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Evaluation of RTK-GPS and Total Station for applications in land surveying

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Accuracies of Real-Time Kinematic Global Positioning (RTK-GPS) system and Total Station (TS) were investigated in GIS environment. In geostatistical evaluations, Kriging method was used with spherical, exponential, and Gaussian models. The survey results demonstrated that an area of 3.5 ha or smaller can be best explained with Gaussian model, while the larger areas require a spherical model. A vertical error of 60 cm and a horizontal error of 30 cm can be observed when the survey points outside the construction area are eliminated. The optimum area per survey point was calculated to be 20×20 m^2 to increase the accuracy. This case study showed that an inaccurate survey can result cost over estimations up to 27%.

1. Introduction

Many agricultural engineering practices require a substantial investment. Therefore, an accurate cost estimate is vital for design and construction of the projects. An inaccurate survey results in a topographic map that does not represent the construction area. Topographic maps have also been used to delineate sub-field management zones (Fraisse *et al* 2001) and site-specific soil management (Franzen *et al* 1998).

The Real-Time Kinematic Global Positioning System (RTK-GPS) is an integral part of topographic surveys. RTK is a technique employed in practices where precision is a must. In RTK, corrected GPS signals are transmitted in real time from a base receiver at a known location to one or more rover receivers. With the recent developments in RTK-based GPS systems, a horizontal accuracy of 1 cm can be achieved by compensating for atmospheric delay, orbital errors and other variables in GPS geometry (Elsani *et al* 2004).

Satalich and Ricketson (1998) reported that time-dependent systematic errors may affect the vertical accuracy of RTK-GPS systems. Clark and Lee (1998) determined the topography of field size areas using RTK-GPS equipment with elevation errors of 4–9 cm. Wilson *et al* (1998) reported that even small differences in RTK-GPS derived elevation at individual points can result big differences in such parameters as slope gradient and catchment area.

Although successful application of RTK-GPS systems can increase the quality of a topographic survey, there are cases where the accuracy of these systems is questionable. Any blockage from natural or man-made obstacles such as trees and buildings can make use of RTK system limited or impossible. In such cases, Total Stations (TSs) are used. Borgelt *et al* (1996) compared the accuracy of RTK-GPS systems to TS. They reported elevation errors of 12 cm. Precise measurements can be made using TS. However, field conditions do not always allow the instrument's accuracy.

Keywords. Land survey; RTK-GPS; Total Station; Kriging; data analysis; instruments and techniques.

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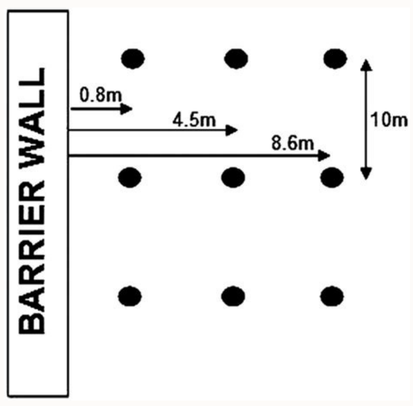

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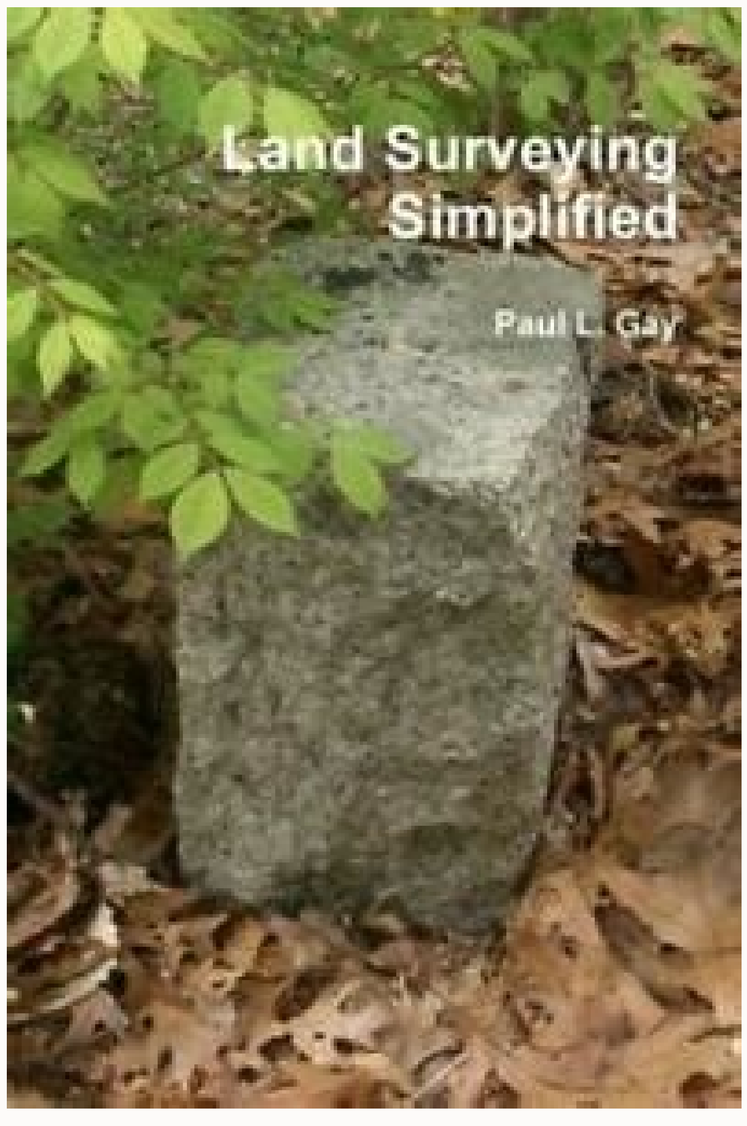

projects. He is also an authorized real estate broker. In addition to his legal and investigation Paul, he also has a degree in Geological Sciences from Brown University. Paul L. Gay is an authorized land superintendent and practicing lawyer. Paul has been in practice for over 35 years. He specializes in border and real estate law investigations, including border disputes, facilitations, adverse possession, forensic investigation, real estate contracts and numerous other issues relating to the real estate property. Paul has developed and teaches a college course on the legal aspects of the border survey. He served as an expert witness in evidence from the Eastern coast to Alaska. He has written several books on the border investigation including "Fundamentals of Boundary Surveying", 2002, "Practical Boundary Surveying" Springer Science Publishing, 2015, "Land Surveying Simplified" 2nd Ed., "Land Surveying Mathematics Simplified", 2nd ed. , and, more recently, "Boundary Surveying in Metes and Bounds States". He also started a series of books on turbine technology and published the first in oneof books on the subject entitled "Elic turbine technology, aerodynamic". Paul is also a pilot and holds an air transport certificate together with the flight instructor certificates. He is also authorized by the FAA as a drone pilot and used drones in his he activates for aerial mapping projects. He is also an authorized real estate broker. In addition to its legal and detection activities, Paul also has a degree in Geological Sciences at Brown University. University.

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