The Current Status and Future Development of Automatic Control of Laser Ranging System at Shanghai Station

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Abstract

Based on the achievements made on the kHz SLR system, the development of automatic control at the Shanghai station is also being underway. The aspects of automatic downloading CPF files and satellite prediction, setting the range gate, adjustment of telescope pointing offset, post-processing laser data is preliminary realized and the work of remote laser measurement control are also implemented through the installation of monitoring equipment and the remote-control software for operation terminal, laser room and telescope dome. The more work of automatic and remote laser measurement control will be developed, such as automatically processing satellite schedule, checking the status of signal cable lines, improving the integration of SLR system and so on, to further increase the performance of SLR system at Shanghai station.

1. Introduction

Since 2011, Shanghai SLR station has upgraded kHz repetition rate laser observation and the performances of SLR system and the amount of laser data have been improved and increased obviously. With the development of laser measuring ability, the way of SLR system automatic control is being considered in order to increase the maneuverability of laser ranging system. Currently the configuration of Shanghai SLR system is composed of two computers and one micro computer controller (Figure 1). ① is used for downloading CPF files, uploading laser data, checking the laser data from data center, laser beam and satellite guiding; ② is for laser ranging control and data process and ③ is for tracking servo control.

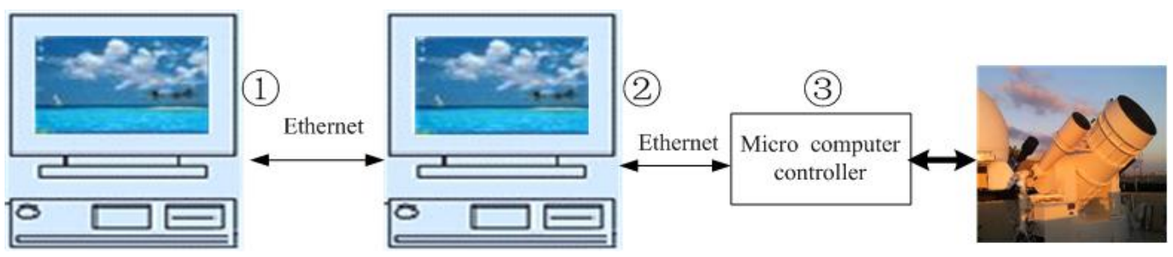


Fig.1 The configuration of Shanghai SLR system

Based on the above configures of SLR system, the automation and the remote control are implemented to enhance the system running ability and construct the new SLR system in future.

2. Prediction and data post-processing

As shown in Figure 2, the multi-functions of FTP software are developed for automatic downloading CPF files at the fixed time per day, uploading CRD laser data files.

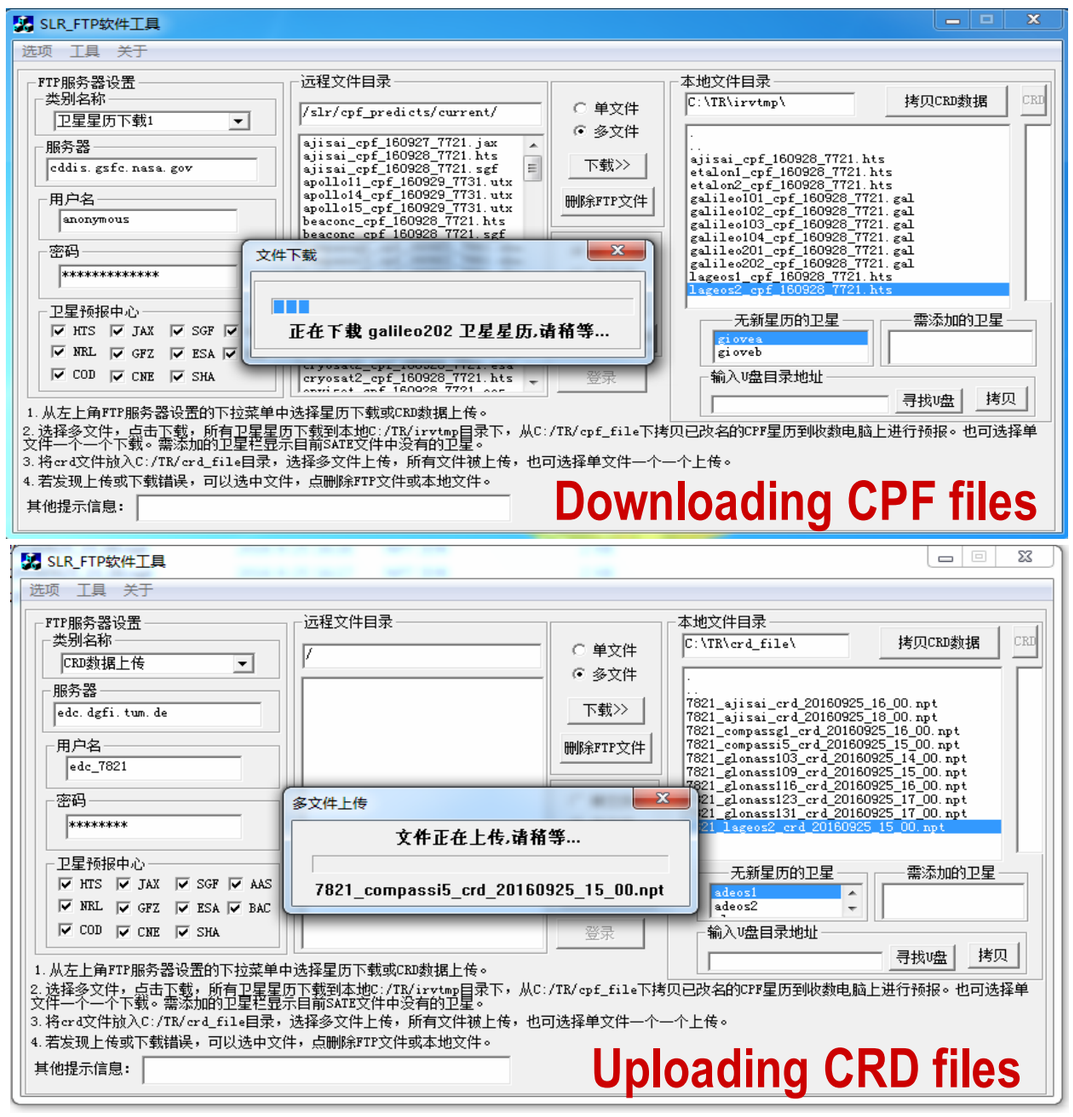


Fig.2 The interface of FTP software for downloading CPF files and uploading CRD files

After downloading CPF files, the satellite schedule and site position data are automatically calculated.

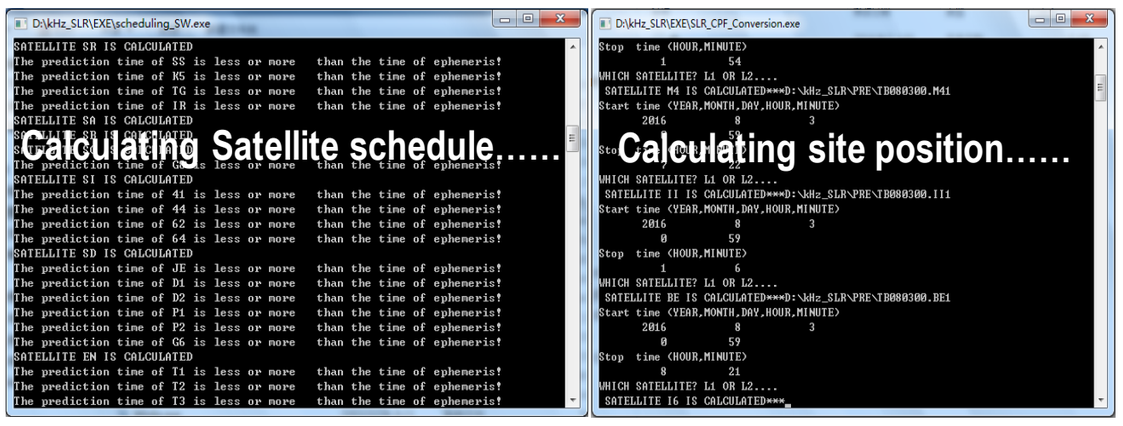


Fig.3 The calculation of satellite schedule and site position

Adopting kHz laser echoes extraction method based on the range residual time correlation. The function of automatic data processing software is developed to produce CRD data files.

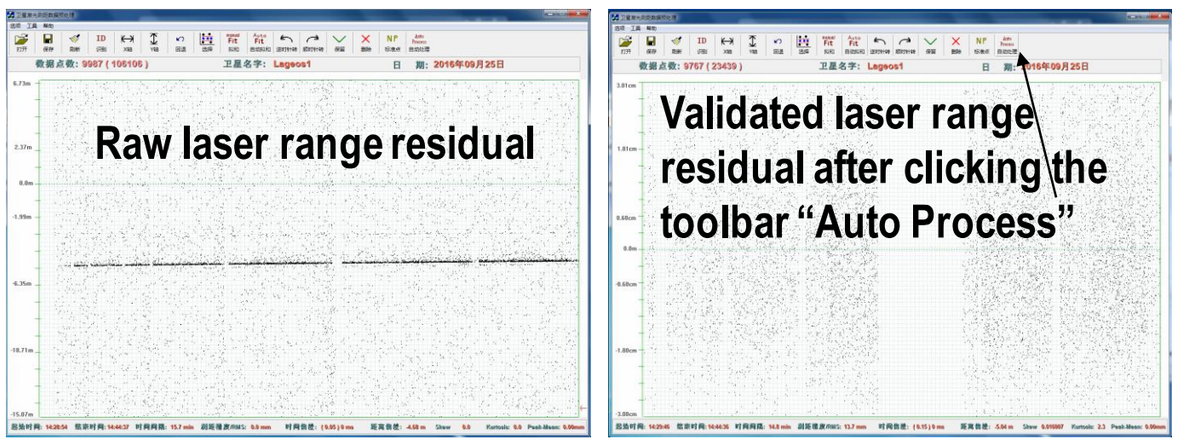


Fig.4 Laser data processing software with manual and automatic data extraction function

3. Development of real-time kHz SLR software and automatic control

Because of the increased amount of laser data for kHz SLR system, the real-time for laser measurement software are required, the SLR control software under Window 7 OS has been developed with the function of automatically setting the range gate at the approximate 80ns before laser echoes according to the echoes extraction. The telescope azimuth and elevation pointing offset can be researched and adjusted automatically. We also used polarization technique to control the laser energy to switch to the calibration mode from satellite mode.

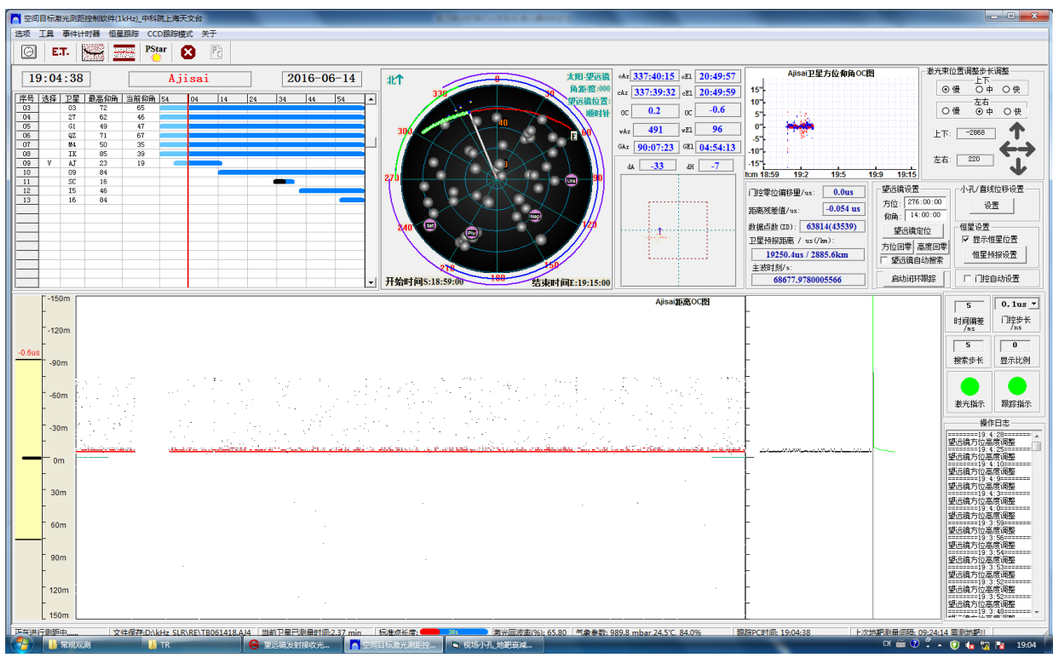


Fig.5 Master SLR control software

For reducing the time consuming of SLR software while servo tracking, the micro computer controller are developed based on PC104 as the slave terminal which is a small computer module through Ethernet to communicate with master terminal. The instrument named Chaotic Time domain Reflectometer (CTR) is also adopted to detect the connectivity of cables lines for system status check.

Fig.6 PC104 for servo control and equipment for checking the connectivity of cable line

4. Development of SLR remote control

1) The remote control software

The remote control is realized by using the commercial software named Anydesk which offers fast and convenient remote control by using DeskRT technique. This software is installed at the computer ① or ② by accessed from the remote terminal which also install Anydesk software.

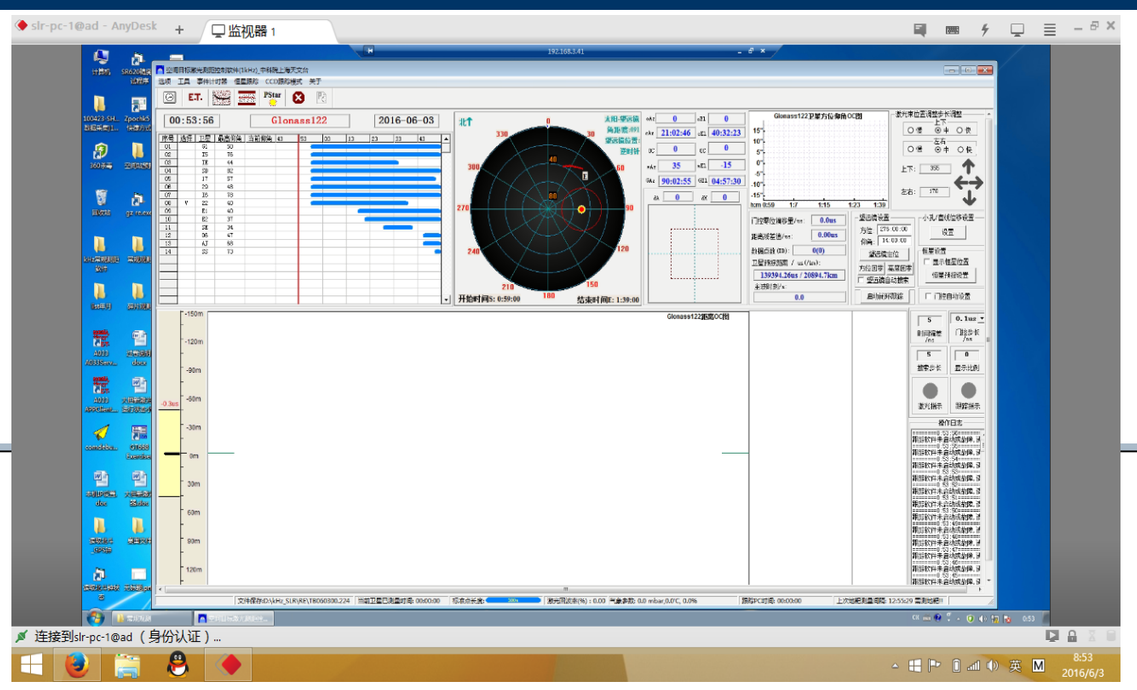
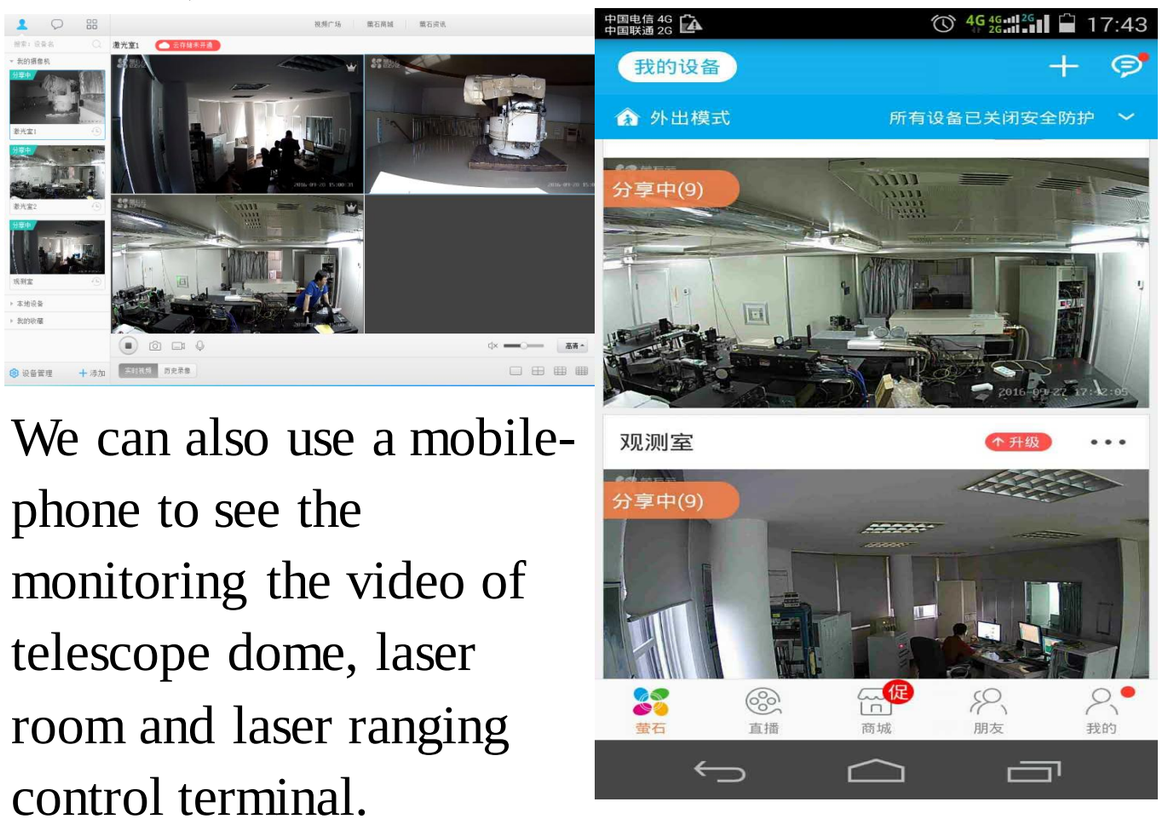


Fig.7 Remote SLR software control on #② PC through Anydesk.

2) The Video monitoring system

We also build a network video monitoring system by using the IP camera. The monitoring system can show the real-time video of the ranging control terminal, laser room and dome.



We can also use a mobile-phone to see the monitoring the video of telescope dome, laser room and laser ranging control terminal.

The above remote control software and monitor equipments have been applied in the remote SLR measurements and the observation experiments have been performed.

The sky monitor CCD to show the cloud in sky area where the telescope points to is also developed in order to adjust the measuring time of satellites. And more works and further improvement for remote SLR system should still be performed in future.

5. Summary

Shanghai SLR station has performed automatic works at the aspects of satellite predict, data post-process, tracking servo control, calibration mode, and so on. Remote SLR control has also been preliminary implemented. In future we will enhanced our SLR system automation by building the light path automatic connecting system, realizing the automatic function of the laser ranging software and the detection of working status of the SLR system to make Shanghai SLR station as a automatic remote control SLR station. We can observe on remote and know the status of the station on the remote control terminal.