

Monitoring systems set new standard for tribrach performance

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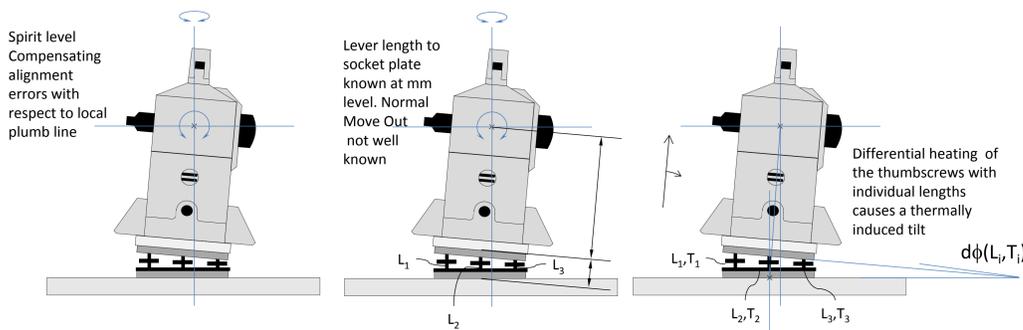
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The combination of contemporary total stations and computers provides the possibility to set up very sensitive monitoring systems. However, as all parts of such systems are subject to the influence of environmental parameters it is necessary to detect and separate new error sources in order not to misinterpret data. We show how differential solar heating of a tribrach's thumb screws propagate into the coordinate time series of a reflecting target.

Total station dual axis compensator

The internal reference point of a total station is the intersection of the trunnion and vertical axes. Built in compensating devices appears to account for vertical misalignment and internal variations inside the instrument, possibly to the base plate but neglecting the influence of the tribrach.

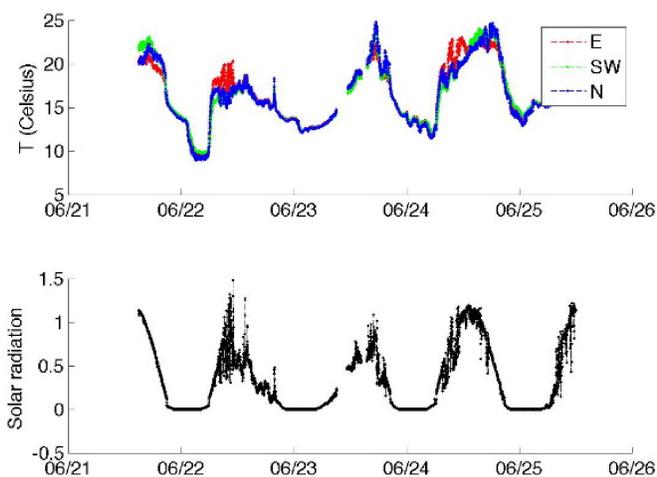


Resulting angular errors

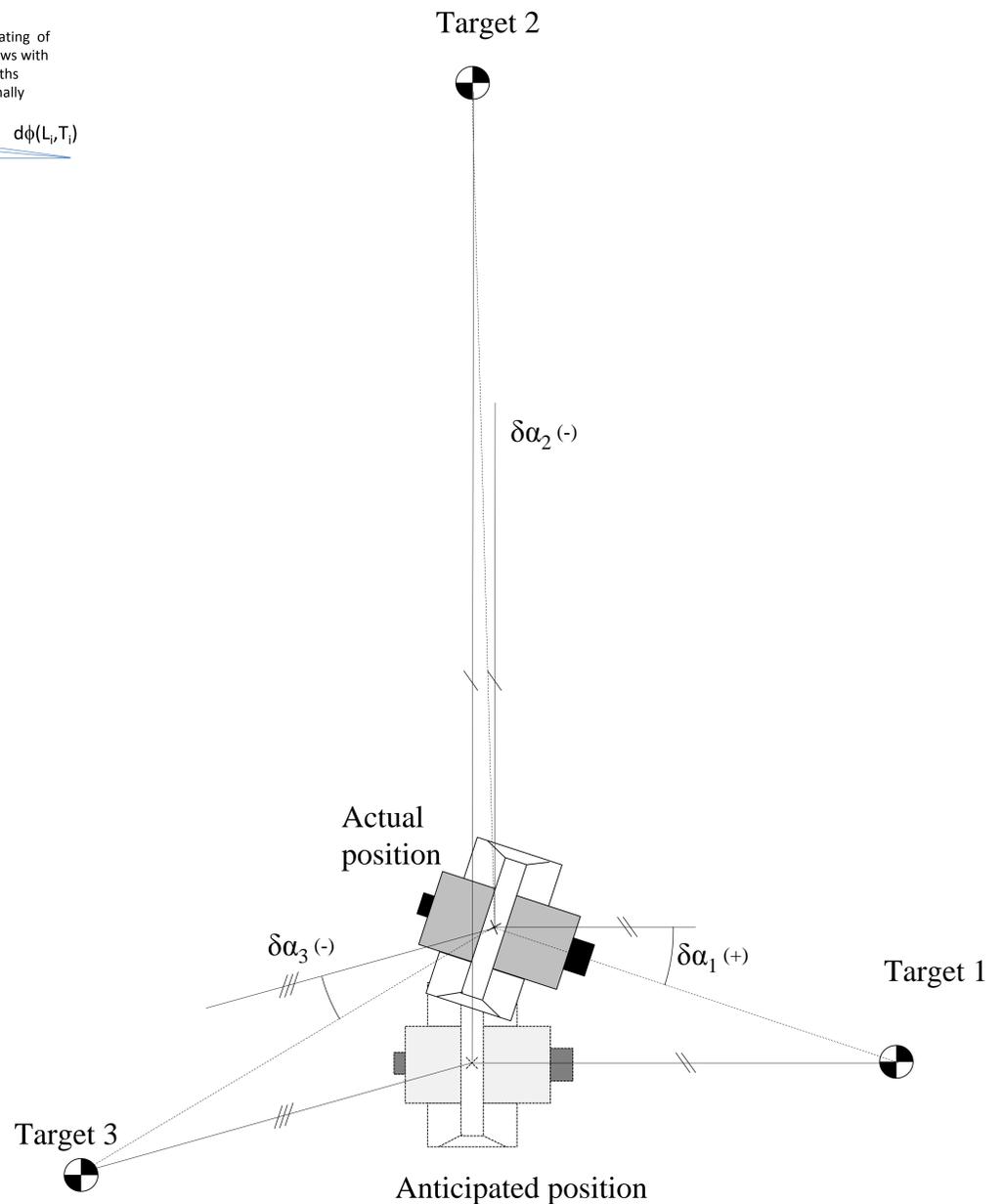
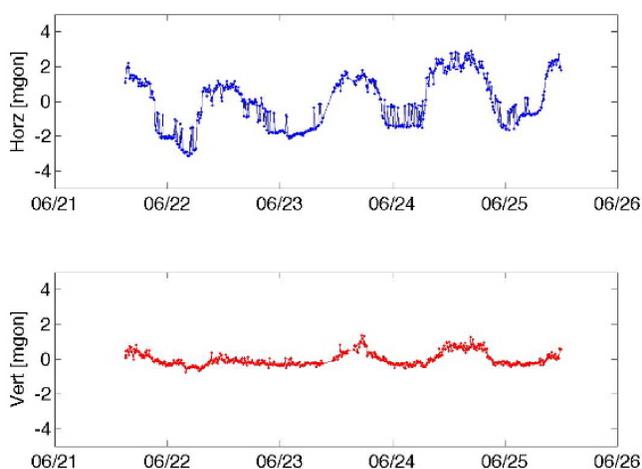
The intuitive result of the temperature induced tilt might be that a common rotation is visible in all target time series. However, as can be deduced from the geometry shown in the figure below, the resulting error is strongly dependent of both distance and direction to the targets and will appear differently in all time series. Therefore, the coordinate perturbations must be actively sought for in order to be detected.

Thumb screws, sunshine and coordinates

For monitoring purposes, the measurand sought for is the variations of the coordinates in the system. The figure below displays the temporal correlation between solar radiation and the temperature of the thumb screws on a total station's tribrach over four sunny days. The evidence is clear that the Eastern screw has higher temperature in the morning, then followed by the Southwestern and the Northern screws in the afternoon and evening, respectively.



The resulting effect of the differential heating is a tilt of the total station and a movement of the origin in an otherwise stationary network. Below are the corresponding angular read-outs from the total station attached to the tribrach and with the dual axis compensator activated. The temperature-induced coordinate fluctuations are most obvious in the horizontal components time series, but also visible in the vertical.



Concluding remarks

Two European patent applications have been filed to improve the situation.