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

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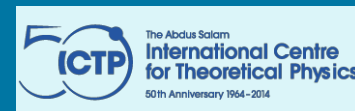
United Nations/ICGTP Workshop on GNSS
Trieste, 1-4 December 2014

Geodesy and Satellite Navigation Laboratory
UNIVERSITY of TRIESTE ITALY

EGNOS (European Geostationary
Navigation Overlay System)
Kinematic Applications

Sat Nav/Sat Com technologies integration
for **Disaster Management**

Cefalo R. (2008). "The integration of SatNav/SatCom technologies
for environmental monitoring and management of emergencies"
In: United Nations Office for Outer Space Affairs. 3rd ICG Meeting
Presentations. Pasadena, California (USA), December 8-12, 2008.

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SISA Project *Coordinator prof. Giorgio Manzoni†*


Real time kinematic Applications

Integration with Laser Scanner data

Manzoni G, Bolzon G., Cefalo R., Gherdevic D., Martinolli S., Piemonte A., Rizzo R., Sluga T. (2006). "CER TELEGEOMATICS APPLICATIONS AND PROJECTS IN CENTRAL EUROPE". *Reports on Geodesy.* vol. 6 ISSN: 0867-3179**)**

FRA 2014/2015 UNITS Project   GNSS/INS innovative technologies application to cable cars plant monitoring for passengers safety
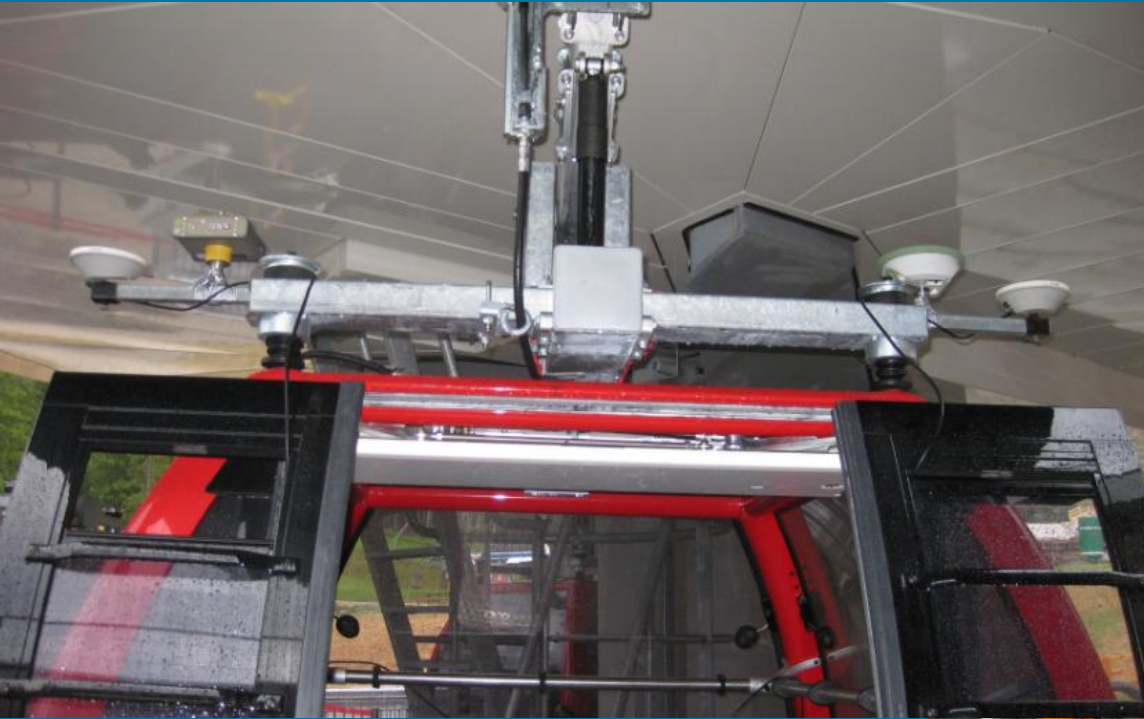
Cefalo R., Piemonte A., Sciuto G., Sosic B. (2013) "Applicazioni di metodologie satellitari GNSS in modalita' cinematica per il controllo di impianti funiviari". Atti della 15° Conferenza Nazionale sulle Prove non Distruttive Monitoraggio Diagnostica, Trieste 24-26 Ottobre 2013
DOI: 10.13140/2.1.4065.9201

Cefalo R., Piemonte A., Sciuto G. (2014) "Applicazione di tecniche topografiche e satellitari per il collaudo di impianti funiviari", Bollettino SIFET (Societa' Italiana di Fotogrammetria e Topografia) 4/2013
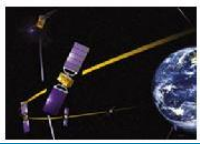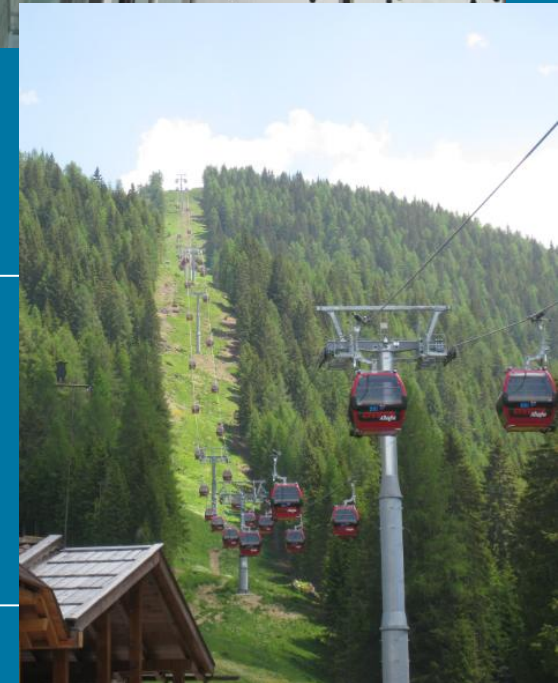
Kinematic tests

Funifor - Ravascletto (UD) plant:

• 2 lead cables and 1 pulling ring cable

•**2 km lenght,** 830 m height difference
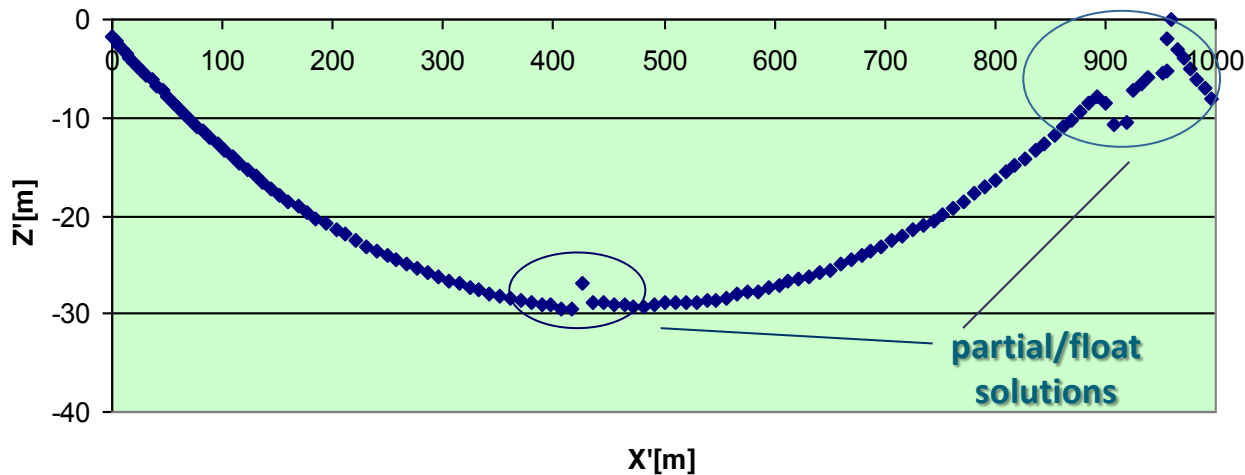
• 1 middle station, 2 same lenght spans

Pian de Pezze' - Alleghe (BL) plant:

• 2 km lenght, 15 spans of different lenght

• 1445 m msl - 1986 m msl

Catenary shape determination

Traliccio-stazione a monte (Legacy)

partial/float solutions

Central pillar – mountain station catenary
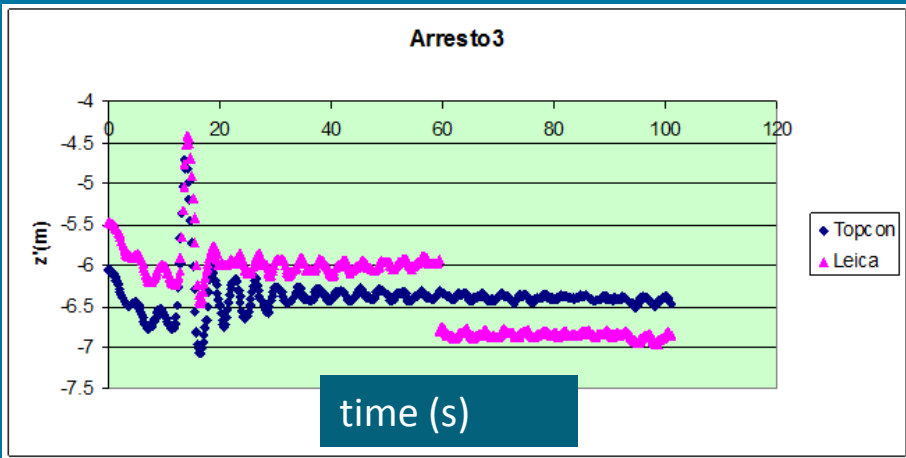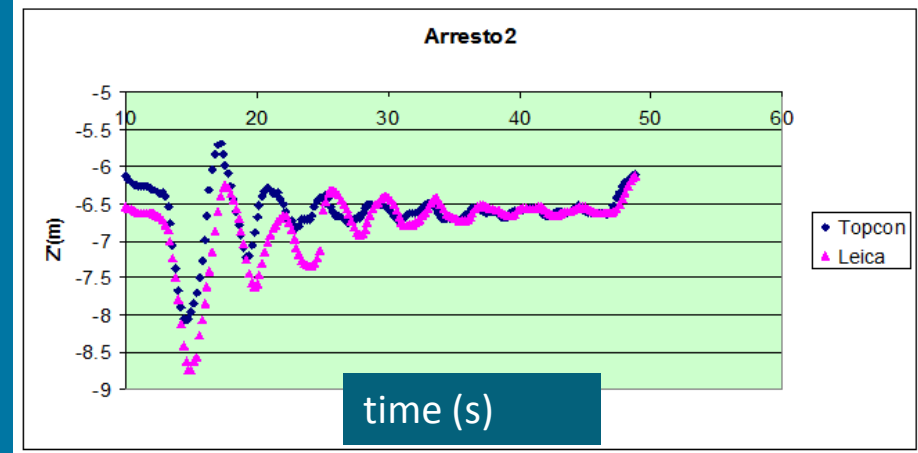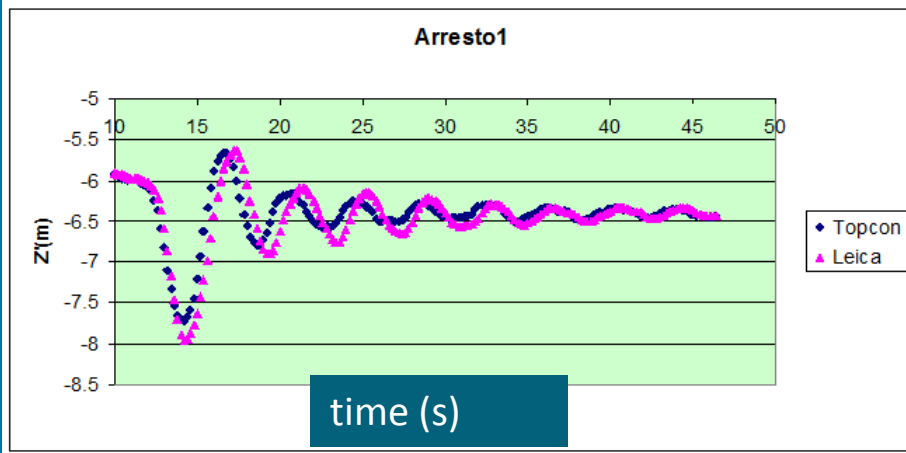Topcon Legacy receiver

Central pillar – mountain station catenary
Hyper Pro Topcon receiver

Traliccio-stazione a monte (Hyper)

partial/float solutions

Cefalo R., Piemonte A., Sciuto G. (2014)
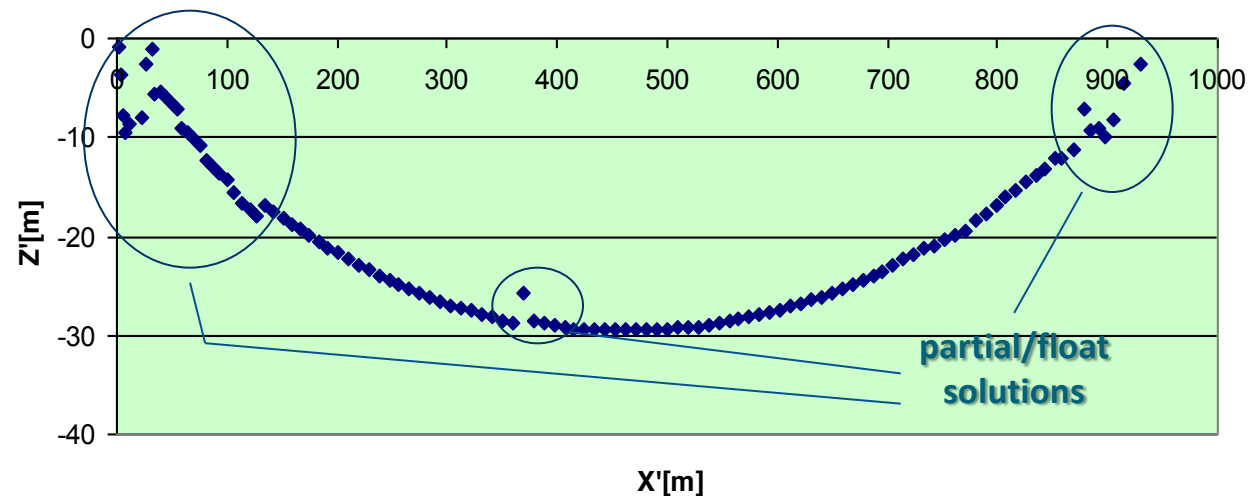
Vertical cabin oscillation due to 4 sudden emergency breaks

from: Cefalo R., Piemonte A., Sciuto G. (2014)
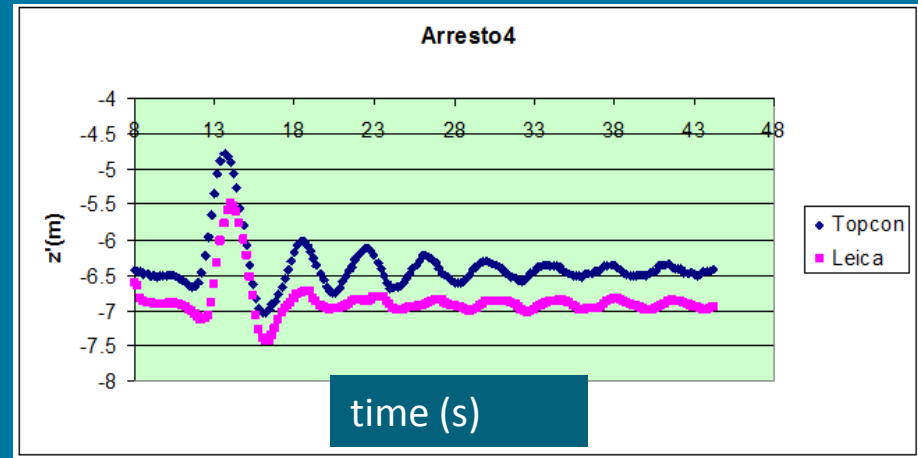
GNSS/INS real-time integration

Applanix POSPac Software
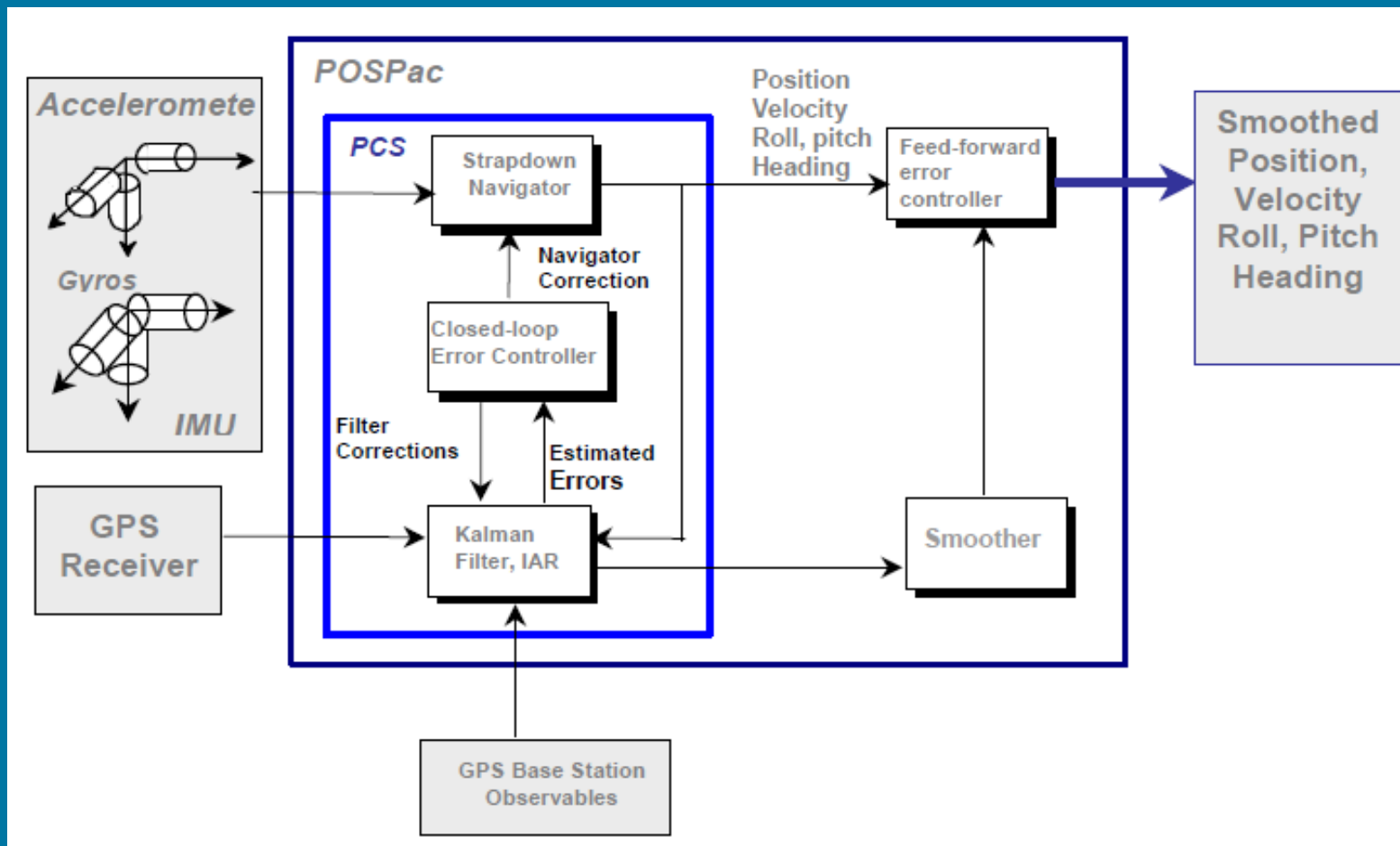
Cable cars dynamic behaviour determination

Cable and cabins dynamic behaviour (cable cars) have been monitored, giving the following parameters:

- Catenary shape during operative phase
- Cabin oscillations due to sudden emergency breaks → effects on passengers comfort, pumping effect, structural checks to verify the norm requirements
- Dynamic torsion effects on the pillars due to cabin passage

Using the actual adopted methodologies these aspects cannot be monitored

from: Cefalo R., Piemonte A., Sciuto G. (2014)

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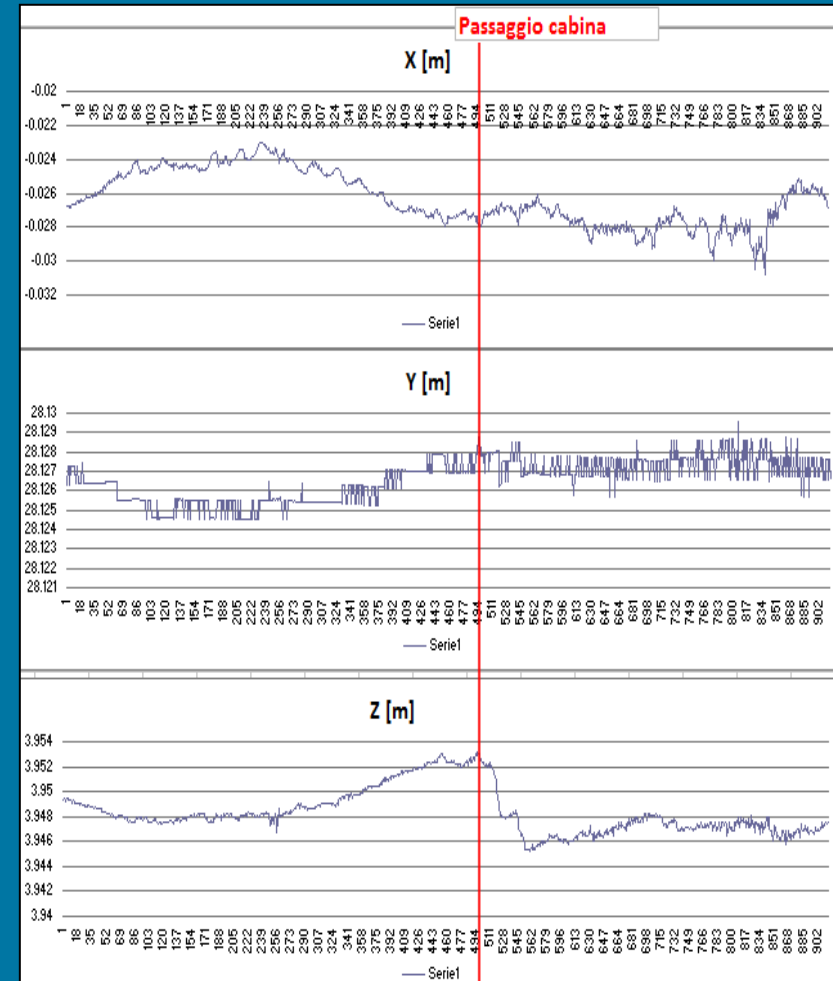
Pillars monitoring

Pillar monitoring at the **two cabins contemporaneous passage using a robotic motorized Leica TS30**

Monitored point

senso di marcia

punto di monitoraggio

scarpa di appoggia

from: Cefalo R., Piemonte A., Sciuto G. (2014)
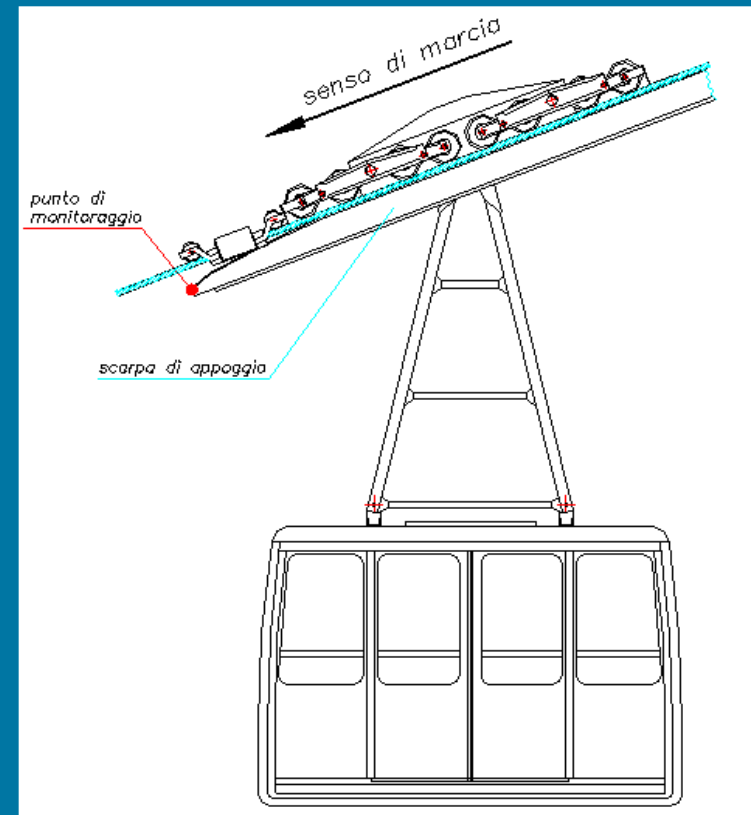
Conclusions and future developments

Cable cars dynamic behaviour determination requires:

- satellite signals continuity

 - high level of accuracy

 - redundancy for safety reasons

→ **sensors integration**

High accuracy 3D INS (Applanix POS LV)/real-time Kalman filtering /multiple GNSS receivers/integration with classical sensors

Future developments:

standard definitions/norms updating

Experimental data server hosting EGNOS and RTCM/RTK correction data for terrestrial navigation

Experimental System Architecture

Choke ring antenna

splitter

COM1

COM1

EGNOS messages
RTCM and RTK corrections

Data Server

VPN

TCP/IP

Internet

NovAtel MiLLennium geodetic L1/L2 receivers

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

TCP/IP

User Platform

P.C.S. (POS Computer System)

Integration of the user terminal with other sensors

MMS (Mobile Mapping System)
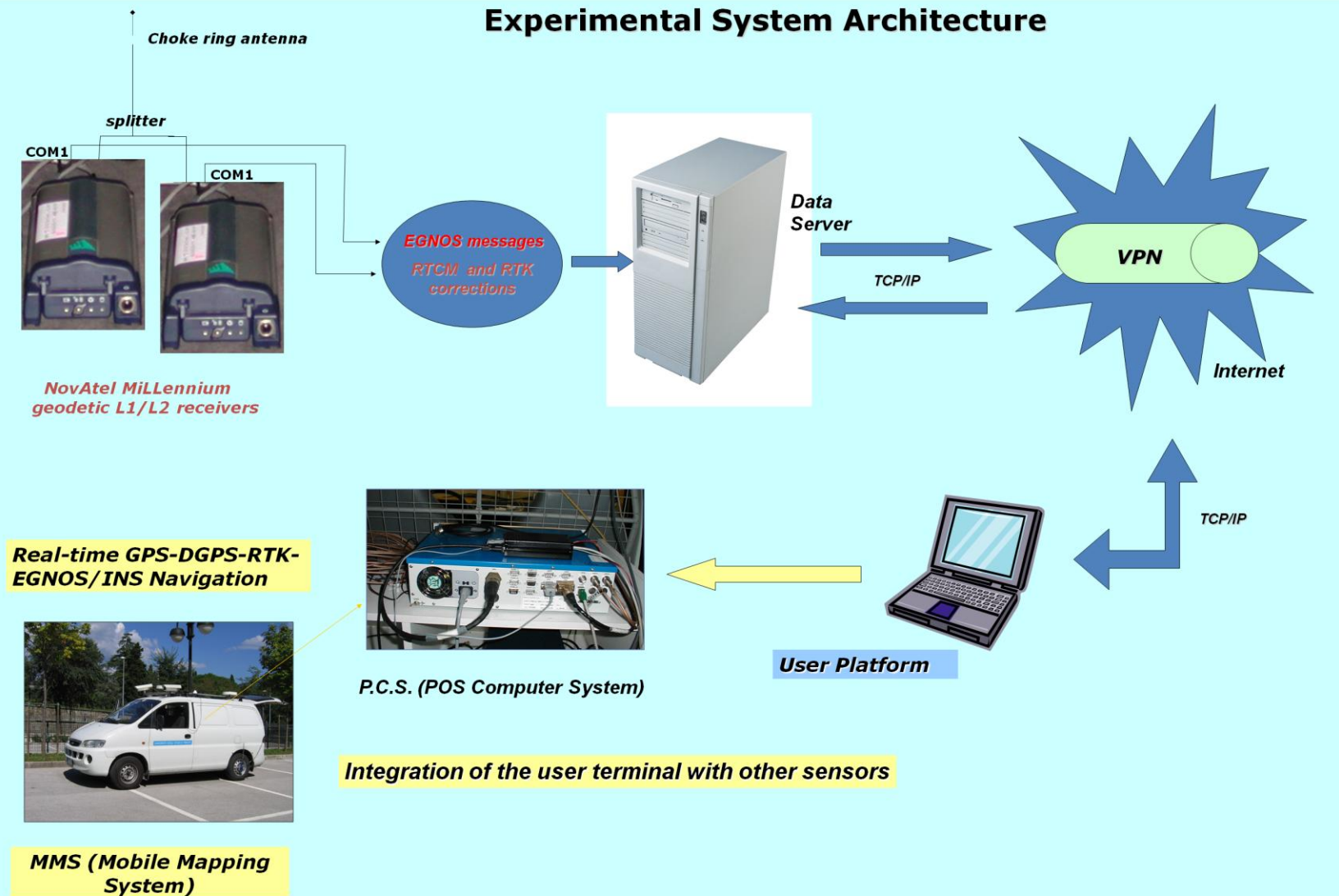
Client/Server Application

- *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.*

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.*

- *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.*
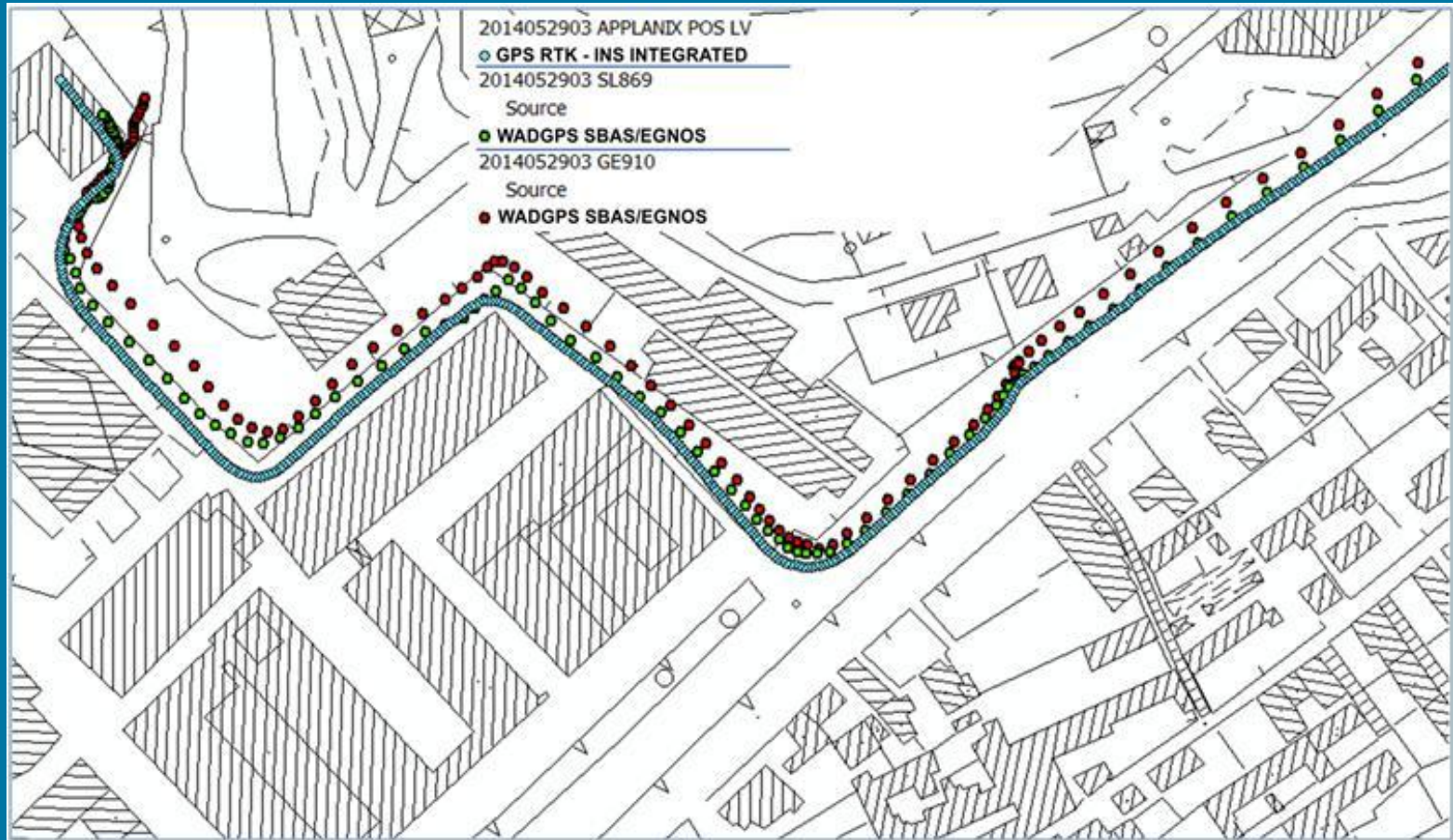
GeoSNav Lab Data Server
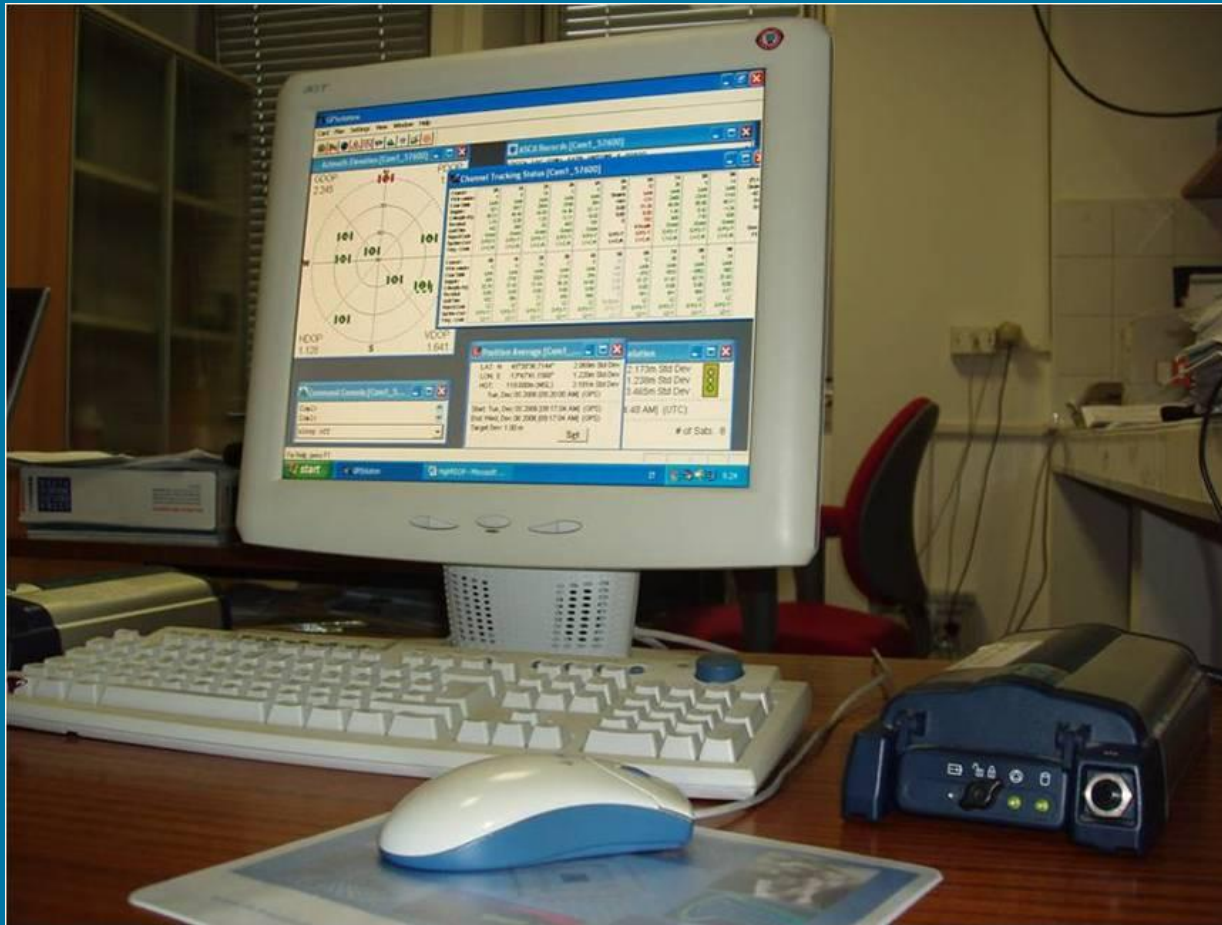
Real Time Data Processing & visualization

Novatel Millennium L1/L2 receiver

Applications to Terrestrial Navigation

Cefalo R., Piemonte A. 2014

References

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Thank you for your attention!

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