



Combining terrestrial laser scanning and UAV photogrammetry for fast and lightweight surveying

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To create detailed and accurate 3D maps of small- to medium-sized areas surveyors often turn to a terrestrial laser scanner (TLS). A TLS can make thousands of lidar measurements per second with centimeter-level accuracy even at long ranges, using scanning mirrors to aim the laser up/down and left/right for full coverage of the target area. One limitation of using a TLS is that complex objects may require many more TLS survey positions than simpler ones. Since protrusions may block line of sight to certain areas that can only be seen from particular angles, surveyors must survey from several additional locations to make sure the entire area is covered. This is particularly true for setups where the scanner cannot be elevated to gain line of sight to all the areas that are required to be surveyed.

To resolve this issue, surveyors often turn to aerial survey vehicles. An aerial vehicle's bird's-eye perspective resolves features easily and its mobility lets the surveyor quickly capture the whole survey region from multiple angles. To survey more efficiently, surveyors can combine the strengths of TLS and airborne systems, resulting in a cost-effective method of mapping small- to medium-sized sites with 3D data and imagery. This process uses a standard TLS to survey from a few points around the area of interest, particularly vertical faces that would be difficult to survey from the air. Simultaneously, the surveyor uses a lightweight UAV equipped with a camera, gimbal, and basic GPS receiver to collect photogrammetric imagery over the site.

During post-processing, the aerial imagery is processed to create 3D data of its own using automated triangulation software. This aerial 3D data is then merged with the 3D data created by the TLS. The aerial 3D data is discarded where it conflicts with the more precise TLS data, but is used to fill in the gaps in the areas where the TLS could not collect any data at all.

Finally, the resultant 3D data is merged with the original aerial imagery, creating an accurate and complete colored 3D map of the survey area for use in geology, open-pit mining, and more. This process offers significant time savings for surveys of complex areas while collecting richer data than either the UAV or the TLS alone.