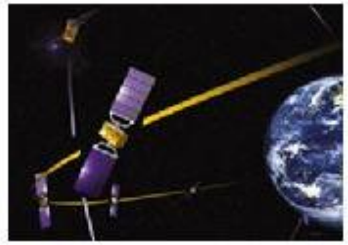
GeoSNaV

GeoSNaV Laboratory
Geodesy and Satellite Navigation Laboratory
University of Trieste, Italy



Università di Pisa

DIA Department of Engineering and Architecture
University of Trieste Italy

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

***Raffaela Cefalo*[1], *Mauro Calderan*[1], *Andrea Piemonte*[2]**

[1] GeoSNaV Laboratory, Department of Engineering and Architecture, University of Trieste, Italy

[2] Department of Civil and Industrial Engineering, University of Pisa, Italy

The Abdus Salam International Centre for Theoretical Physics
50th Anniversary 1964-2014

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

International Committee on Global Navigation Satellite Systems

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.

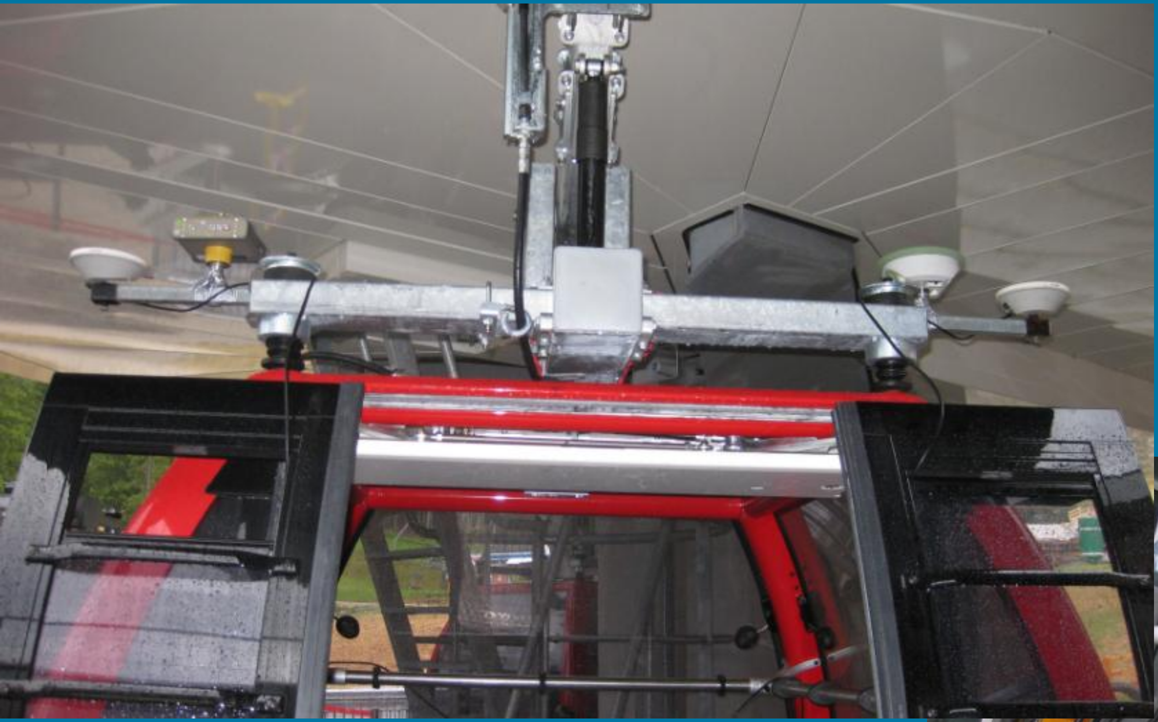
SISA Project *Coordinator prof. Giorgio Manzoni†*

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

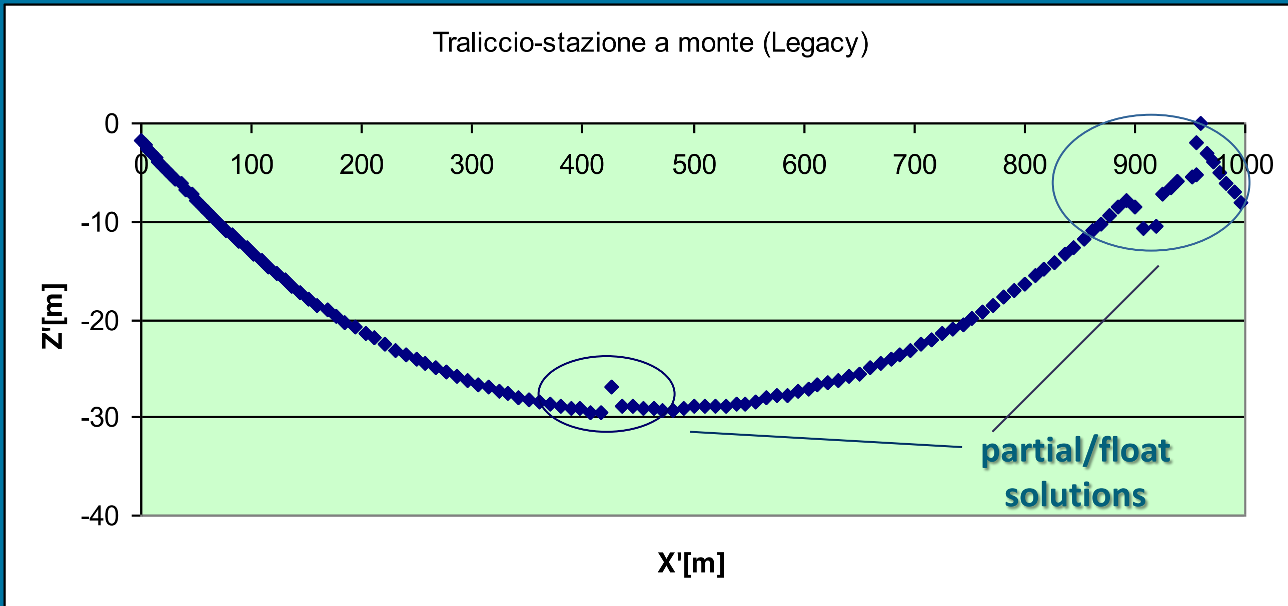
Funifor - Ravascletto (UD) plant:

- 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

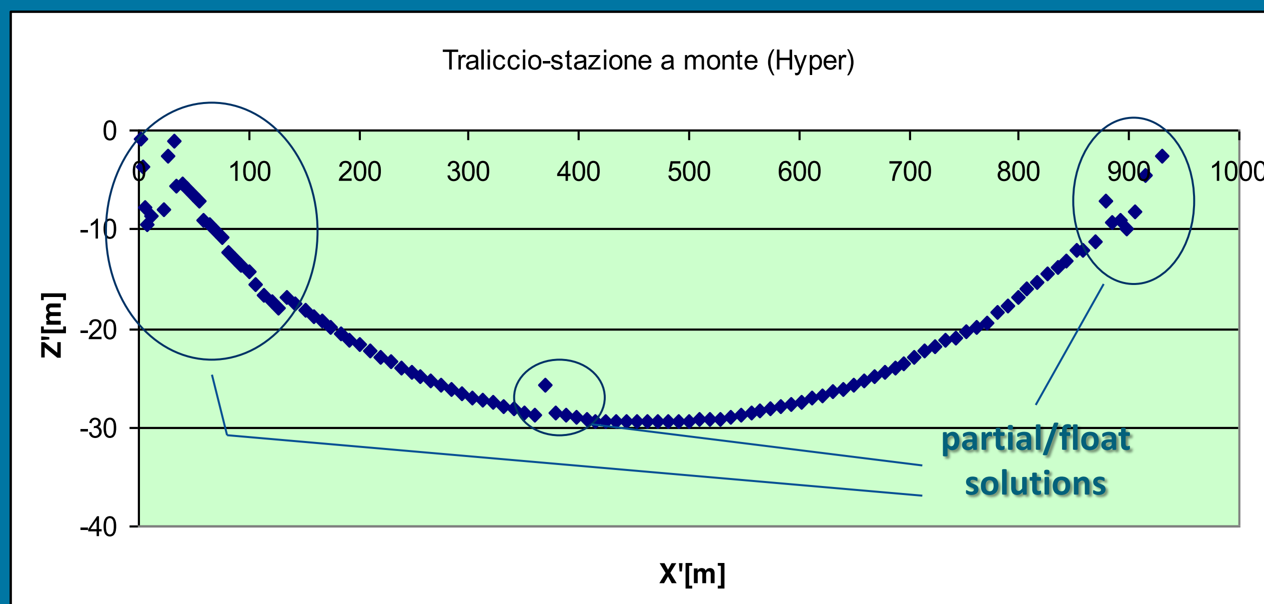


Central pillar – mountain station catenary

Topcon Legacy receiver

Central pillar – mountain station catenary

Hyper Pro Topcon receiver



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

Vertical cabin oscillation due to 4 sudden emergency breaks

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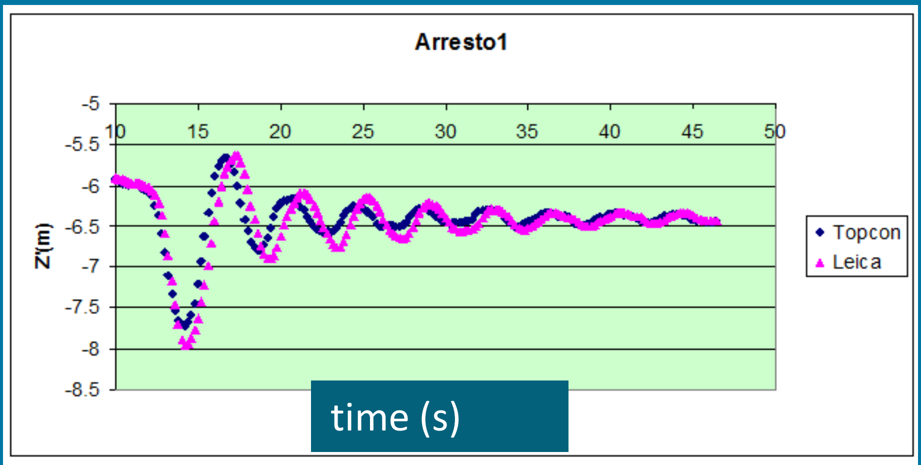
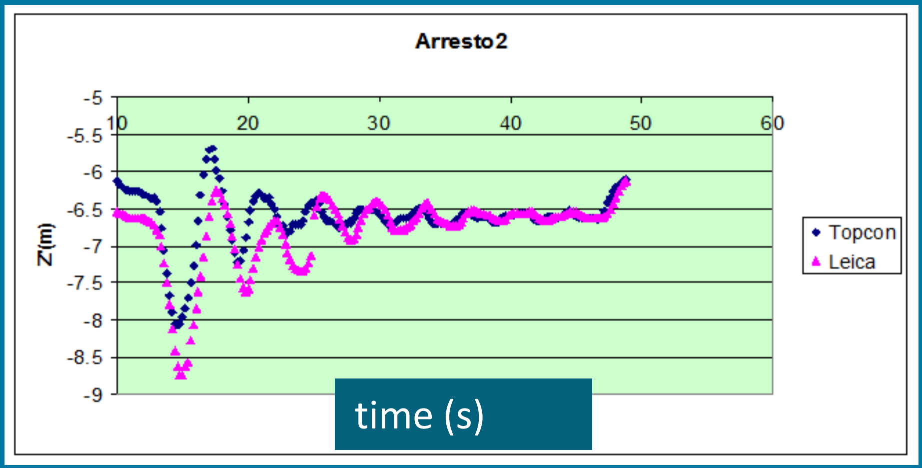
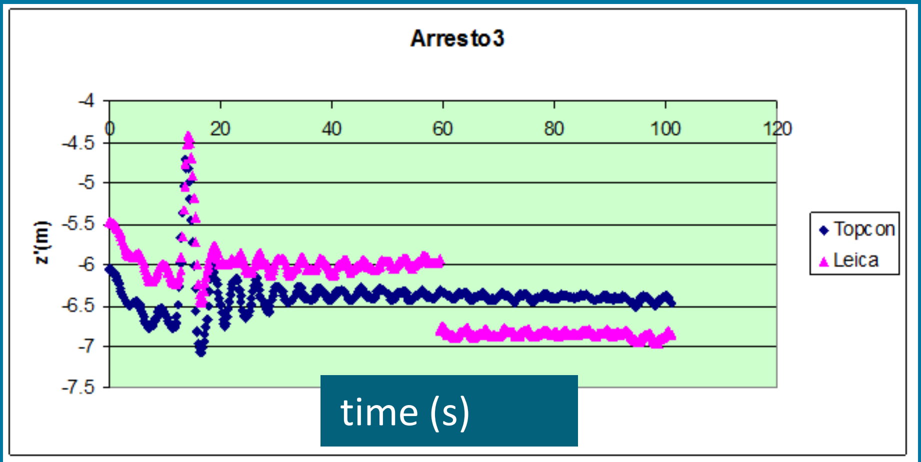
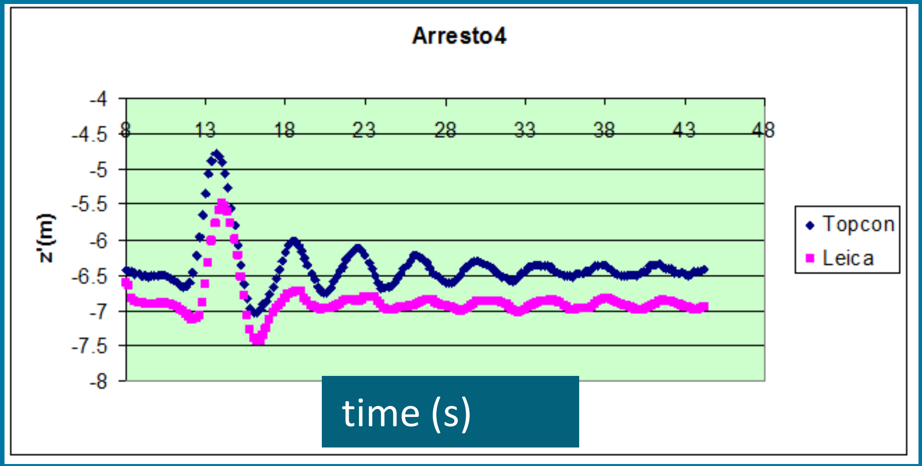






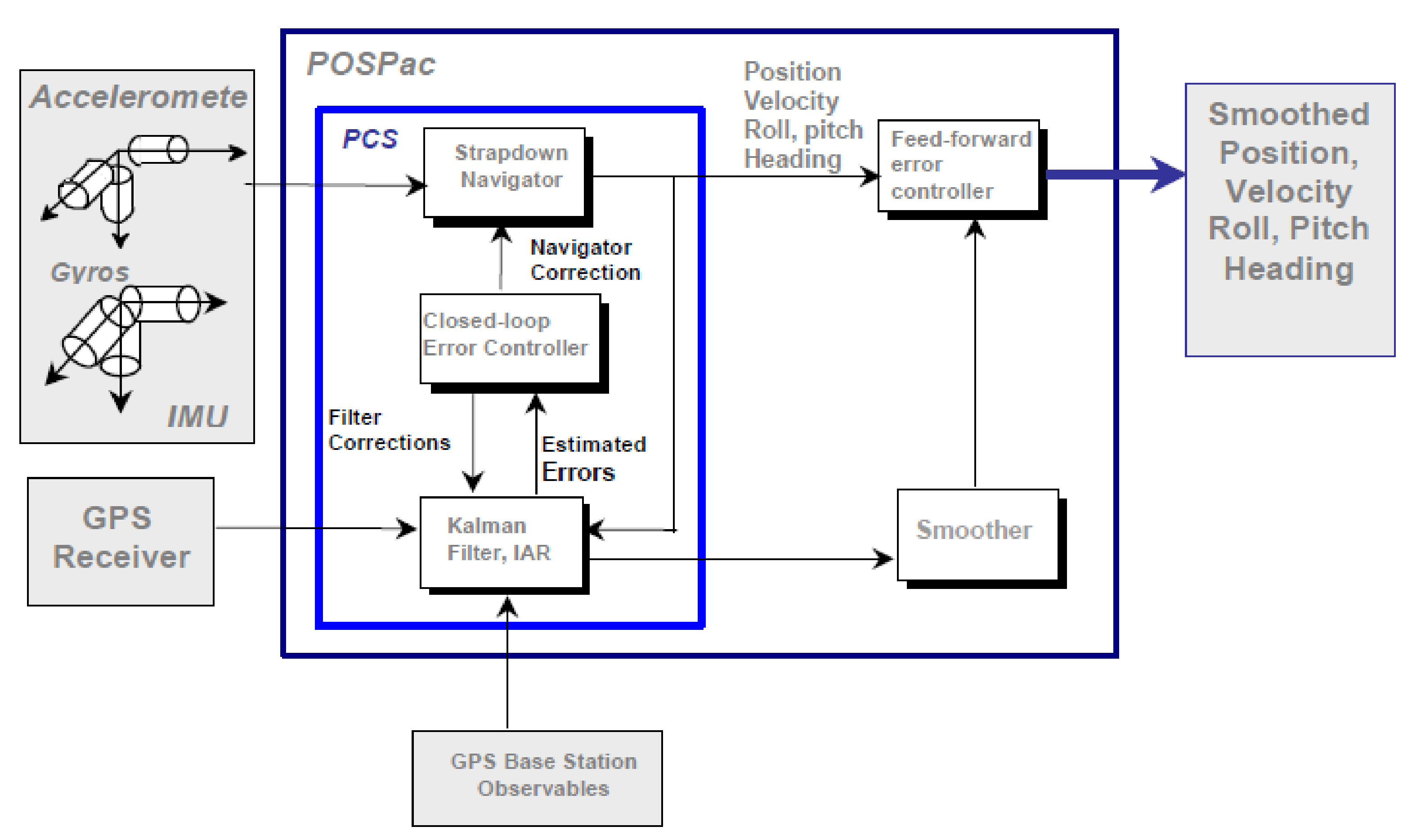


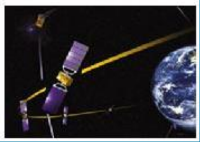
■ RTK trajectory ■ post-processed trajectory

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

GNSS/INS real-time integration

Applanix POSPac Software



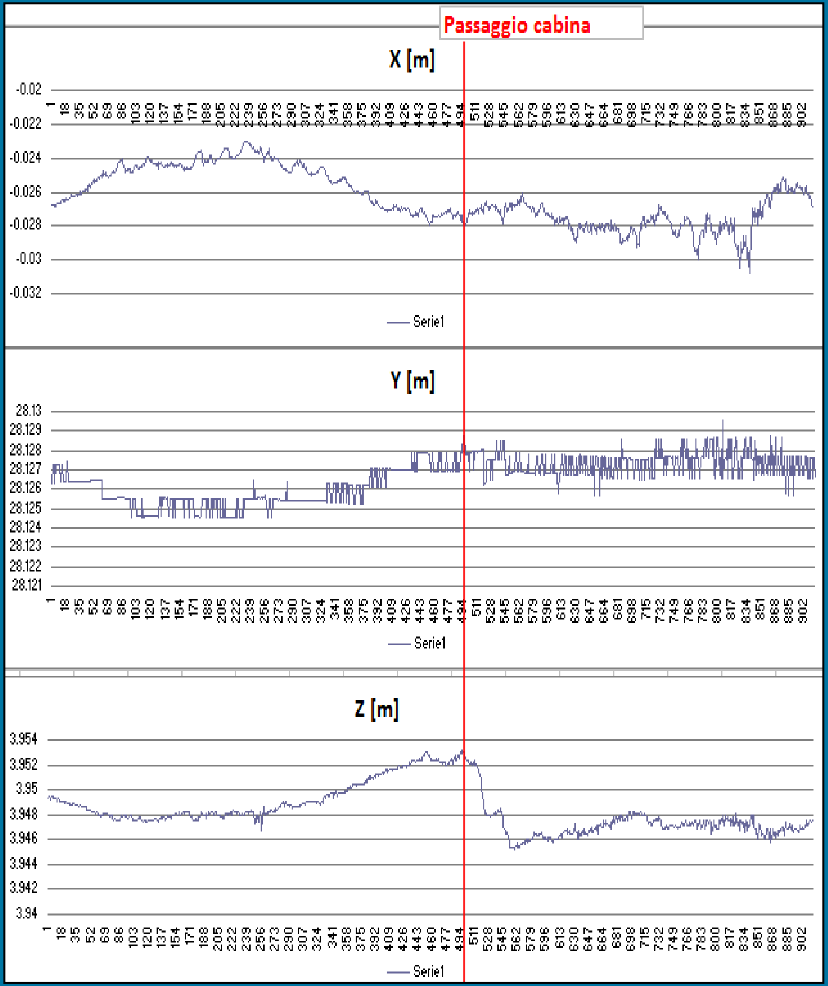


Cable cars dynamic behaviour determination

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

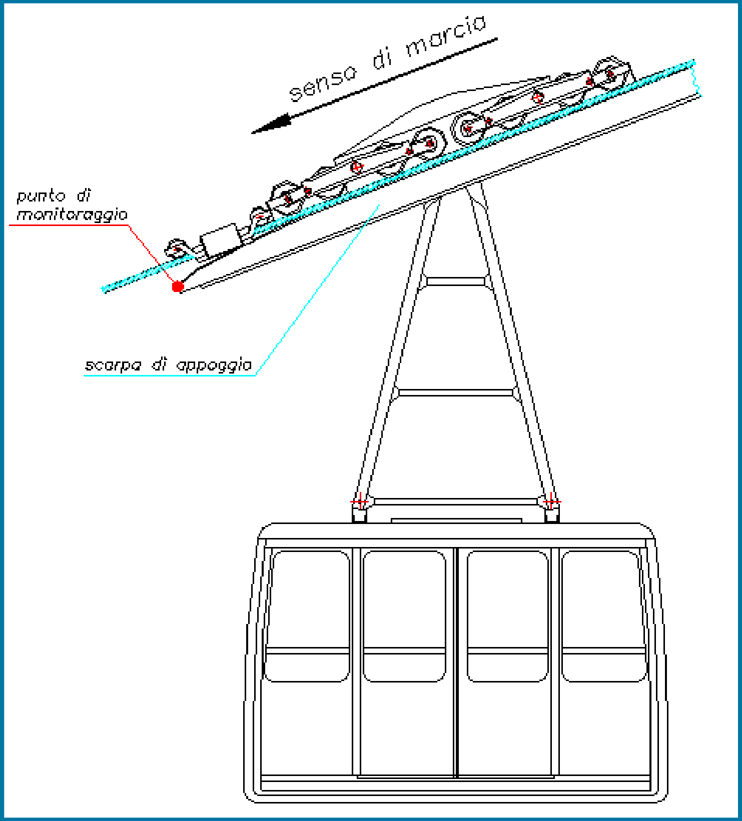
Using the actual adopted methodologies these aspects cannot be monitored



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

Pillars monitoring

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



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Conclusions and future developments

Cable cars dynamic behaviour determination requires:

- satellite signals continuity
- high level of accuracy
- redundancy for safety reasons

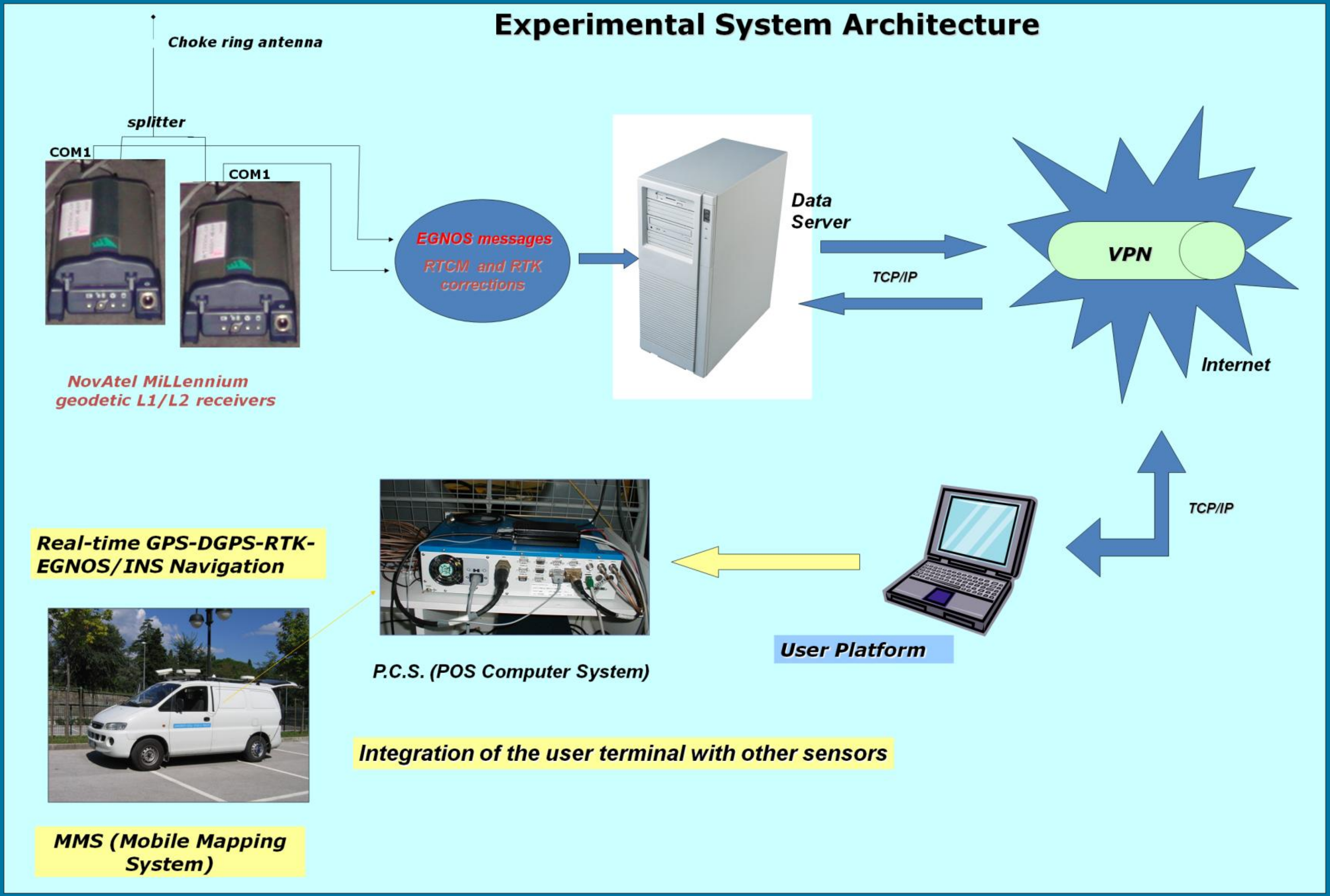
→ **sensors integration**

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



Client/Server Application

- *The implementation of the **EGNOS Message S**erver (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.*

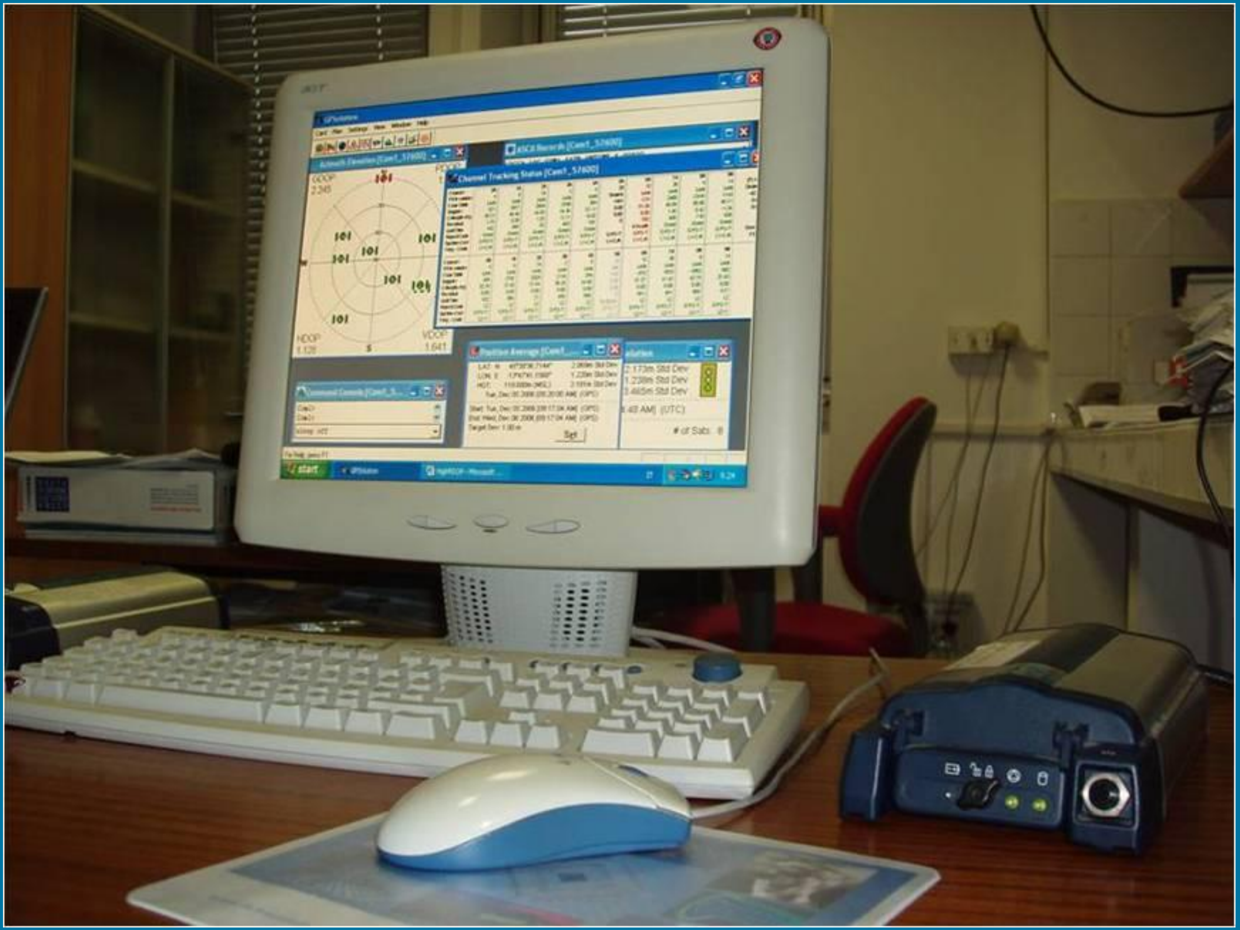
- *One possible application is to provide GNSS users with the best available correction data for their GPS measurements within the area of operations. Corrections can be based on: SBAS, RTCM and RTK data.*

- *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.*

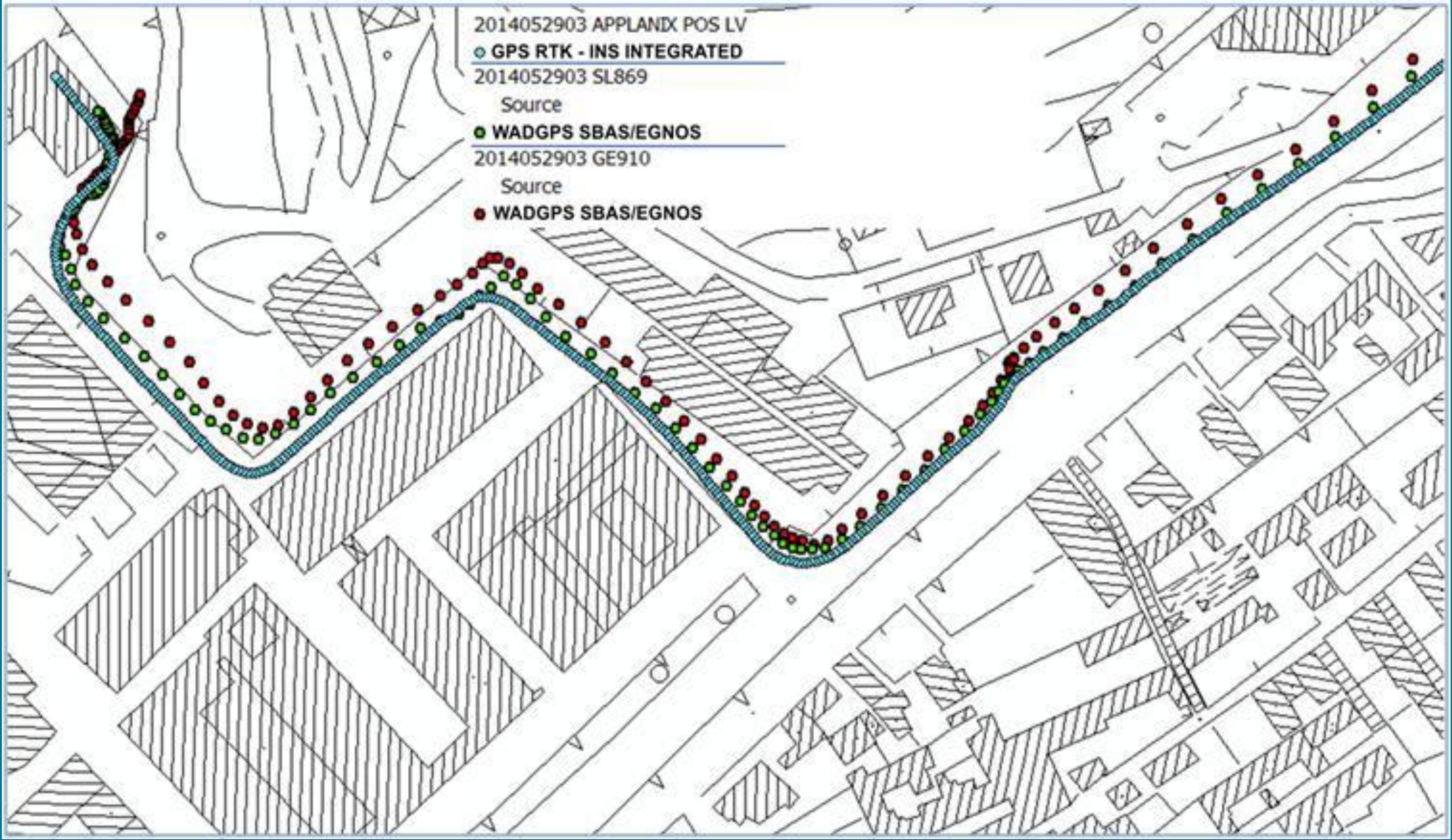
GeoSNav Lab Data Server



Real Time
Data
Processing &
visualization

Novatel
Millennium L1/L2
receiver

Applications to Terrestrial Navigation



Cefalo R., Piemonte A. 2014

References

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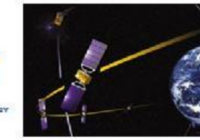

Thank you for your attention!

Prof. Raffaela Cefalo, **eng. Mauro Calderan**
GeoSNav Lab
University of Trieste, ITALY
cefalo@dicar.units.it; calderan@iuav.it

Prof. Andrea Piemonte, DIC, University of Pisa, ITALY
andrea.piemonte@dic.unipi.it