Taming errors... pt. 7: Redundancy is not a crime

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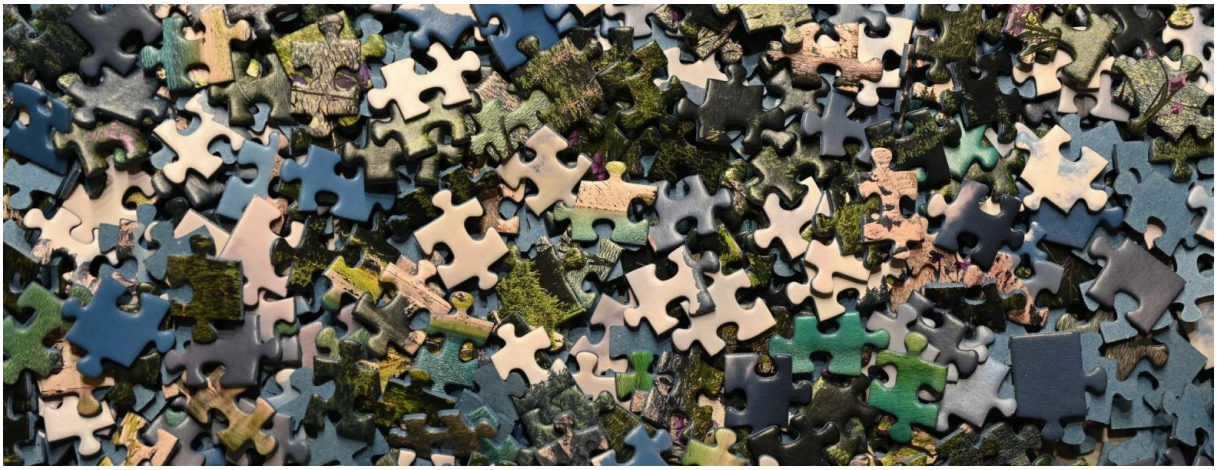
16th April 2020



3.1 Redundancy is not a crime

The wheels of an ordinary car are typically attached to the hub by five wheel nuts. If you happen to commute to work with your race car, then you know that every wheel is secured by exactly one centre-lock. If you lose one of the centre-locks, you apparently also lose a wheel including all unpleasant consequences that are naturally included. And that, my dear colleagues, perfectly demonstrates the concept, and most importantly, the power of redundancy: if something goes wrong, you're able to tell right away which then allows you to apply countermeasures!

When processing measurements redundancy was and still is the key to a) control / verify measurements and b) to improve the quality of a network – regardless which geodetic sensor was used to capture the data. An urban myth that is frequently mentioned in the laser scanning community is, that you need to control your registrations with an instrument of higher accuracy. Let's stress this logic and think it through:

Terrestrial laser scans are controlled by total station measurements. But how you know that your total stations measurements are correct? According to the aforementioned logic you would have to use a laser tracker with superior accuracy to the one of the total station to control the tacheometric observations. But how do you know that your laser tracker measurements are correct? You would have to control the laser tracker measurements with what…faith???

While the general thought is not bad at all - you're increasing the redundancy within your network by additional observations - there are always economical restrictions. You cannot survey every single station in your network for the sake of quality

assurance since that would simply burn your profit. If you'd like to stabilise your network by e.g. carefully chosen tacheometric control points that tame error accumulation, for instance to satisfy a required accuracy, then this is an entirely different problem which will be discussed at a later stage. At first, our aim is to create a network that is free of errors among adjacent scans. And for that your first mantra should be: If there's no redundancy – there's no way to find errors! Options to increase the redundancy of your scanning network by additional observations are:

1. Carry out GNSS-, tacheometric and / or levelling measurements
2. Add more registrations - regardless based on which strategy
3. Tie in inclinometer data

The figure below illustrates a scanning project based on a publicly available dataset (Leica Geosystems, then click Indoor multi-setup data) where circles highlight scanning viewpoints and arrows registrations. The network on the left that does not contain any redundant registrations. Thus, it is impossible to verify if the network contains erroneous registrations. The very same dataset was then processed in a redundant and hence self-controlling configuration where each scan is connected by at least two registrations. Consequently, it is impossible to fail – if the redundant information is used to full effect. How? That will be the subject next week.

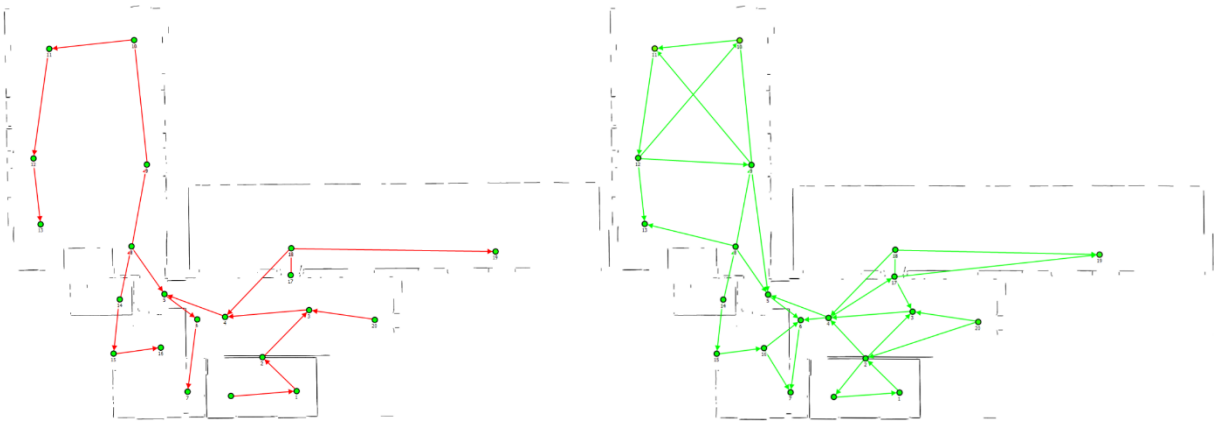


Figure 1: Uncontrolled network configuration (left)
and self-controlling configuration (right)