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User Manual: Automatic Measurement with a Total Station via GeoCOM

Overview

The software is designed to automate the operations of a Leica TS60 total station. It enables users to configure the total station settings directly from a computer. Moreover, the software can measure sets of points (angles, distances) autonomously, provided that the total station was manually turned to the required points in phase 1 of the initial set. Additionally, it performs an analysis of these measurements following the ISO 17123-3 norm, which outlines a simplified test procedure for horizontal directions. The software also saves both the measurements and the output log on the local storage of the host computer. The software is primarily based on the Python libraries NumPy [2], Pandas [3], and PySerial [4].

Configuration of Total Station and Measurement Procedure

First, the user should modify certain variables located at the top of the Python script. These variables, along with their default settings, are listed in the table below. For additional configurable options, the GeoCOM user manual for the specific Leica total station in use should be consulted (definition can be found using the provided GeoCOM ASCII-Request ID).

Variable Name	Default Value	Request ID
ATR_mode	1 (ATR on)	18005
ATR_window	10 gon	9041
tolerances	0.00063662, 0.00063662 gon	9007
prism_type	0 (Circular)	17008
target_type	0 (Reflector)	17021
reflector_height	0 m	2012
FACE	1,1,0 (POSMode, ATRMode)	9028

Whilst operating the software, users will be asked to input the desired output file name, select a port, and specify the number of sets and points to be measured interactively in the terminal. The software then automatically establishes the connection to the total station.

Manual Measurement

After initializing all settings and establishing the connection, the user can enter the ID or Name of the first point to measure. The software will then prompt the user to align the total station with the desired measurement point. Subsequently, the user can perform the measurement from the Python terminal. This procedure is repeated for each point in the first phase.

Automatic Measurement

Next, the software will take control of the total station and automatically measure the same points in the second phase for the first set without requiring user interaction. Similarly, the point measurements are automatically repeated in two phases for the remaining sets that were specified. Once all measurements are completed, the connection to the total station is closed to release resources.

Software Output and Data Analysis

After completing all measurements, the software automatically saves all point measurements as a .csv file in the "Measurements" folder within the project. This file includes the point name/ID, horizontal and vertical angles in gon, distance in meters, as well as the measurement phase and set ID of each measurement. Additionally, the software generates and saves a log file in the "Output_log" folder. This log contains all user-provided information during software interactions, all conducted measurements, and any notifications from the software regarding successful operations or errors.

Furthermore, the software conducts a simplified test procedure for horizontal directions following the ISO 17123-3 norm [1]. The results of this test can be found in the "Output_log" folder, stored in a file with a name ending in "_iso_17123_3.log."

References

[1] International Organization for Standardization. (2001). ISO 17123-3: Optics and optical instruments – Field procedures for testing geodetic and surveying instruments – Part 3: Theodolites. Geneva, Switzerland: ISO.

[2] Harris, C.R., Millman, K.J., van der Walt, S.J. et al. Array programming with NumPy. Nature 585, 357–362 (2020). DOI: 10.1038/s41586-020-2649-2.

[3] The pandas development team. (2020). pandas-dev/pandas: Pandas. Zenodo. DOI: 10.5281/zenodo.3509134 (source)

[4] PySerial. (n.d.). PySerial Documentation. Retrieved October 28, 2023, from https://pyserial.readthedocs.io/en/latest/pyserial.html