

First SLR Operation in Korea using TROS, Chinese Transportable Ranging Observation System

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Abstract

The memorandum of agreement (MoA) between Institute of Seismology, China Earthquake Administration (ISCEA) and Korea Astronomy and Space Science Institute (KASI) was concluded for a productive collaboration in the field of space geodesy in June 2008, which specially includes a collaborative operation of TROS in Korea. TROS was moved to Korea in August 2008 on the basis of MoA and it will be operated by July 2009 in KASI headquarter in Daejeon. The all-electronic part of TROS is integrated in one FPGA board, including event timer, GPS locked clock, range gate generator, servo system, software and so on. Additionally, it is capable of KHz ranging and ISCEA succeeded in obtaining laser ranging data using KHz laser system in the beginning of 2008. Now TROS is operated by using a laser system with several Hz repetition rate because the new KHz laser system is not decided. ISCEA brought a new KHz Laser system in January 2009, but it's not easy to move to Korea. KASI and ISCEA want to contribute to the international laser ranging societies by a collaborative operation of TROS.

TROS upgrade

The second Chinese mobile system, TROS was developed by ISCEA in 2000 and had been operated for several years. However, all electronic systems had not only been upgraded for the KHz laser ranging since 2005 but also the external feature was changed to be more stable and convenient for transportation. The all-electronic part of TROS was integrated in one FPGA board, including event timer, GPS locked clock, range gate generator, servo system, software and so on. A new KHz laser system provided by a University of China was installed in Beijing in the beginning of 2008. Even though there was stability problem in KHz laser system, TROS got some successful KHz results in Beijing experiment. TROS upgrades enhanced the signal return rate remarkably and improved the tracking precision and system reliability. Figure 1 shows external change between old and new TROS system. Tables 1 also show comparisons in laser, servo and electronic system. The schematic diagram of TROS FPGA board is represented for KHz laser ranging capability. Finally, Figure 3 shows KHz laser ranging result, which was done in March 2008 for Ajisai satellite.



Figure 1. Exterior change of TROS (left : old, right : new)

Table 1. TROS upgrade for laser, servo and electronic system

Component	Feature	Old	New
Laser System	Max. repetition rate	10Hz	1KHz
	Pulse width	25~35ps	10ps
	Energy per shot	30mJ	1~1.5mJ
Servo System	Resolution	1"	0.1"
	Max. arc speed	1500"/s	20000"/s
	Signal	Mix of analog and digital	All digital
	Index point	Manual	Automation
	Feedback	2 sensor (inductosyn and velocity meter)	Optical encoder
Electronic System	Stability of Frequency	5×10^{-12}	2×10^{-12} (Atom frequency)
	Precision of PPS	<100ns	<20ns
	Precision of Gate	<200ns	<5ns
	Resolution of Gate	100ns	2ns
	Capability of Gate	300ns—800ms, max 20Hz	50ns—5s, max 10KHz
	Fire Control	1—10 times/second	1—2000 times/second
	Control Method	Cable	Laptop and Wireless
	Time Counter	Interval Time Counter	Event Counter

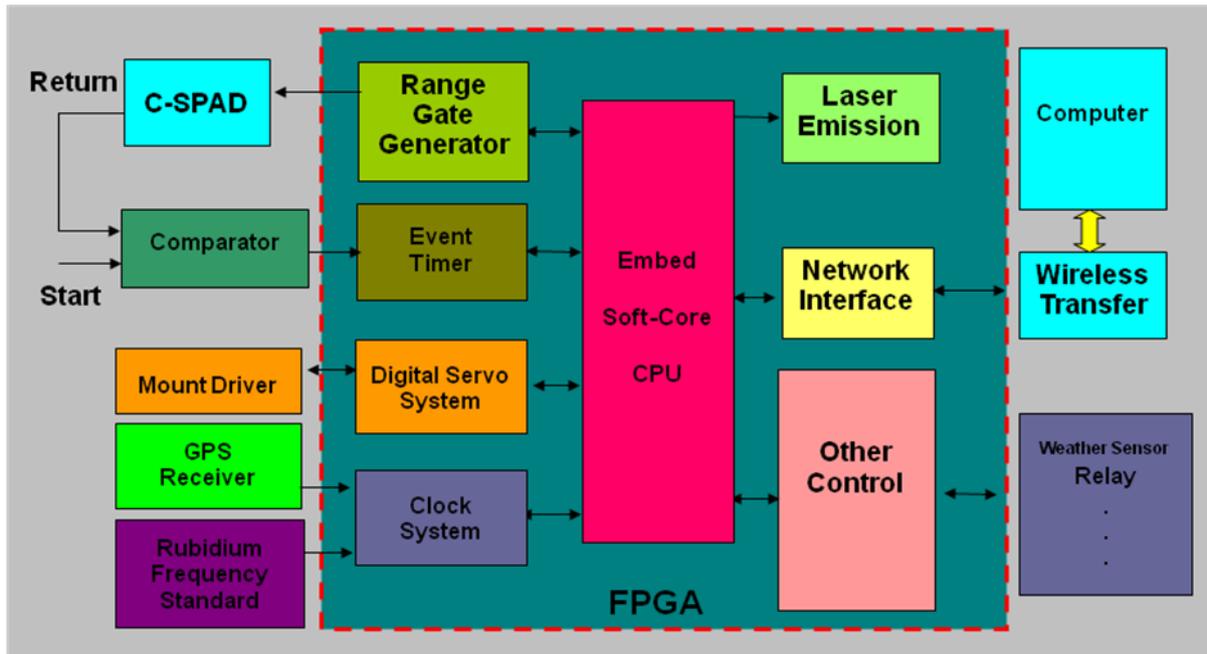


Figure 2. TROS FPGA board for KHz laser ranging

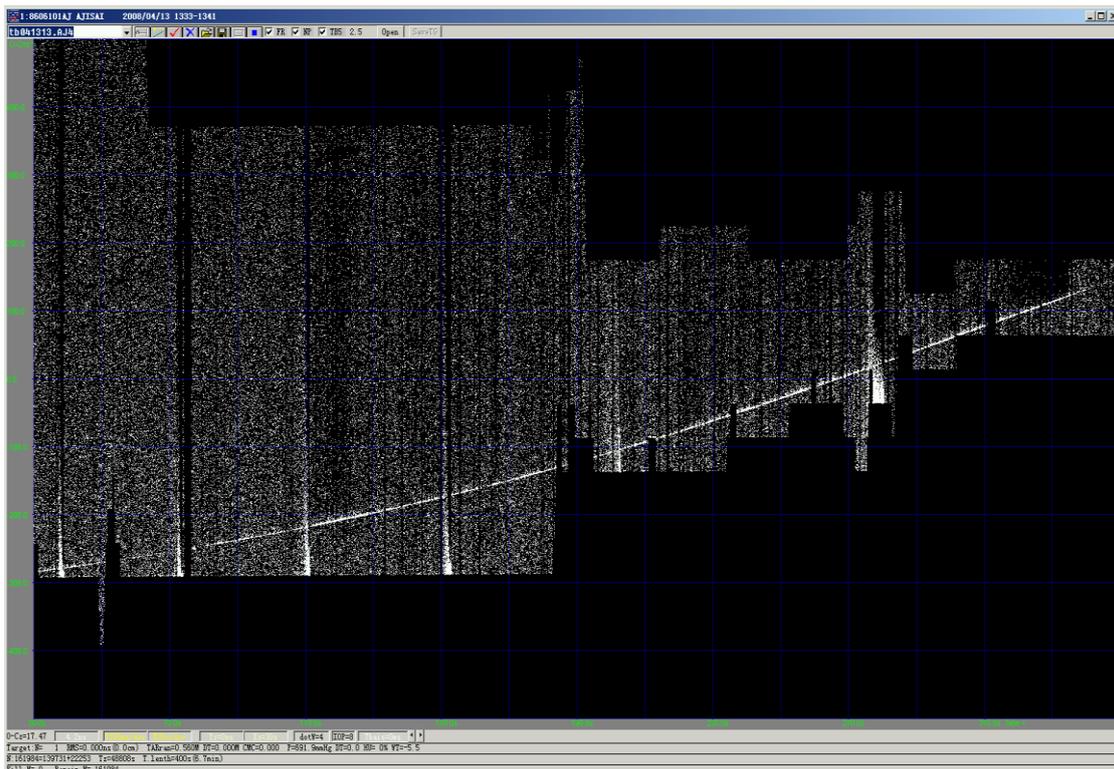


Figure 3. TROS result of KHz laser ranging (Ajisai satellite)

TROS operation in Korea

The MoA was made between ISCEA and KASI for a productive collaboration in the field of Space Geodesy in June 2008, especially for TROS operation in Korea. TROS was moved to

Korea in August 2008 on the basis of MoA and it was scheduled to be operated for 12 months in KASI headquarter in Daejeon. TROS uses an old laser system with several Hz repetition rate because the new KHz laser system had not been decided before TROS was moved to Korea, ISCEA brought a new KHz Laser system in January 2009, but it's not easy to move to Korea. In the early days of TROS operation, there were some problems with the instrument, including some part damage when TROS was in the ship and some misalignment of laser, and some device are too old and inefficiency. In addition, it was very difficult to find the satellite using the ICCD camera due to high background light because the site is 5km away from Daejeon downtown.

After 4 days of TROS installation, we got the first pass of Ajisai satellite on Aug 26th, 2008. However, the normal operation was difficult because it was mostly cloudy and sometimes foggy. Even though we hoped to contribute to the international laser ranging societies by a collaborative operation of TROS in Korea, we could not transfer SLR measurements data to ILRS data center because TROS operation is temporary in Korea and the measurements are performed occasionally due to the bad weather. However, we hope China and Korea will keep good and close relationship in the field of SLR technology and its applications.

Now KHz SLR control system is tested in Wuhan(7231) and Beijing(7249) stations, and all ILRS correlative satellites results can be obtained, including LEO, Lageos1/2, high pass and geostationary orbit satellites.

References

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