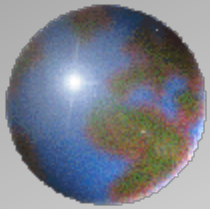




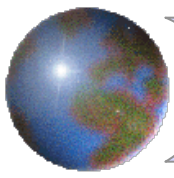
长春人造卫星观测站
Changchun Observatory, NAOC, CAS



Development of Any Frequency Fire Rate SLR Control System

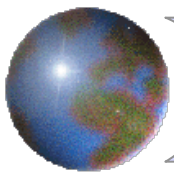
Cunbo FAN, Xue DONG, Xingwei HAN, You ZHAO

Changchun Observatory, 130117, China



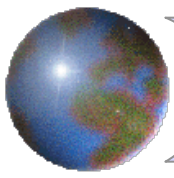
Outline

- Introduction----Control System Status
- Hardware Design
- Application Program Design
- Experimental Results
- Summary and Conclusion



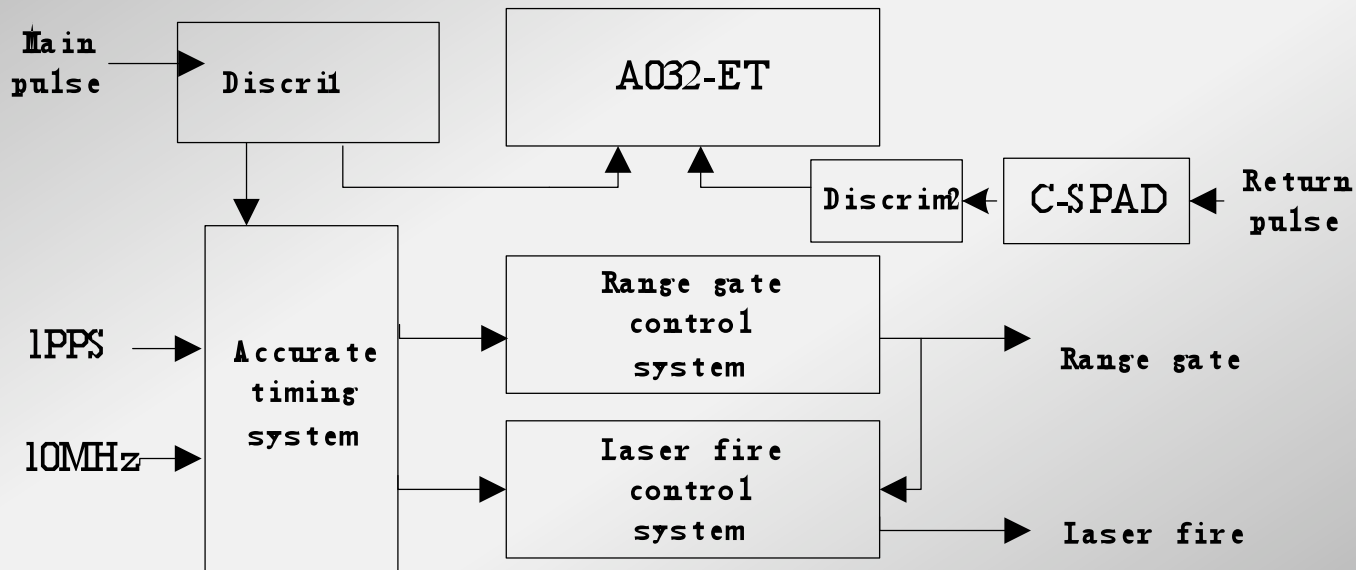
Status of Changchun KHz Control System

- Now Changchun observatory is developing the Kilohertz SLR, and has already completed hardware and software subsystems at from several hertz to more than 2 kilohertz frequencies under Windows XP environment.
- This new subsystem has been applied in Changchun SLR system at 20Hz due to lack of Kilohertz laser. Then, a Kilohertz laser borrowed from Wuhan was used to test in this system and it worked very well during that period.

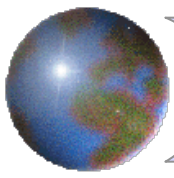


Hardware Design

- The hardware control system is mainly composed of three parts: accurate timing part, range gate control part and laser fire control part.



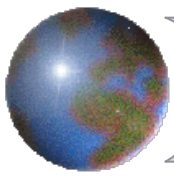
Control system Frame



Hardware Design

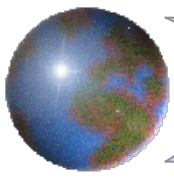
From the above frame , 1PPS signals and 10MHz signals are provided by HP58503A GPS time and frequency receiver, and range gate control system is used to produce the range gate and laser fire control system to produce laser fire.

ISA bus is used to transfer the data in real-time between PC computer and control circuit.



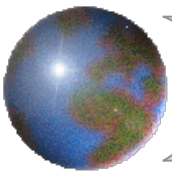
Hardware Design

- **Accurate timing part needs standard 1pps signal and 10MHz signal to support its normal running, which are provided by HP58503A GPS time and frequency receiver.**
- **Range gate control part calculates and generates range gate signals.**
- **The range gate signals depend on the main pulse. Once the main pulse signal is detected, the range gate signal is allowed to be generated. At this moment, read the accurate time-tag from timing system, calculate the range gate, put it into the FIFO buffer, and send the range gate at the corresponding time to produce range gate signal.**



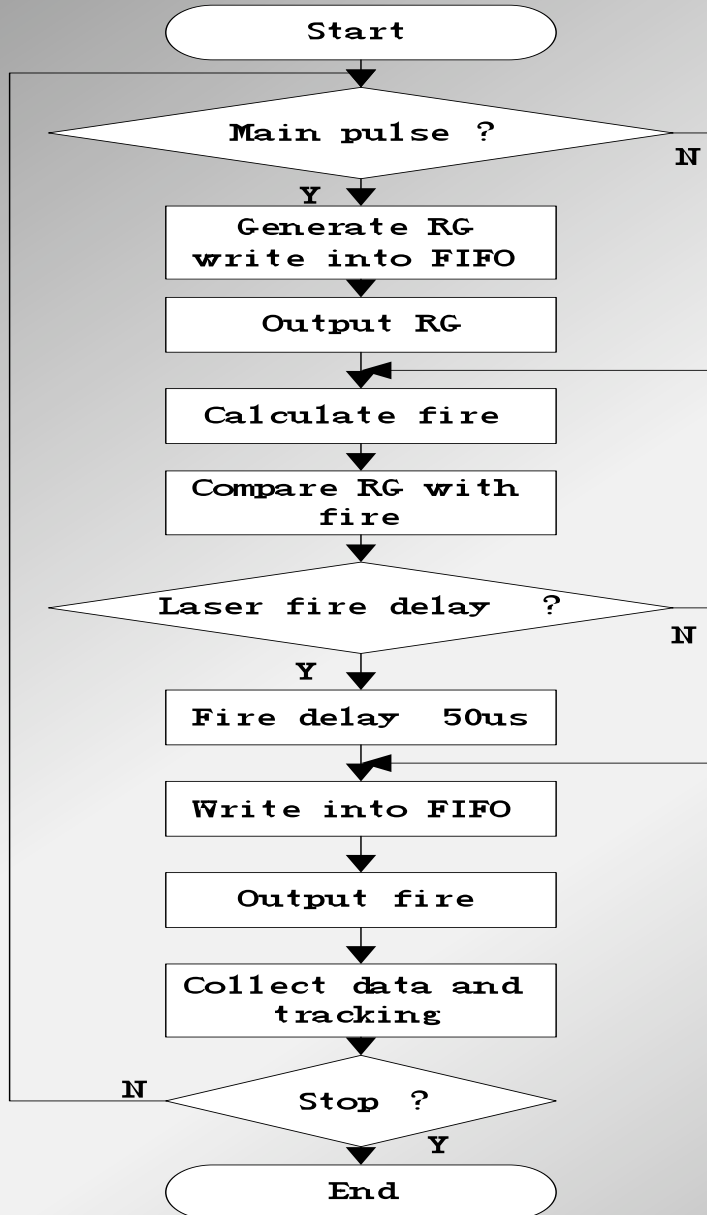
Application program Design

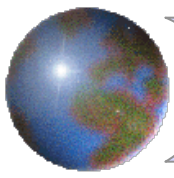
- **The software is compiled in VC++6.0 language, running under Windows XP environment. Windows XP is a multiply users' operating system, hence its real-time capability is not so good as single user's operating system such as DOS.**
- **The software completes the following functions, such as data calculation, range gate and fire control, data collection, and tracking control and display. While the interface capability provided by Windows XP is well.**
- **The runtime environment as follows: Windows XP, CPU Pentium4 3.0G, Resolution 950*680, Main memory 1G.**



Application program Design

Software flow chart





The Laser

Model	DS20-532
Wavelength	532 nm
Average Power @ 10 kHz	18 Watts
Nominal Pulse Width @ 10 kHz	40 ns
Pulse Energy @ 10 kHz	1.8 mJ
Beam Mode	TEM₀₀ - M² < 1.1
Polarization	100:1 Vertical
Beam Diameter	1.0 mm
Beam Divergence	1.6 mrad
Pulse-to-Pulse Instability	<3% rms
Long-Term Instability	+/- 3%
Pointing Stability	< 25 μrad
Pulse Repetition Rate	500 to 10kHz



Experimental Results

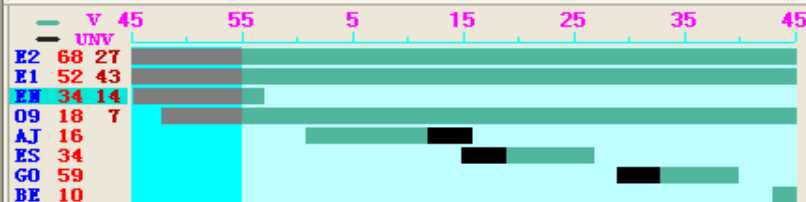
SLR Track (2KHz)

操作(O) 编辑(E) 帮助(H)

2008年07月19日

13:55:10

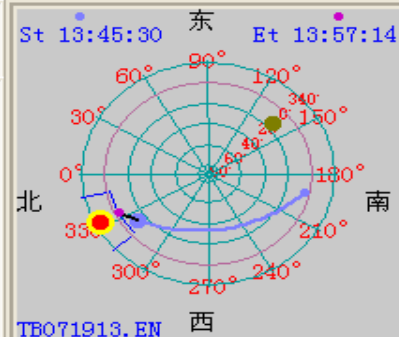
Envisat



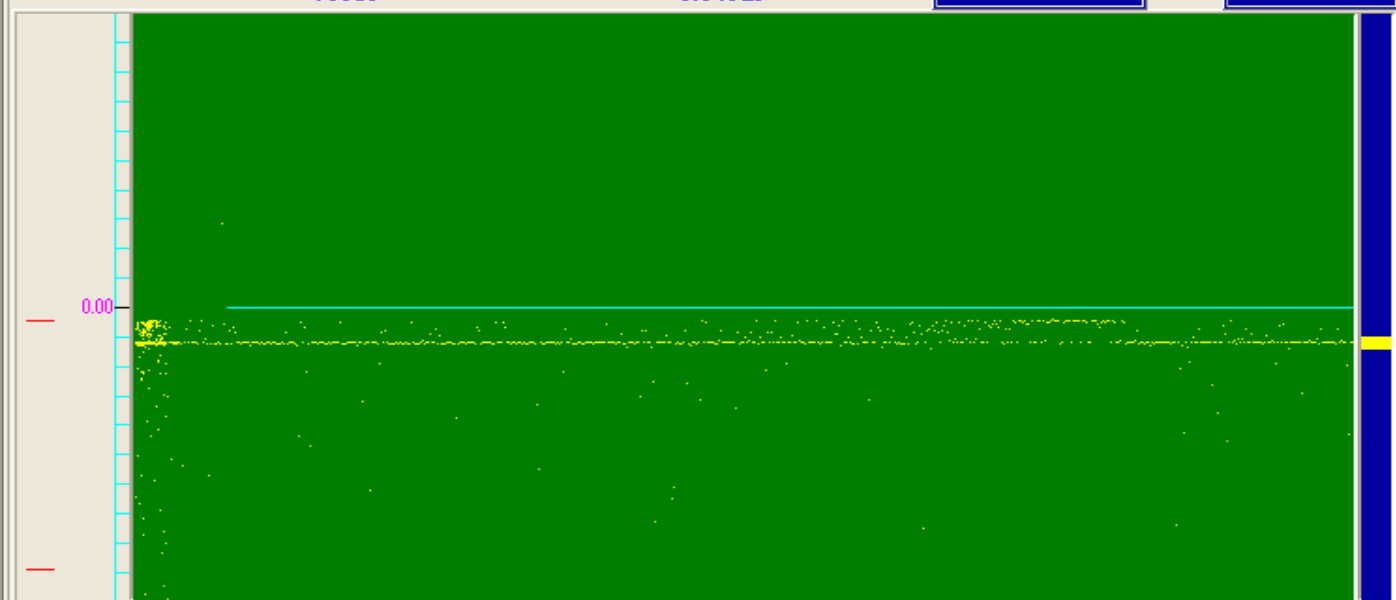
δA :	11	δH :	-17
ωA :	323:24:56	ωH :	14:29:56
cA :	323:25:08	cH :	14:30:12
O-C:	0	O-C:	0
ωA :	418	ωH :	-325
GA :	71:49:47	GH :	1:23:38

Sun	
Az	332.63
E1	347.36
Moon	
Az	139.09
E1	16.82

Counter: Event Timer A032 位置值 125 122



RG: 0.20us Num: 70616 O-C: 0.546us RO: 9707.183246us RC: 13639.907us



0.0	10	9.0us	1.20
TB (ms)	Scale	Width	Display
<input checked="" type="checkbox"/> Laser			
<input checked="" type="checkbox"/> Track			
136.6			
Cal. RB (m)			
-15.51			
Cal. TB (ms)			

激光束位置调整 ->

Control for laser beam position adjustment, showing a crosshair with four directional arrows (up, down, left, right).

T键有效 19319

CCD触发延迟 133us 步长 100

自动距离门 自动时间偏差

防过卷跟踪 自动距离偏差

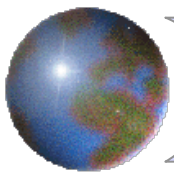
经纬仪位置: 逆时针转动位置 -1

Save File: C:\RE\TB071913.EN4

DbEchoRate: 100% OutRate: 0.0 2kHz

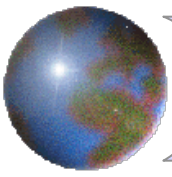
Status: Stop tracking

气压: 978.939mb 温度: 20.718℃ 湿度: 89.3%



Summary and Conclusion

- The hardware circuits run well such as fire control circuit and range gate control circuit, and the software could complete all works such as collection data and tracking.
- We can draw a conclusion from the experiment above changchun KHz SLR system that it provides good practicability, strong dependability, and wide compatibility.
- If there is a suitable high repetition rate laser instrument (up to several KHz), Changchun SLR system can work at that frequency now.



Thanks !