Automated Operational Software at Shanghai SLR Station

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Abstract

A real-time operational software /interface under Windows95 system at Shanghai station was reported in the 11th International Workshop on Laser Ranging in 1998 in Deggendorf, Germany. For the needs of ranging automation and daylight tracking, we developed automated operational software, based on above software system.

The software has been used in Shanghai SLR station and partly used in Graz.

1. Sun avoidance software

We adopted two measures of software and hardware to ensure daylight tracking safely. The software avoidance idea is: when the telescope moves to a desired angle apart from the Sun, the specified path is designed by software, and the telescope will move safely around the Sun with the specified path. The hardware philosophy is: when the telescope is moved and pointed close to the Sun due to some reasons, the power of servo system will be cut off and the shutter before SPAD will be closed. However, most of tracking is controlled by software first. In 1998, we developed another protection software in Graz. It is more effective than the first one. It has worked well since 1998 at Graz on a simple 486 PC (66Mhz), running 1.4ms at DOS mode. It also worked better at Shanghai station under Windows version since 2000.

2. Return identification and ranging gate setting

To meet needs of ranging automation and increasing observing passes/points, we improved the orbit prediction with adopting daily IRV and using observed data to calculate orbit bias for correcting orbit prediction for next passes. The return identification method and algorithm developed by Graz group was adopted in the real-time program in Shanghai, with which a new residual compared with the last 100 residuals, taking into account semi-train pulses. When the new residual coincides with more than 3 previous ones with 300ps judgment standard, the one is regarded as a valid return at a different color appearance on observation minus calculation (O-C) frame of the computer screen. In addition, we developed the first track identification from semi-train pulses and set ranging gate by automation. The ranging gate will be reduced to 100ns before the first track as soon as the first track detected. Then, range gate width is narrowed to decrease the number of noise counts. It is more effective and fast than operator's operation. It can also avoid SPAD "50ns" effect to ensure data high quality from our station.

3. **Real-time prediction orbit correction**

Although prediction improved with above mentioned methods, a bias in the orbit prediction and imperfect knowledge of satellite motion still exist, and will introduce a slope in O-C frame and a displacement of the signal data from the calculation. All of us know, the effect of range bias is level, so the slope is caused by time bias. When a slope happens, operators cannot narrow the ranging gate effectively to reduce noises, and cannot identify the signals from a lot of noises, especially in daylight tracking. Basing on above return identification and observed slope, we develop an algorithm for real-time estimate time bias of orbit prediction from relationship between time bias and residuals, and to keep signal data level. It corrects time bias only when time bias changes more than 1ms. It has been demonstrated that the time bias can be calculated within the precision of 1ms for most of satellites automatically.

In order to decrease random error in actual calculation, we use more identified data by average to estimate time bias value.

Adopting auto-time bias algorithm, the trend of the signal data in the O-C frame is not downward or upward. All of signal data in O-C frame are placed within a narrow bin.

4. **Automatic diagnosis**

With the development of SLR at Shanghai station, more commercial devices are used. These devices can connect to a computer via series or parallel or other ways. We use these ports to diagnose the device statues and to find problem via VB under windows version. It is important and necessary to establish the diagnostics tools, in which more tutorial information of system problems is able to guide operators to solve the problem one by one. When an operator cannot solve the problems, he can inform engineers to get inquire how to process via the check out appearance information.

At current, we can diagnose following subsystems: time/frequency; meteorology; counter; tracking stability and laser status.

The diagnostics tool is setup in the real program and another separate program, respectively. It is executed when the track is running. As one of system programs, operator can execute the separate diagnosis program to diagnostics system before satellites are tracked to ensure to find problems as soon as possible.

References

G.Kirchner and F.Koidl: Automatic Ranging Software in Graz, Proceedings of 10^{th} International Workshop on Laser Ranging Instrumentation, Shanghai,1996.