A KINEMATIC GPS +LASER ROAD SURVEY METHOD

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In another paper (Caroti et al.,1997) presented in this meeting, a short description of an original survey road method has been given. It is based on the integration between the GPS geodetic kinematic positioning of an antenna mounted on a car and a soil scanner made up of a Laser distance meter without prism reflector: the reflection is generated by the soil itself.

This method has been applyed to a segment of 16 km on the highway running from Florence to Pisa. The operations and the results will be given in detail hereafter.

This highway needs to be widened since it has no emergengy stop lane. Hence a survey of road sections every 50 m was necessary, including the features of the terrain for a length of about 10 m left and right of the road.

Since this highway has a very high traffic, its closure was not possible; then the survey had to be carried out quickly and in the traffic.

Due to these costrains a new method was devised, the soil was scanned by a Laser distance meter (EDM), which needs no optic reflector; the Laser EDM coordinates were measured by the GPS method. Both the Laser EDM and the GPS antenna were mounted on back of an open pick-up car. The soil scanning was usually performed normally to the car longitudinal axis.

The GPS was used in the differential kinematic mode, with the maximum possible accuracy by measuring the phase delay of the satellite emitted carriers. The Fast Static initialisation and the On The Fly reinitialisation were used. Both the position of the GPS antenna and the zero of the Laser distance meter were determined with a few centimetres accuracy in few seconds at every stop of the car during the whole 50 m step survey.

The Laser is a GaAs diode pulse modulated at 100 MHz. The EDM measures the distance as the propagation delay of the pulse arrival after soil reflection in respect to start time; the centimeter accuracy is obtained by means of a time to amplitude converter of the wavelength fraction.

The Laser beam is rotated in the vertical plane containing the GPS vertical antenna, and is orthogonal to the vehicle longitudinal axis.

The whole survey has been linked to the Istituto Geografico Militare geodetic network The cartographic Gauss-Boaga coordinates of the points have been computed:

- a 7 parameters transformation between WGS84 and IGM40 has been found by means of the GPSurvey proper software on the basis of the IGM double reference coordinates of the fixed points;
- the WGS84 coordinates of the fixed intermediate points used during the survey , so to avoid the continuous GPS occupation of the IGM reference points, have been computed through the GPS raw data ; after that the WGS84 coordinates of the surveyed points have been computed;

- the above-mentioned 7 parameters have been used for the transformation of the WGS84 surveyed coordinates into the IGM40;

- the Gauss equations have been used to project the IGM40 geographic into the cartographic ones.

Summarising, a sort of the back and forth Porro principle for the deformations in optics was used

A complete map of geometry of the road and its surrounding is obtained with a few centimeters accuracy.

The survey was performed with the cooperation of ANAS, Florence.

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REFERENCES:

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