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## Russian Laser Tracking Network

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### Abstract

*Basic parameter are presented of six laser tracking stations now installed in Russia. Besides SLR, the stations also provide angular measurement and photometry. Some applications of obtained data are also specified.*

### Introduction

The Russian SLR stations comprise three optical channels: ranging channel, angular measurement channel, and photometric channel, providing the following accuracy of measurements:

- Ranging: 5 - 10 mm (RMS of NP)
- Angular measurements (in reflected sunlight): 1 arcsec

Photometry (in reflected sunlight):  $\approx 0.2$  star magnitude.

### Ranging data applications

The high precision of laser ranging allows use of SLR as a single source of calibration data for GLONASS ephemeris determination, providing solution of following problems:

- Estimation of accuracy, and calibration of radio-frequency means for GLONASS orbit measurements.
- Providing SLR stations with geodetic-class RF navigation receivers connected to hydrogen maser frequency standards allows monitoring of on-board clocks and use of the data for operational control of GLONASS time and ephemeris data.
- SLR station coordinates are used as geodetic base for the GLONASS reference frame.
- SLR data are used to provide declared values of ephemeris precision, as well as to provide computation and forwarding of accuracy factor in the navigation frame of GLONASS – M spacecraft.

### Angular measurement data applications

Angular measurement data obtained on SLR stations are used for implementation of single-point scheme of flight control for commercial geostationary spacecraft with periodical measurements of orbit inclination to provide retaining of the geostationary spacecraft standpoint within  $\pm 0.1$  deg. in longitude and  $\pm 0.1$  deg. in latitude.

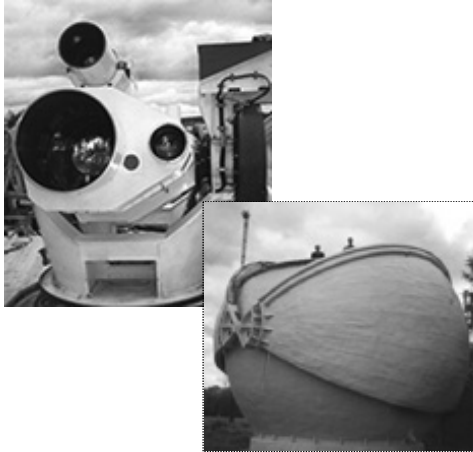
### Photometric data applications

- The presence of a high-sensitivity TV channel provides registration of flight phases (motors turn-on, booster separation, etc.) during launching of spacecraft on high elliptical and geostationary orbits.

- The photometric channel supports determination of spacecraft motion relative to its center-of-mass, as well as of its attitude stability.

Taking into account the unfavorable astro-climatic conditions on most of the country territory, efforts are made to expand the Russian laser tracking network. Currently, five SLR stations are in operation. In 5 years, the number of stations will increase to 15...20, as declared in the new Global Navigation System Federal program.

### Russian laser tracking network



*Figure 1: SLR Station in Shelkovo (near Moscow)*



*Figure 2: Altay Optical and Laser Tracking Center*



*Figure 3: Komsomolsk SLR station*



*Figure 4: Compact SLR station installed in Arkhys (North Caucasus)*



**Figure 5:** Mairanak Optical and Laser stations (Uzbekistan) (currently, an interstate agreement is under preparation concerning the mutual control and operation of this station).



**Figure 6:** Mobile SLR station installed in Baikonur



**Figure 7:** Russian laser tracking network