Taming errors... pt. 5: Compensators and the eternal question

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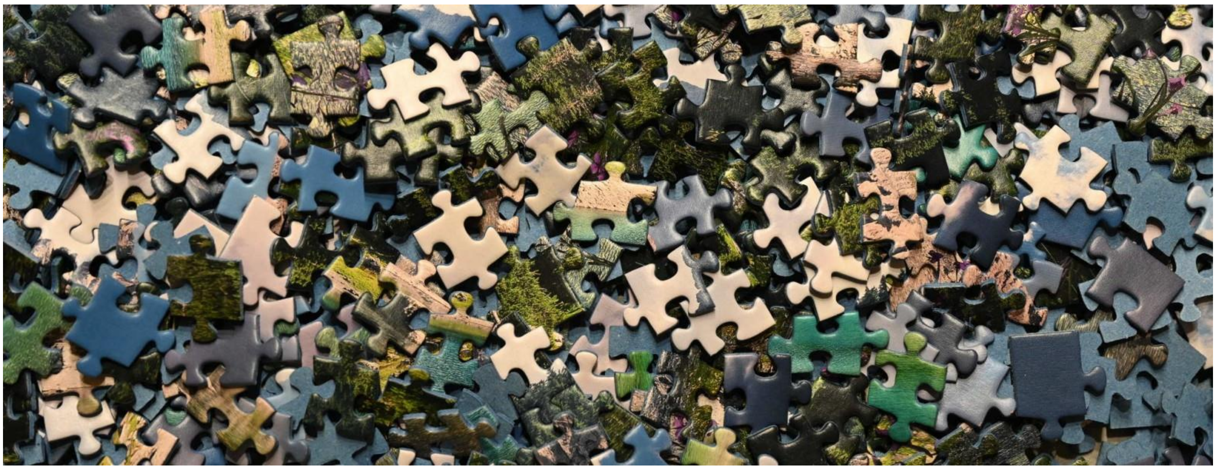

2.3.2 Compensators

Parents undeniably do a lot for their children – yet, they are human and thus not perfect. Compensators undeniably do a lot for their scanning network – yet, they are sensors and thus not perfect.

Before we have a deeper look at the latter statement, we should understand why compensators are so important and most importantly what they do. Whenever you setup a geodetic instrument, and terrestrial laser scanners fall into this category, you want the sensor's vertical axis to coincide with the direction of gravity. If this assumption is satisfied, you have already determined two out of six degrees of freedom, see part 1 for details, namely the rotation about the X and Y-axes. Now that's great, yet the problem is that there is no perfection! This means that there will always be differences between the instrument's vertical axis and the physical plumb direction that's pointing to the earth's centre of gravity. Everyone who attended survey school, TAFE or studied geodesy (hopefully) remembers extensive exercises that just focus on this inconspicuous aspect. For centuries surveyors used bullseye bubbles in order to roughly set an instrument plumb and a tubular bubble to determine its final alignment. This procedure was time-consuming and, if performed by poorly trained staff, error prone. Hence, the manufacturers of geodetic equipment started adding sensors that measure the vertical orientation of an instrument over the course of a survey, for instance inclinometers.

Some manufacturers measure the vertical alignment of the scanner before, during or after data acquisition – or a mixture of the three. Why is that important? Well, you should know when things can go wrong and because sensors are never perfect. Obviously, compensators should be switched off when the scanner is operated on instable platforms such as ships, dodgy scaffolds or lifting ramps. Yet, daily life provides several malicious pitfalls that can produce erroneous tilt readings. Vibrations triggered by e.g. sledgehammers or traffic are an obvious source that cause oscillations of the compensator and consequently biased tilt-measurements. Another potential error source can be your very own (impatient) staff who walk around the scanner to check its status or to “save” time by moving the device as soon as data acquisition is completed – yet the compensator hasn’t finished his job.

This subject will be revisited in the next part of this series where we will have a look at how to identify erroneous compensator readings and how compensators contribute to a network’s stability.

2.4 Which registration algorithm do I need?

Discussions about registration algorithms and their accuracy among scanning folks usually follow the exchange of “arguments” comparable to Bugs Bunny’s “wabbit season” cartoon (Maltese 1953). As always in engineering there is no definite answer to this question. There is not THE scanner and not THE registration algorithm that works just perfect for all potential tasks. Hence, the answer for “which registration algorithm do I need?” has to be “all of them”! It could well be that you need e.g. cloud to cloud registration outdoors, a mixture of cloud to cloud and artificial targets in long corridors and plane to plane or cylinder to cylinder in a production hall - in just one project.

The main reason why people lean towards one or another solution is that they trust or rather believe in certain algorithms. Typically, they have encountered unpleasant situations where the quality measures of the applied algorithm were all fine while the result showed the opposite. It is very important to understand that registration ironically does not end with the computation of registration parameters – it’s just an intermediate result of a bigger process! As mentioned in the very first part of this series, ALL registration algorithms can fail – hence, relative quality measures based on single registrations that tell you “how perfectly well” two scans fit together should not be trusted at all. Instead, we must verify that the achieved results are free of blunders, contradictions and tensions based on redundant information – just the way it has been done in surveying for 200+ years (Legendre 1805, Gauss 1809). The second part of the registration process is called block adjustment and is quite frequently simply left out of the processing chain and hence will be discussed in greater detail in the next part. This task identifies noteworthy misclosures among all different types of observations in your network, which could be registrations of any kind, compensator readings and tacheometric measurements. Thus, the result of the block adjustment helps you to get rid of observations in your network that would otherwise cause costly revisions in the production or post processing phase, see part 1 of this series. Note that sometimes the term bundle adjustment is used – even though this notion stems from classical photogrammetry. Once the block adjustment shows no more significant discrepancies, the registration process can be considered as completed.

References

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