# HIGH-PRECISION SCANNING SYSTEM FOR LIDAR COMPLEXES

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*System for high-precision scanning of lidar complexes has been designed on the basis of three-degree gyroscope. The main performance characteristics of the system are presented.*

The lidar measurements require the use of a system for high-precision scanning, and, in first of all, this applies to mobile systems, because different vibrations of a platform, on which the system is mounted, cause measurement errors. Besides, in a number of cases it is expedient to refer to the control (or reference) points. In this case a control path is formed, at the far end of which a reflector is installed, and in the course of scanning the atmospheric transmission along control path is measured periodically. The control paths allow to increase the convergence of the processing algorithms. Considering all the above-mentioned we can draw a conclusion about the necessity to develop lidar complexes with a high-precision scanning system.

Figure 1 shows the block diagram of a scanning system for a lidar complex. The system consists of a laser range-finder, an optical viewing device, a three-degree gyroscope, controls, a computer, a tilt sensor, a path memorizing device and $N$ reflectors. The principle of system operation can be explained as follows. With the help of controls an operator turns the aiming device in such a way that one of $N$ reflectors is at the opposite end of the sighting line. Then a radiation of the sounding pulse and a reception of the reflected one are conducted with the laser range-finder. The information from the latter enters into a computer. In a stationary variant of a lidar system the control path is memorized with a device, which conducts interrogation of all $N$ reflectors. In order to attain a high stabilization of the sighting beam in the system, the three-degree gyroscope is used, the direction of the main axis of which is varied under the action of the controls. In a mobile variant for a decrease of the measurement error a tilt sensor is used, which is a gyroscope. The signal from this tilt sensor enters into the computer for computing a correction.

A tracking of a target by the sighting beam of optoelectronic system represents an oscillating process, dependent on a character of the motion of a target, dynamics of a platform, on which the system is mounted, and also on the work of an operator, who controls the lidar system. For high stabilization of the sighting beam at scanning, in the lidar system a stabilizer is used, made on the basis of a three-degree gyroscope. The motion of sighting line in the field of view of the optoelectronic system is determined by the motion of the gyroscope main axis. The vibrations of sighting line are inevitable, because they are induced by the vibrations of a polar axis of gyroscope rotor of lidar system.

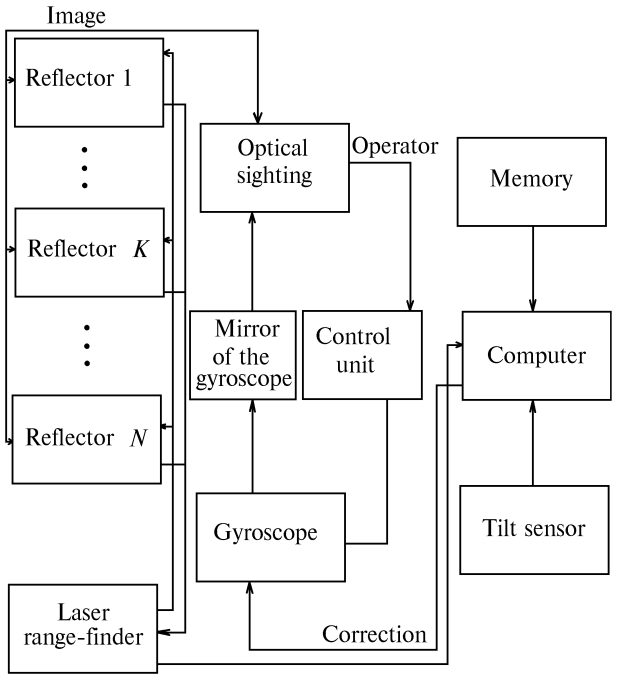


*FIG. 1. Block diagram of a high-precision scanning system for lidar complexes.*

In order to transmit the sounding pulse and receive a reflected one, a laser range-finder was used in the lidar system, which uses a Nd:YAG laser and is installed on the same chassis with the stabilizer.

As was mentioned above, the vibrations influence the system accuracy characteristics. Particularly this applies to mobile systems. For moderation of influence of vibrations on the accuracy characteristics in the given system, the tilt sensor is used, which is a gyroscope. The signal from the tilt sensor also enters into a computer.

The presence of an analog computer allows one to take into account, with high accuracy and speed (in real time), destabilizing factors, which have an effect on the measurement process, and to decrease measurement error on the whole.

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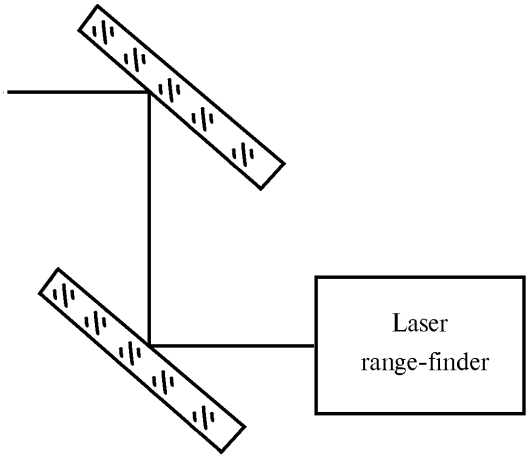


*FIG. 2. System of mobile mirrors.*

Visual observations of a target are performed by an operator with the help of an optical sighting device and controls. The scanning is carried out in the object region by the system of mobile mirrors. Figure 2 presents the system of mobile mirrors, which consists of two mirrors and a laser range-finder. Mirrors are installed at 45° relative to the laser beam. The main feature is that the mirrors have three degrees of freedom, that decreases the dimensions of the system.

The lidar system developed has the following performance characteristics:

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|---|---|
| operating range, m | 400–4000 |
| angles of scanning, deg. | |
| in the horizontal plane | −20 – +20 |
| in the vertical plane | −10 – +25 |
| resolution, rad. | 0.001 |
| scanning rate, deg/s. | 1–23 |
| pulse power of the laser range-finder, MW | 0.5 |

Thus the developed lidar system has small dimensions, is relatively simple in design, and provides high reliability of measurements of atmospheric transmission.