

Differences in Measurement Uncertainty Between Horizontal and Elevation Angles

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SUMMARY

As introduced in Murakami (FIG WW2023), we are conducting research toward modernizing the General Standard of Operation Specifications for Public Surveys. Within this research, we investigated the angular measurement uncertainty of total stations (TS). While we initially assumed the measurement uncertainties for horizontal and elevation angles were equal, the results suggest they are not.

From surveying instrument inspection data, we investigated the angular measurement uncertainty of TS units with 1-second and 5-second readings.

The measurement uncertainty for horizontal angles was:

1.1 seconds per sighting, in terms of standard deviation for 1-second reading;

1.7 seconds per sighting, in terms of standard deviation for 5-second reading.

The measurement uncertainty for elevation angles was:

1.8 seconds per sighting, in terms of standard deviation for 1-second reading;

2.4 seconds per sighting, in terms of standard deviation for 5-second reading.

The measurement uncertainty for elevation angles is approximately 1.5 times that for horizontal

angles.

Since we estimate TS instruments are most frequently set to 5-second readings in the field, TS was set to 5-second readings for the field experimental observations. From the field experiment data, we also investigated the uncertainties.

The measurement uncertainty for horizontal angles was:

2.5 seconds per sighting, in terms of standard deviation.

The measurement uncertainty for elevation angles was:

5.0 seconds per sighting, in terms of standard deviation.

The measurement uncertainty of elevation angles is twice that of horizontal angles.

The reasons why the measurement uncertainty of elevation angles is greater than that of horizontal angles, and why the measurement uncertainty in experimental observations is greater for both elevation and horizontal angles than that in instrument inspection, are currently under investigation.