New Automatic Method of Free Stationing by Drone

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SUMMARY

Setting up a total station can, in some cases, be very time-consuming, for example in a city with not enough known coordinate points or in a forest. In these situations, surveyors usually measure a few points on the ground with a GNSS rover (in RTK mode) and use these points afterward to set up the total station. However, there are risks of setting up a device on poorly measured points due to multipath (in cities) or poor GNSS coverage (in forests or urban canyons). We propose a new method using a quadcopter drone (UAV) equipped with an RTK-GNSS receiver (10Hz sampling) and a mini prism 360°, that is continuously tracked by the total station, at 10Hz as well. A Raspberry Pi single-board computer controls the whole system. The software was developed in Python which is distributed under an

open

license. It allows the operator to supervise and visualize the acquisition

in real-time on a smartphone. The 3D coordinates of

the free station, including precision and reliability information,

are automatically calculated and sent to the total station to set

the new coordinates and orientation of the instrument. Once this

process is completed, the total station is ready to measure with

its new stationing. The usage of the drone allows positioning in

places where GNSS coverage is better than at ground level. In

order to make the system work in real-time all that is required is

a SIM card for mobile internet and an RTK-GNSS service. The

system is designed to operate on a Leica Geosystems robotic total

station. Time synchronisation is properly accounted for and

communication between the different parts of the system is implemented

in a very robust way.

This prototype has been put to experiment in the Swiss projection

system. Within 5 minutes of data acquisition, a precision

better than the centimetre for the 3D coordinates and better than

0.001 gradian (1.57e-4 radian) for the orientation of the total

station was obtained, without any coordinate reference points

on

the ground. We believe that our system has a huge potential to enable high precision surveys in difficult environments, such as urban canyons or areas with no or only a few coordinate reference points.

Besides these validation results, the technical paper will hold a detailed description of the design choices and the implementation of this innovative system.