Norbert Haala
Institute for Photogrammetry, University of Stuttgart
Germany

"POINT CLOUD GENERATION: WHERE IS RESEARCH GOING?"

Dense 3D point clouds are standard photogrammetric products. However, despite the fact that image based 3D reconstruction is a classic problem in photogrammetric computer vision since decades, approaches for dense Multi-View-Stereo-Matching developed to sophisticated software tools only recently. Meanwhile, they provide 3D information basically for each image pixel at considerable quality if sufficient image overlap is available. Typically, this is frequently guaranteed for airborne scenarios due to the high along-track overlaps from modern digital cameras. However, the polar measurement principle of LiDAR sensors is still advantageous whenever the object appearance changes rapidly when seen from different positions. This holds true for semi-transparent objects like vegetation or crane bars, for objects in motion like vehicles, pedestrians, etc., or in very narrow urban canyons. Nevertheless, matured commercial tools are available for both techniques. Thus, point cloud generation is feasible from airborne as well as terrestrial platforms at remarkable robustness, accuracy and reliability. This might not only pose the question where is research going, but even whether research still is required.

In the past, LiDAR and image matching were considered as competing techniques. Research efforts therefore mainly focused on optimizing point cloud generation by an individual and separate improvement of the respective sensors and algorithms. Nevertheless, the closer integration of both techniques is the logical next step. As a simple example, LiDAR echoes can be enriched by color information from synchronously acquired images. Similarly, combining very high resolution texture mapped, meshed 3D point clouds from image matching with information from multiple laser returns occurring for example at twigs and branches opens new opportunities for the following point cloud analysis. In addition to the further improvement of point cloud geometry, integrated processing will facilitate the subsequent semantic analysis during point cloud classification or object detection. Similarly, adaptive filtering and smoothing of meshed 3D points will benefit from integrating knowledge on different semantic classes. In this context, a prior assumptions on the shape of the captured surface patches are frequently applied. Integration of active laser and passive image sensors is beneficial for traditional airborne scenarios like topographic data capture. Furthermore, terrestrial data collection in complex urban environments will open up even more possibilities also as a result of the demands and developments in the context of autonomous driving. So without any doubt there are more than enough interesting research questions on point cloud generation waiting to be tackled in the future.