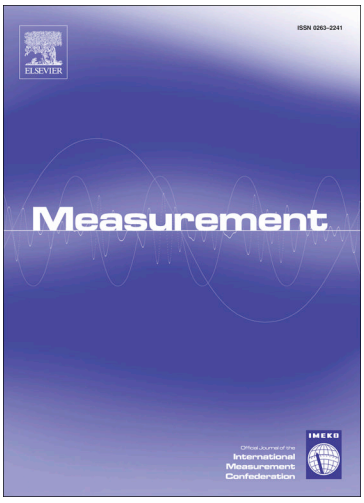

High-precision topographical methodology for determining height differences when crossing impassable areas

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High-precision topographical methodology for determining height differences when crossing impassable areas

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Abstract:

With the arrival on the market of high-precision topographic total stations, professionals today, using appropriate methodologies, can determine altimetric connections to an accuracy that is almost comparable to those obtainable using high-precision geometric levelling. This aspect is of particular interest when it is not possible to proceed with classical geometric levelling operations due to logistical or other reasons: for instance, where levelling lines need to cross impassable areas such as streams, soft soils or canyons. Currently, height differences between two points separated by an impassable area are mainly measured using optical-mechanical levels by procedures that present a number of difficulties. This work presents the results achieved through several trials conducted on the use of high precision trigonometric levelling for measurement of height difference between benchmarks at opposite sides of streams. In particular, it describes the project where simultaneous and reciprocal measures were taken using two high-precision robotic total stations.

Keywords: geometric levelling; trigonometric levelling; river crossing; deformation monitoring.

1. Introduction

Geomatics, or surveying engineering, provides many effective tools for acquiring spatial data to study environmental phenomena and support the assessment and mitigation of environmental risks. Precise heights and height differences are needed for various geodetic and engineering applications that range from monitoring ground movement in more or less extensive areas to controlling large structures and infrastructures, and from the design and setup of water systems to the prevention and/or recovery actions as part of risk management.

The most recent applications in the study of environmental and anthropogenic phenomena at a regional spatial scale involve the use of modern techniques such as GNSS, LiDAR, Remote Sensing and DInSAR. However, when there is the need to obtain a highly-precise and detailed elevation model of the area of interest that also faithfully reflects the physical reality of the Earth's gravitational field, the more traditional geometric levelling (GL) technique is widely used. As we know, this technique is based on measuring height differences through levels and rods. Benchmark heights can be determined through these measurements by imposing some constraints, which consist of setting fixed heights for one or more benchmarks and then carrying out a statistical adjustment of the data measurement set. This technique has the added advantage of providing, using appropriate precautionary techniques, the geoidal height differences relative to sea level ("zero"), defined through the local elevation datum. The GNSS technique can undoubtedly offer

GL geometric levelling; TL trigonometric levelling; LFTL leap-frog trigonometric levelling