Fulfillment of KHz SLR daylight tracking of Changchun station

Xingwei Han, Xue Dong, Qinli Song, Haitao Zhang, Jianyong Shi

(Changchun Observatory/NAO，Chinese Academy of Sciences, Changchun, China)

Abstract:

This paper presents the solution of one key problem of too much background noise in daylight SLR tracking, which incorporates smaller receiver field of view, application of narrowband interference filter and higher pointing stability. We successfully accomplished the KHz daylight tracking SLR system, and some results in daylight tracking of KHz system are shown in the paper and the observation results are analyzed.

Key words: KHz SLR, daylight SLR, background noise

1. Introduction

Changchun SLR station upgraded the original system in order to adapt the new technology—Daylight KHz SLR. Using independent research software and hardware, Changchun SLR station successfully achieved Routine kHz SLR and daytime tracking. It includes kHz laser system, Event Timer, designing nanosecond accuracy of Range Gate Generator with event mode and back-scattering avoiding circuit, using smaller receiver field of view, applying narrowband interference, confirming higher pointing stability, developing real-time control software and data pre-processing software. The paper presents the progress in KHz SLR at Changchun station, including ranging to the LEO and HEO satellites at night and daylight tracking. In addition, some new measuring results also showed in this paper.

2. The main upgrade of kHz Daylight Tracking

Changchun SLR station successfully achieved Routine kHz SLR and daytime trackong. It includes kHz laser system, Event Timer, designing nanosecond accuracy of Range Gate Generator with event mode and back-scattering avoiding circuit, using smaller receiver field of view, applying narrowband interference filter, higher pointing stability, developing real-time control software and data pre-processing software.

2.1 Back-scattering avoiding circuit

Back-scattering is a special phenomenon that occurs when radiation is scattered predominantly backwards along its original path. For the high frequency of Changchun SLR system, the echo from the satellite might be quite near from the main pulse transmit to the satellite, the system could not distinguish them. So the main pulse which should be transmitted being delayed, the delayed time is a few hundred microseconds.

2.2 The smaller receiver field of view

In Changchun SLR System, remote control is used in the adjustable iris (0.5mm-7mm). The field of view is in a rang of 30″ -- 420″ . The smaller receiver field of view is for daylight tracking. Fig. 1 shows the machine frame of the adjustable iris.

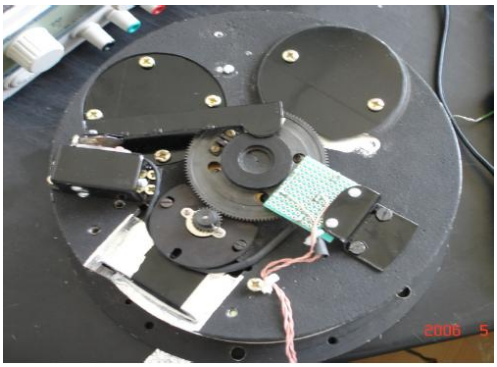

Fig. 1 The machine frame of the adjustable iris

2.3 Spectrum Filter

The narrow interference filter in Changchun Observatory is from BARR Corporation. The performances listed below.

Tab.1 BARR Filter Performances	
Center Wavelength	531.955nm
Transmission	>70%
Bandwidth	0.15nm
Size	Φ25.0+0/-0.25nm
Operating Temperature	23℃

The application of 0.15nm narrow interference filter and the constant temperature box could cut more background noise and make the filter working in a constant temperature environment. (shown in Fig. 2).

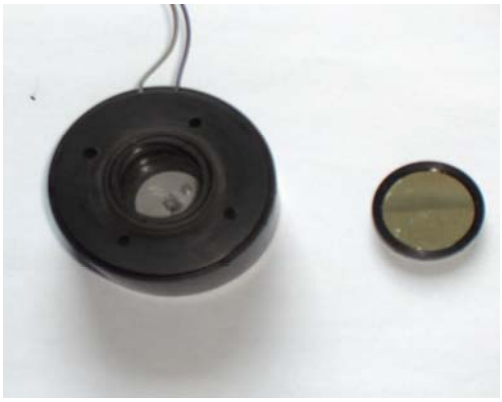

Fig.2 Spectrum filter in constant temperature box

2.4 Pointing stability

The mount model is applied to modify the pointing of telescope. The result in application of mount model is quite fine. The RMS of Azimuth is 5.5″ ,and the RMS of Altitude is 4.8″ .

3 Results

After upgrade of Changchun SLR System, the quantity of data in routine operation is quite fine. Also, the observation of HEO (Glonass 115) satellite in daylight with the kHz SLR system is successful. The details from Jan 2009 to Dec 2010 in kHz ranging and daylight tracking are shown in table 2 and table 3. The upgrade of Changchun Observatory is successful, and the system runs well since then. Changchun Observatory ranks No.2 of 40 stations in ILRS network owing to the daylight observation (Fig. 3).

Tab.2 Passes in 2009 and 2010

2009	Total	6158 passes
	Daylight	1141 passes
2010	Total	7789 passes
	Daylight	2159 passes

Tab. 3 Data quality table

Single shot precision	< 13 mm（Lageos）
Normal Point (RMS)	<1mm（Lageos）
Far target calibration	6.0mm

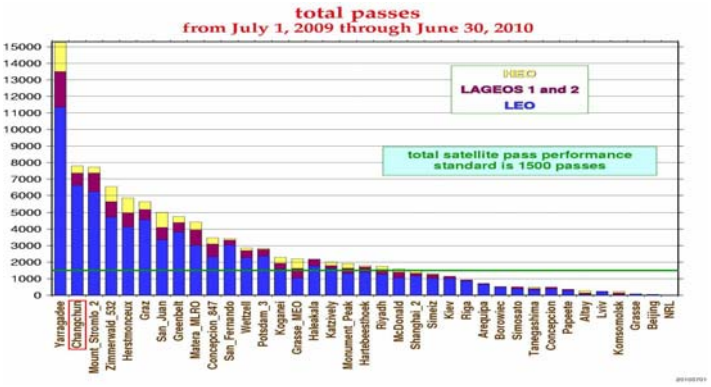

Figure 3 No.2 of 40 stations in ILRS network

References

1. *G. Kirchner, F. Koidl, Low Cost laser Beam Imaging for Daylight Tracking, 12th International Workshop on Laser Ranging Instrumentation, Matera, Italy*
2. *Werner Gurtner, Ulrich Schreiber, Daylight Tracking, 13th International Workshop on Laser Ranging Instrumentation, San Fernando, Spain*

Correspondence

Xingwei Han
Changchun Observatory/NAOC
Jingyue Lake, Changchun, Jilin, CHINA 130117
hanxw@cho.ac.cn