Experiences with Terrestrial Laser Scanning in Russia

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SUMMARY

Nowadays one of the most dynamical trends in geodesy is the application of terrestrial laser scanners (TLS) in different branches. In Russia laser scanners came into use eight years ago. Owing to terrestrial laser scanners this period was marked by immense changes in services market grouping. Advanced terrestrial laser scanners and software as well as their state-of-the-art in Russia and key problems limiting its development are outlined in this paper.

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In Russia laser scanners came into use eight years ago. Owing to terrestrial laser scanners this period was marked by immense changes in services market grouping. There have appeared the Russian companies offering laser scanners. Among these companies are follows: Geokosmos (Geopolygon), Jena Instrument, Leica Geosystems, Navgeocom. Marketing analysis to reveal the potential users of laser scanners has begun. Two geodetic higher educational institutions, that is, the Moscow State University of Geodesy and Cartography (MIIGAiK) and Siberian State Academy of Geodesy (SSGA) have started scientific studies on terrestrial laser scanners and its technology. For example, SSGA bought five laser scanners of different companies, associated software and created a special subdivision – the Regional Centre for Laser Scanning. It is for the first time in Russia that PhD theses on laser scanning have been written and successfully defended by fellows of both universities. Special attention is given to training of students and masters in theoretical and practical applications of terrestrial laser scanners and technology. Moreover, terrestrial laser scanning technology was promoted among surveyors by organizing special workshops, pilot project execution, etc. Terrestrial laser scanning has become of current interest in many fields of human activity. Today the authority of the Russian fundamental scientific schools in terrestrial laser scanning is coming to light throughout the world. Professionals from different countries participate in major scientific conferences held in Russia ('Geokosmos' in Moscow, 'GeoSiberia' in Novosibirsk). Active information interchange has started. There were appeared serious scientific developments devoted to investigation and calibration of terrestrial laser scanners, their applications in engineering surveying, archeology, mining, etc. More popular in Russia are terrestrial laser scanners of such companies as RIEGLE, Leica, Optech and Trimble (Mensi). Oil-and-gas and mining companies, design-and-survey institutions, manufacturing companies, departments of architecture and others became the main users of terrestrial laser scanning products.

Terrestrial laser scanners have sufficiently wide range of specifications and they should be considered in choosing the equipment. The accuracy of measurements, measurement rate, and range can be accepted as major. The Russian market is supplied by scanners of such companies as Leica Geosystems, Riegl Laser Measurement Systems, Zoller+Frohlich, Faro, Optech and Trimble. The given companies permanently update their equipment. According to the method of distance measurements, scanners are broken up into two categories - phase and pulse scanners. The highest scan rate up to 500 thousand points per minute (fig. 1) is the main advantage of phase scanners. Leica Geosystems, Zoller+Frohlich, Faro companies are producers of these scanners.

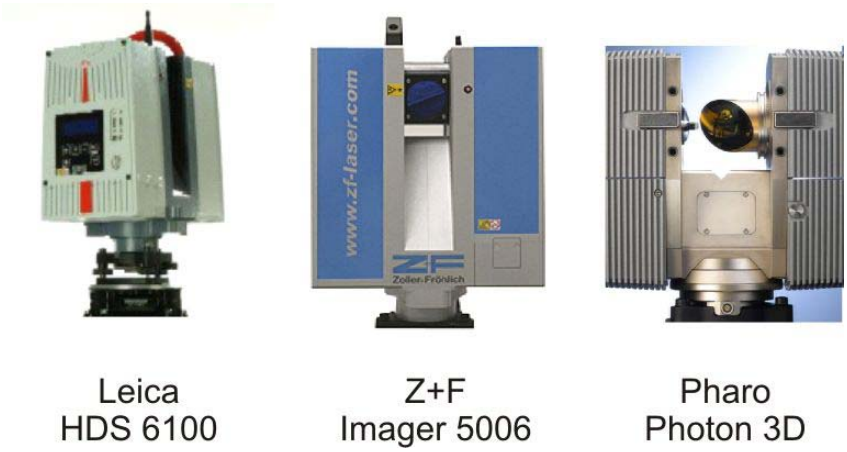

Figure 1: Phase terrestrial laser scanners

Nevertheless, these scanners have limitations in range up to 80 m. It is necessary to mention the appearance of high-speed pulse terrestrial laser scanners Riegl VZ-400 and Leica ScanStation2 capable to make measurements with a rate up to 50 and 125 thousand points per second consequently (fig. 2).

Figure 2: High-speed pulse terrestrial laser scanners

Pulse scanners are less restricted in range and capable to provide distance measurements from 350 to 2000 m. These scanners are produced by Leica Geosystems, Riegl Laser Measurement Systems, Optech and Trimble companies (fig 3).

As a whole, the tendency has been observed toward the increase of terrestrial laser scanners capacity, which can be achieved by following ways: the increase of scan rate and field of view, autonomous scanner control, data capture, and add a compensator in the design (to avoid the labour-intensive process of scans orientation by marks).

Figure 3: Pulse terrestrial laser scanners

At present, a terrestrial laser scanning technology, thanks to its high efficiency and new quantitative spatial data representation and highly accurate real object information, is used for:

1. Creation of large-scale topographical plans of populated localities. Generation of 3D landscape features.

Figure 4: 3D model of urban territory

2. Certification of motor roads. Creation of 3D models for complicated road sections.

3. 3D model generation of bridge crossings and complicated junctions.

4. 3D model generation of industrial facilities areas, oil-and-gas production facilities, and large electrical substations.

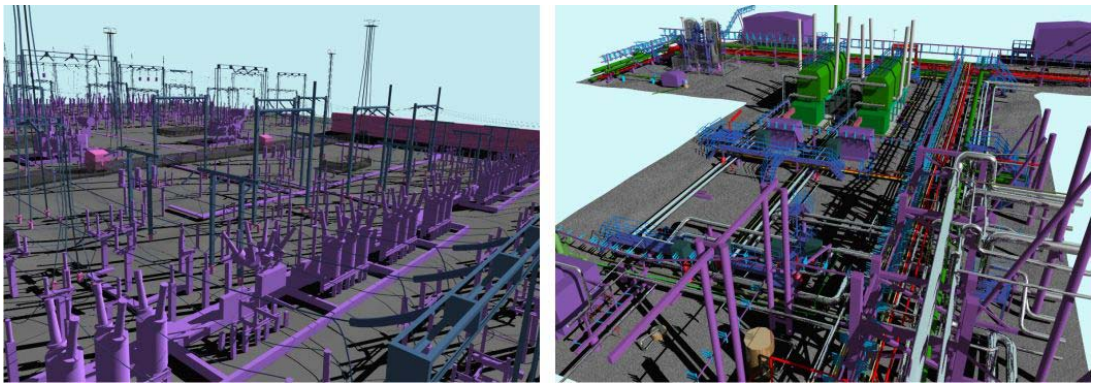

Figure 5: 3D model of an electrical substation and oil pumping stations

5. 3D model generation of hydraulic objects.

6. 3D model generation of architecture and historic monuments heritage.

7. Surveying of quarries for calculation of earthwork volumes and quarry monitoring.

8. Surveying of shop floors and sophisticated equipment.

9. Volume calculations of quantities of rock, soil, bulk and other material, etc.

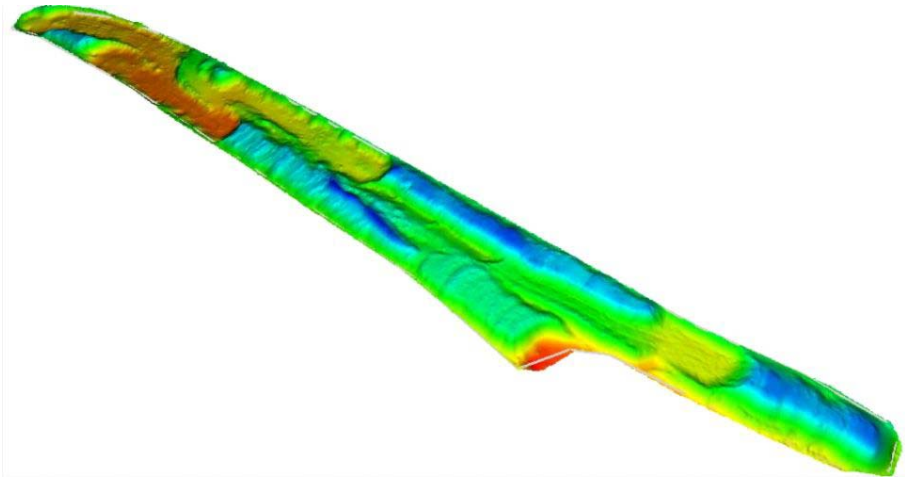

Figure 6: 3D model of an ore stockpile

10. Surveying of architecture monuments and details of architectural appearance.

11. Surveying of facades.

12. 3D model generation of tunnels and underground mines.

Terrestrial laser scanning data are used for creation of 3D models, topographic plans, digital elevation models (DEM), and drawings. There is a variety of software with a wide range of

features used for data processing produced by such companies as Trimble (RealWorks Survey), Leica Geosystems (Cyclone, CloudWorx), InnovMetric Software (PolyWorks), Inus Technology (RapidForm), Kubit (PointCloud). The given software products can be both independent applications and complementary modules for computer-aided design (AutoCAD or Microstation).

It is needless to say that nowadays the problems of practical application of terrestrial laser scanners are of great significance. Firstly, it is caused by advances in technology itself (hardware and software components) and, secondly, by high activities of research, commercial and manufacturing companies increasing a number of applied problems to be solved and promoting these equipment to the Russian market. However, despite of high efficiency of a procedure used, today its promotion in Russia is limited by several factors.

First of all, it should be mentioned the unavailability of some design organizations to operate with 3D models. We consider that it is caused by the use of traditional technologies, topographic maps and plans. For changing to advanced procedures, it is necessary to reorganize all the technological design processes. Unfortunately, some companies are not ready today for these changes. Besides, when there is a necessity to reorganize existing plants, very often occurs that design drawings have been lost or they don't correspond to reality. In this case only laser scanning can be efficiently used for initial data capture as far as traditional cartographic products do not provide. Only those companies who use advanced technologies for data capture are the most competitive.

The application of terrestrial laser scanning is not regulated by ordinances, that is, in many cases they are provided. The main reason is that the majority of these ordnances were developed at the time when technologies for laser scanning did not exist. In response to this problem it is necessary to join together efforts and develop technologies for practical use of laser scanning and their integration in manufacturing processes.

In last few years there was a situation when manufacturing companies interested in getting terrestrial laser scanners had no an idea of their functionalities. The matter is that it is very complicated to evaluate a real opportunity of using a particular scanner based only on advertisements. Advertising campaigns of selling firms are the arguments for purchase of a scanner. These companies often try to realize the expensive equipment not taking into account their further efficiency of use. Due to the fact that state-of-the-art scanners have a wide range of specifications and various nuances of their uses, all the above mentioned results in downtime, inapplicability in desired conditions, and formation of negative opinion on terrestrial laser scanning as a whole. The analogous situation happens with software for laser scan data processing. Here a variation of functionalities is even more observed. Therefore, the situation when data processing is limited by software inadaptability is not rare in occurrence. In this connection we have to mention the Siberian State Academy of Geodesy, which is not looking for getting the benefits from promotion of scanners, but renders consulting services on terrestrial laser scanners, software and training. Its activity makes easier to form objective user opinion on the equipment and software hey need to make the works in future more effective.

We also consider that for successful evolution of terrestrial laser scanning technology it is necessary to develop a network of services inasmuch as today equipment maintenance and logistics are carried out abroad that causes the losses due to lengthy downtime and high cost of logistics.

In spite of above mentioned, we are sure that in the nearest future a volume of services using terrestrial laser scanners is expected to be considerably increase in Russia and all the revealed problems will be successfully solved. This results also from key advantages of terrestrial laser scanning technology (detail, productivity, etc.).

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