LOW COST MOBILE SURVEYING TECHNIQUE WITH GPSSIT

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ABSTRACT

Since GPS technology which is intensively used in surveying application today, can not directly be employed to measure some details such as building boundaries, it is still a necessity to establish control points on the ground and coordinate them by GPS and then measure the details by a total station set up on these control points. Establishment of control points on the ground and their compulsory use increase the cost and course of a detail surveying project.

In this research, GPSSIT technique is transferred into a motorized surveying technique adapted on a pickup by a low cost mechanism that enables GPS and laser total station integration. So that, this technique makes possible to measure details in a remote distance without establishing any control point on the ground and carrying out all measurement processes on a pickup not on the ground. Motorized GPSSIT provides great advantages in term of course and cost of work and applicability contrary to conventional surveying technique. Technique was applied to measure details in lodging area of Selcuk University, campus area. The results obtained in this area were then used to analyze the practical applicability of the technique by comparing the results from conventional and other ground based surveying techniques.

Keywords: Detail measurement, Motorized GPSSIT.

1. INDRODUCTION

Today, Real Time Kinematic (RTK) and Stop and Go GPS techniques are widely used for the measurement of details on the ground if the details are accessible and reachable directly. On the other hand, if the details and their environment are not reachable or do not allow surveyors to apply GPS antenna directly over them, in this case, for the measurement of such details, combined or sequent measurement techniques are applied in the practice such as GPS+EDM techniques. This solution is also dependent on traversing stations installed on the ground as being in conventional traversing using polar measurement technique, with just one exception that stations are not coordinated by conventional surveying techniques but GPS. Every one will be agree with that this dependency to the installed stations on the ground makes the surveying process longer and hard and adds some additional cost and effort when it is compared with the surveying processes in the case at where GPS antenna is applicable directly and vertically over details. So that, current approach of this case dependent combined surveying technique is not practical with respect to a technique which is independent of installed stations.

In this research, here in Selcuk University campus, it is developed a practical and rabbit motorized GPS surveying technique which is called as Motorized Mobile GPSSIT (MM-GPSSIT) to overcome those problems experienced in practice and caused by detail features. GPSSIT basically makes detail surveying independent of traversing stations installed onto the ground since it uses virtual stations determined by GPS antenna phase center just few meters above the ground as it is explained in author' previous paper (Corumluoglu, 2007). On the other hand, Motorized Mobile GPSSIT represents more than that. So, in terms of surveying technique, MM-GPSSIT fundamentally depends on GPSSIT, but not on the ground, on a vehicle. After the design stage was completed, system was tested in campus area of Selcuk University to understand whether it can be applicable into the practice.

2. MOTORIZED MOBILE GPSSIT

It has been being applied in the practice in a way that GPSSIT was made compatible to work on a vehicle by using an adjustable carrying bar (fig.1). Finally, it was concluded as a motorized mobile GPSSIT (MM-GPSSIT). Similar GPSSIT surveying procedures are followed in a one stop measurement section even when MM-GPSSIT is applied for a detail surveying. During the one stop measurement section, first of all, GPS antenna plugged into a tribrach with bubble set up on a specially designed bar fixed on the vehicle and GPS data is collected for several minutes. This point called as GPS virtual point (GPSVIP) in GPSSIT is determined in 3D coordinates by GPS. Then GPS antenna is removed from the tribrach and an EDM is attached to it. Since a single tribrach is used for both devices, GPS antenna and EDM, this device combination is called as single triprach (Tek Tribrach – TeT) combination technique (fig.2). Meanwhile, GPS antenna is attached on a surveyor pole located at a place on the vehicle as far as from the triprach on the bar. Therefore, most suitable place for the surveyor pole on the vehicle can be one opposite corner of the vehicle, i.e. pickup. The line between these two points on the vehicle determined by GPS forms a starting direction as reference for angular reading to be collected by the laser EDM at the first GPSVIP just over the bar (Kalayci, 2003 and Corumluoglu, 2007). Once GPS data collection is completed, detail surveying can be started by surveyor without alighting from the vehicle if a laser total station is used. Once all details measurable from the location where the vehicle is stopped at are collected by laser EDM, it means first one stop measurement section is completed and vehicle can now move to the second one stop measurement site and so on, until all the details are measured in the project area.

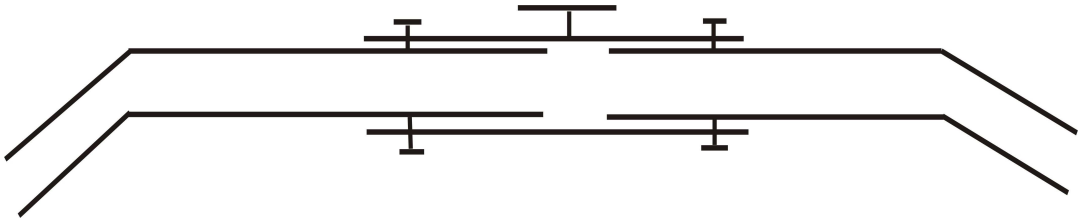

Figure 1: An Adjustable steel carrier bar designed to put on a vehicle (most probably pickup truck) vessel.

Figure 2: Use of single tribrach (TeT) combination technique for both GPS and EDM

As it can be seen from Figure 1, the adjustable steel carrier bar can easily be fitted to top of any vehicle vessel by extending or shortening it from both ends. Then this carrier bar acts as a tripot set up on the ground for both GPS antenna and laser total station, but not on the ground on a vehicle.

Figure 3 also shows flat disk fixed in the middle of adjustable part of the steel bar. This flat disk carries the single tribrach and so that GPS antenna which is used to determine first GPSVIP and laser total station to measure details around without alighting from the vehicle.

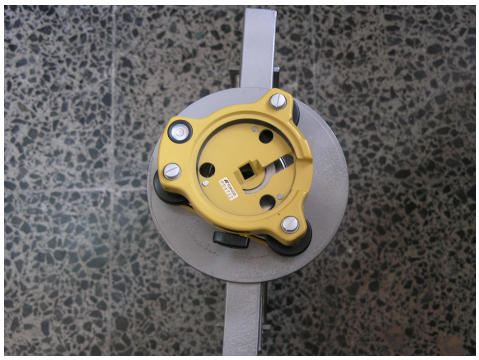

Figure 3: the top view of flat disk fixed on steel bar carrying tribrach with bubble.

To construct a reference direction from first GPSVIP over the bar, it is required that a second point must be introduced. Therefore, a second GPSVIP can be described for this purpose by GPS antenna removed from the first GPSVIP and set it up on a surveyor's pole fixed at the far corner of the pickup truck vessel (fig.4 and 5). After the collection of GPS observations and GPS processing, second GPSVIP coordinates will have been determined with a high accuracy. These two points determined as first and second GPSVIPs construct the reference direction for detail measurements to be carried out by laser total station. Stop&go or RTK GPS observation technique can be chosen as GPS technique. Surveying technique will be polar measurement technique for details.

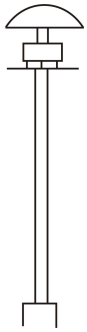

Figure 4: GPS antenna set up on top of a surveyor's pole at the second GPSVIP

Figure 5 shows both antenna locations, one on the adjustable steel bar and other one set up on a surveyor's pole at one corner of pickup truck vessel as far as from first location.

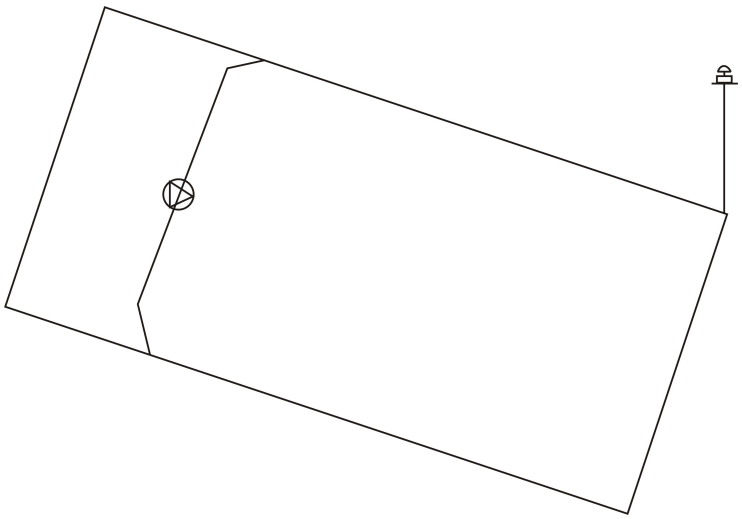

Figure 5: General view of both antenna locations on the vehicle

3. CASE STUDY AND MEASUREMENT RESULTS

To test applicability of motorized mobile GPSSIT to the practice, the campus lodging area of Selcuk University was chosen as a test residential land and details in the area were then measured by ground based GPSSIT and motorized mobile GPSSIT as well.

Leica SR 9500 GPS receivers were used in the applications of both GPSSIT surveying techniques and Stop&go GPS surveying technique was also chosen as GPS measurement technique during the determination of GPSVIP' coordinates. As a laser total station, a reflectorless Topcon GPT 3007 device was used. So that, during the detail measurement, being at the site of measured details was not a compulsory requirement since reflectorless total station was used and all the details were measured in the pickup truck vessel.

58 and 37 detail points out of totally 95 were determined in 3D coordinates (X, Y, an H) and in 2 dimensions (X, and Y) respectively and they were compared with respect to results from ground based GPSSIT. Standard deviation of position errors of the entire details were found as $m_p = \pm 3.57$ cm. and standard deviation of height as $m_h = \pm 2.83$ cm.

4. CONCLUSION

Conclusions obtained after the practical application in the test area can be summarized as those, it is seen that MM-GPSSIT is applicable as a detail surveying technique especially in the residential areas at where direct GPS observations are not possibly collected. As future study, it is considered that MM-GPSSIT surveying technique will be evaluated in a comprehensive project which includes various comparisons with other detail surveying techniques and accuracy analyses. On the other hand, it will be evaluated with respect to time, overall cost, easiness in applicability to practice and some other criteria.

5. REFERENCES

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