISNeT (Signal-In-Space through the Internet) and **EDAS technology** have encouraged the development of a number of applications within the GNSS users community.

- One possible application is to provide GNSS users with the best available correction data for their GPS measurements within the area of operations. Corrections can be based on: SBAS, RTCM and RTK data.

- Aims: Make all correction data available on a data server, allowing GNSS users to access this server through a communication link and download the desired corrections. In this way GNSS users, depending on the application and on the operation area, can always benefit of the best available corrections.
Depending on the operational conditions and on the operation area (distance from reference station/visibility of EGNOS satellites),
the user can choose the augmentation to be included in the computation of position, velocity and time.

The research project has encompassed: the development of the data server, the development of the user terminal, tests on the availability/accessibility of augmentations on the data server, tests on the communication link between the server and the user terminal, static and dynamics tests to assess the navigation performance of the user terminal and the integration of the user terminal with other sensors.
Experimental Data Server

• An experimental Data Server making available at the same time EGNOS augmentation messages as well as RTCM and RTK differential corrections computed by dedicated receivers located at a known reference position, has been set up at GeoSNav Laboratory, Department of Engineering and Architecture, University of Trieste, ITALY.

• All the corrections available on the Data Server are made accessible via VPN (Virtual Protected Network) through the Internet to authorized users equipped with an integrated GPS/GPRS terminal.
GeoSNav Lab Data Server

Real Time Data Processing & visualization

Novatel Millennium L1/L2 receiver
Applications to Terrestrial Navigation

Calderan M., Cefalo R., Piemonte A., Sluga T. 2014
Kinematic tests: comparison between the ellipsoidal heights obtained using interferential post-processed data and the EGNOS real time data (EGNOS iono model and L1/L2)
Dettaglio delle traiettorie rilevate contemporaneamente con MMS (traiettoria verde) e moduli: GNSS SL869 STD (traiettoria rossa), SL869 custom (traiettoria blu), GNSS/GPRS GE910 (traiettoria viola)
Importazione di rilievi test eseguiti a Trieste su piattaforma Google Earth - visualizzazione in modalità Street View – Dettaglio delle traiettorie percorse - Mobile Mapping System (traiettoria verde), modulo GNSS SL869 STD (traiettoria rossa), SL869 custom (traiettoria blu), GNSS/GPRS GE910 (traiettoria viola)
Analisi dei dati di posizione – RMS della soluzione PPP (Precise Point Positioning)