Terrestrial Laser-Scanning – Universal Method or a Specialist's Tool ?

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Key words: Terrestrial Laser Scanner, 3D Modeling, True Ortho Image, Cultural Heritage Documentation, 3D Visualization

SUMMARY

The methodology of laser scanning is in transition very fast. Coming in from other fields of metrology, like machine construction or medicine applications, the impact on classical surveying methodology is tremendous. Currently the manufacturers of instruments are on the way to develop the market. From the applicants point of view, the easy to use data postprocessing capability is as, or maybe more important, than the scanning device itself.

Effective data processing of huge amount of data points is the true challenge in this discipline. It is essential to define a workflow from data acquisition of 3D point clouds in combination with color from CCD cameras to deliverables which are able to fulfill the customer's demands. A set of examples is used to show several workflow characteristics, optimized for specific requirements.

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1. INTRODUCTION

The methodology of laser scanning is under most rapid development in surveying in the past decade. As well as in airborne laser scanning also terrestrial devices were introduced in the market and permanently improved from each month to the next. This development was indicated by several authors since around 1995 with strong focus on instrument developments. The processing perspective was characterized by Prof. Kraus (Kraus, 2001) as change of paradigm. His argument was that methodologies form surveying and photogrammetry are soldered in sensors combining laser scanned geometry and color information. He also claimed new, or better to say adapted processing routines. Several groups elaborate such modified processing systems on universities and also in corporation with private companies (Ullrich, et. al. 2003).

Today several firms focus on the production and maintenance of such instruments. The origin of these firms is either manufacturing classic surveying instruments or industrial metrology. The outcome of such instruments is more or less similar to describe as a 3D point cloud. Core question is, how to process such typically huge volumes of points in an applicable way to final products as planes, 3D models, etc.

Looking on competitors in the product field of 3D Laser scanner devices underlines the estimated market potential of this technology segment. Currently some prominent companies are on the way to enter the market through acquisition of small technology firms. The two key players in the market of surveying instruments realized this potential to improve their product portfolio. Leica Geosystems (Leica, 2004) invested in the acquisition of Cyra Technologies in 2001 and Trimble Inc. (Trimble, 2004) acquired the French MENSI (Mensi, 2004) in September 2003.

The impressive position of the Austrian Company RIEGL Laser Measurement Systems in this market segment of terrestrial 3D laser scanners is about 24% (forecast 2003 with a total of $29.8 million)(SparView, 2003).
For post processing, a number of software products in the market promise fine results in particular application fields. Typically this developments tends to combine the scanning device and the post processing environment. Reasons to do so are to enable optimized data structures and information flows between the two components, but also to keep consumer on track with one product line from marketing perspective.
Typically real project definitions differ more or less from one sensor or software's specification. Interfaces between different sensor types and post processing software's are often enough either not implemented or of poor quality or performance.

When you are looking at the colorful product folders it sounds so easy to perform data processing, but in manifold projects it ends in frustrating number crunching with poor outcome. Main reasons for that are:

- data volume exceeds physical or practical limits,
- the chosen processing environment is suboptimal,
- data flow from scanner instrument to processing software is too complex and
- the poor compatibility of software tools used.

The workflow has to be seen as relevant for the complete production chain. From the planning and realization of data acquisition the preprocessing including geo-referencing of individual scan positions, the combining and integration of color information, up to processing and derivation of the final product the chain has to be designed slim. The optimized data processing and organization is essential for the further products and for the over all economic aspect.

It is not the aim, to be negative, but the assessment of laser scanning potential in the market has to be realistic. The potential for application of laser scanning is broad. Documentation of terrestrial areas, buildings, up to single objects with high value in money or cultural importance must be seen in this interrelation. The precise and complete documentation of areas and forms causes the high level of evidence of laser scanning. Synchronously acquired picture information, as a supplementary information to the geometry derived from the 3D point cloud rises the level of documentation quality. The relevance of optimized and integrated processing was mentioned above. In the examples presentation part, a selection of projects, including information for the data acquisition and processing and finally some derived products and forms of presentation, will be given.
Finally, laser scanning is recognized as an high efficient method of metrology. Its application has to be planned very carefully for the complete workflow with respect to the parameters of the individual project. Following this principle, impressive and competitive results in the meaning of precision, resolution, completeness and economics can be achieved.

2. GENERAL WORKFLOW CHARACTERISTICS

First reflectors are attached to well-conceived, regular distributed and from all sides well visibly positions. Only a optimal distribution of the tiepoints guarantees a high quality of the georeferenciation. After measuring the reflectors with classical measurement the object is scanned with single scans or using scan sequeces. The number of scans per sequence depends on the aimed accuracy. Usually the acquired 3D-scans are immediately transformed in the national or an other common coordinate system. For coverage control the point clouds of the single scans are combined to a pointcloud. This helps to detect scan shadows and is used to position outstanding scans. (Riegl, 2004).

In the course of post processing the rough refereciation that was calculated in the field

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