D008-006 Room: 303 Time: May 29 14:55-15:09

Precision of GPS point positioning

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[1] None

http://home.att.ne.jp/iota/bluedoor2001/index33.html

GPS point positioning has conventionally been regarded as unsuitable for survey due to its poor precision. However, since SA (selective availability) is off in 1999, the precision of GPS point positioning has been appreciably improved. And it is considered possible to apply GPS point positioning to any survey due to low-cost and simplicity.

This study is about the comparison between the precisions before and after elimination of SA in GPS point positioning and about the possibility of application to survey.

In this study, I used the GARMIN GPSII, a handheld GPS receiver, and the GPS driver of ProAtras2000 by Alps Mapping Co.,Ltd as a data logger on a notebook-PC. The record of GPS point data was made by the marking function of the GPS receiver and/or the GPS driver of ProAtras2000.

The method was that in an agricultural area near the Kouzu-Matsuda fault in Odawara-city of Kanagawa Prefecture the GPS receiver was set at four points of a 10m x 5m rectangle about 1m high over the ground.

The results were got as standard deviations (SD) of horizontal component (2D) 27m before elimination of SA and 7m after this, respectively. Therefore, the precision was improved about 4 times.

Next, a Plain table was set about the center of the same rectangle and the GPS receiver was set at 4 points of a 30cm squire around the center of the Plain table. Twelve times measurements resulted 6.397m as SD of horizontal component. Most provable values (MPV) were gained from data for the four points by the least squire method using condition equations on the distance and the direction. The SD of MPV was 1.897m. Moreover, the MPV of the position of the center of the squire, as the last target, was calculated as the average of 4 points, of which SD was 0.949m by propagation law of error and was surpassing the barrier of 1m. These data were gained using the marking function of the GPS receiver only.

The continuous survey with PC improved the accuracy more than precision and enabled me to record 3D data. The results of 9-times surveys of 100 records (sampling rate=2 seconds) at each point were that SD was 6.505m on 2D and 8.468m on 3D and SD of MPV was 1.349m on 2D and 6.974m on 3D, and that SD of MPV of the center was 0.674m on 2D and 3.487m on 3D.

From these results, it is considered that the GPS point positioning has much poorer precision than that of 1-4 degree Control Point Survey even after elimination of SA, but it is possible to use data of once measurement of GPS point positioning for topographic map survey of 1/10000 scale, 9-times for 1/2500 and 100-times for 1/1000. And it is possible to improve the precision easily by setting a lot of points geometrically around the target point. The continuous survey with PC enables us to gain more precise data in a shorter period and together with 3D data.

Estimating roughly, the continuous survey during a month results about 1 cm precision in 3D, and that during 8 years results about 1mm precision, respectively. Therefore, a continuous GPS point positioning may have such sufficient precision as to measure variance of several cm a year such as movement of a plate.

In particular, GPS point positioning will be very useful in case of survey without sufficiency of surveyors and/or instruments and without correction by a control point in a mountain area or a solitary island, where control points are placed in a poor density. Additionally, GPS point positioning has a remarkable merit that it never stops when the conventional continuous GPS system by the RTK method falls in trouble in case of emergency such as large earthquake.