GPS and GLONASS in Italy

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ABSTRACT:

In 1987, Mariano Cunietti and Giorgio Folloni joined a group of Italian Universities in a national project financed by the Ministry of University. The aim was to purchase a couple of L1 GPS receivers. This was the first geodetic national project with a large participation of researchers. A few months later Giuseppe Birardi joined them in the Brennero-Noto GPS geoidal transverse, by using two more, L1/L2, reveivers of Consiglio Nazionale delle Ricerche. In winter 1997 Alberto Gubellini nad Daniele Pospictchill used the same receivers in the first GPS campaign in Antartica. Since then almost all Italian geodesists have been involved in GPS theory and applications, including tectonic and soil movement monitoring, kinematic positioning in aerial photogrammetry, geoid ondulations modelling, road survey and traffic pollution control etc.. Outside the Universities, the Istituto Geografico Militare, IGM, has established the first order GPS network . Several professional surveyors currently use GPS in cartography. GPS is used for vehicles navigation and fleet management, in robbery alert, in conjunction with GSM. Applications are in progress for air traffic control, which requires the most reliable and advanced GPS and GLONASS methods. The use of real time Differential GPS is expected to increase with the future availabilty of the radiobroadcasted corrections also diffused by telecomunication satellites.

1. MARIANO CUNIETTI and GIORGIO FOLLONI

The history of GPS in Italy is linked to Mariano Cunietti, Politecnic of Milan and Giorgio Folloni, University of Bologna.

1986: Giorgio Folloni organized a GPS measurement in Castel dell' Alpi, performed by IGM, Italian Military Geographic Institute: IGM was already equipped with GPS receivers.

1987: Mariano Cunietti and Giorgio Folloni promoted a request to the Ministry signed by many Universities for a couple of L1 receivers (still working sometimes at the Universities of Pisa and Trieste).

1988: Giuseppe Birardi, University of Rome, obtained from CNR, National Research Council, the funds for a couple of L1/L2 receivers.

1988: Giuseppe Birardi planned the Nord-Sud geodetic GPS transverse from Brennero(Austrian border) to Noto(Sicily), with the cooperation of several Universities (Bari, Rome, Pisa, Trieste, Politecnic of Milan, Politecnic of Turin).

1989: Politecnic of Milan repeated the northen part of the transverse with the cooperation of the same Universities. A similar transverse has been measured in Sardinia by the University and the Astronomical Observatory of Cagliari. The University of Bologna organized geodinamic GPS in Calabria and Tyrrenic islands. This University began GPS networks for monitoring subsidences in Bologna and other sites.

Kinematic GPS tests have been performed since 1988 on terrestrial vehicles in airports, cable cabin, and aircrafts in cooperation among Politecnic of Turin, Politecnic of Milan, Universities of Trieste, Pisa, Ancona, Bologna and Rome and some photogrammetric companies: Alifoto, Turin, CGRA di Parma, Alenia di Roma.

GPS measurements have been performed in Anctartica by Alberto Gubellini and Daniele Pospictchill, both from the University of Bologna, and in Himalaya by the Universities of Trieste and Padua.

Mariano Cunietti, Giorgio Folloni, Giuseppe Birardi, Alberto Gubellini, Daniele Pospictchill are no more with us, and this paper is dedicated to them.

In those years Codevintec Italiana (Milan), WILD Heerbrugg, now Leica, Geotop (Ancona) and may be others lent some GPS receivers to the Universities: therefore these companies gave a very important contribution to the progress of GPS researches in Italy.

Some Italian Universities, under the leadership of Politecnic of Milan, performed very important theoretical researches in particular on the processing methods and in geoidal models.

In 1990 IGM began the measurements for the GPS first order network, IGM95, which is now tha backbone of italian geodesy and cartography.

In the hardware domain, Elettronica SpA, Rome designed and constructed a small number of GPS geodetic receivers for the Italian Space Agency.

2. ACTUAL SATELLITE POSITIONING

Fast Static, OTF (On The Fly) are well known methods which has been commercially delivered since 1995. No other so much important techniques have been introduced in the last years, even if several electronic innovations have reduced the weight and speeded up the GPS receivers.

GPS is now at consumer level; a TV geographic play uses GPS. Nevertheless the diffusion of GPS is less fast than expected. The main limitation to the diffusion of GPS is the lack of a national RTCM radiodiffusion service. Hence our present main effort is to push the production of this service, after having experimented and choosen the best system. among the available, which are

Terrestrial diffusion

-LOW FREQUENCY:

ALF, Accurate Positioning by Low Frequency, operated by Bundesamt fuer Cartographie und Geodesie (BKG) in Frankfurt am Main

Marine Radiobeacon as operated in the past from Venice and now from Vieste (Foggia)

-HIGH FREQUENCY (VHF,UHF):

RDS (Radio Data System)

DARC(Data Radio Channel)/Swift (System for Wireless Infotainment Forwarding and Teledistribution): it is used by ORF, the Austrian Radio Television Company, on the FM band, to diffuse RTCM and RTK in whole Austria

DAB (Digital Audio Broadcasting): it is under test in Germany and in Italy, province of Bozen (RAI and RAS)

Mobile telephones

The University of Trieste has been carried out some kinematic experiments, also in cooperation with RAS, Bozen, on DAB as well as on ALF and on Marine Radiobeacon and with mobile telephones. The results have shown a general feasibility of the methods in terms of accuracy, while the mobile telephone link suffered frequent interruptions

Satellite telecomunication diffusion

RACAL , OMNISTAR are world wide commercial services; EGNOS , European Geostationary Overlay Service , is a European Community project born for air traffc control.

All of them diffuse the RTCM corrections on a carrier in the same band of the GPS signals.

The service is at least continental so that Wide Area refractivity models have to be used in order to reduce the errors due to the long distances from the Master station. Being based on geostationary satellites, their signals can be eclipsed by buildings and other obstacles so that they are not feasible in a limited sky environment like urban areas.

3. RECENT GPS APPLICATIONS IN ITALY

In the last years, the Italian Universities have participated to the repetition of several very important Mediterranean and Europen geodinamical GPS campaigns. Also many geodetic GPS campaigns have been performed for cartography, soil movement monitoring, costruction of transport infrastructures and survey of glaciers. Experiments have been carried out on road survey by means of intergrated GPS/INS and Laser scanning, GPS+GLONASS terrestrial vehicle trajectories , oscillation measurements of a chimney by means of high sampling rate GPS , Airborne Laser Scanning , atmospheric pollution monitoring by GPS positioned vehicles equipped with gas sensors .

Several GPS reference stations are in operation, the first one has been installed in Matera by the Italian Space Agency. Nuova Telespazio SpA operates some reference stations too and participates together ENAV, the Air Traffic Control Authority, to EGNOS: flight experiments have been already done in Ciampino (Rome) airport.

Several professional surveyors work on GPS, having as reference the IGM95 first order GPS network. Some companies are equipped with GPS/INS vehicles for road survey.

GPS is used in some cities to monitor the bus fleet, and some private transport companies use GPS with the same purpose. A GPS security service is used on cars connected with GSM.

4. CONCLUSIONS

The GPS activity in Italy is strong in the research field and in the geodetic applications, supported by the Ministry of Research and University, the Italian Space Agency, The National Research Council. The vehicle management is increasing and a DGPS national service is essential for the diffusion as well as for new applications and research activity.

Real time kinematic DGPS is quite useful also in the current cartographic work since it allows the real time control of the standard deviation

The most promising DGPS method seems to be DAB, which will allow also the transmission of updated maps.

On continental basis for transport applications, the extension to East Europe of GNSS (GPS+GLONASS+EGNOS) is one of the main goal and will diffuse the applications to terrestrial fleet control and other use at consumer level. Diffused applications to air traffic near and inside airports are expected to increase safety.

Lanslide and soil movement GPS monitoring will also increase as the receivers are cheaper and compact.

Moreover cadastal cartography is moving towords the use of satellite positioning, which fact is helped by the reference stations network..

In conclusion, the applications will increases more and more the importance of the satellite positioning methods. The extension of DGPS to east Europe will open a wide new market, which fact means the peace so highly desired at the end of this bloody century.

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