SALRO SYSTEM UPGRADES AND FUTURE PLAN

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ABSTRACT

The paper describes upgrade and future work related to SALRO.

1. INTRODUCTION

Saudi Arabian Laser Ranging Observatory (SALRO) has been described in reference [1] in detail[1]. SALRO has been transferred from Institute of Astronomy and Geophysics Research (IAGR) to Institute of Space Research (ISR). This decision has been taken officially by King Abdulaziz City for Science and Technology (KACST) in 25_{th} of August 1998. ISR consists of Remote Sensing Center, Laser Studies Center, Numerical Simulation Department, and Space Laboratory. Now, SALRO is a part of Laser Studies Center of ISR Institute.
In addition to current application, SALRO will be used for other applications in ISR Institute. KACST is interested in these applications, such as LIDAR and tracking the Saudi Microsat Satellite (SM-SAT). We believe this will let more Saudis to join SALRO and therefore more funds are expected.
This report describes the SALRO's upgrade and its future plan.

2. SALRO PERFORMANCE

The SALRO overall system performance for LAGEOS 1&2:
1- Single-shot Ranging Precision is one Centimeter (RMS) when magnitude three stars are visible at the site to the unaided eye, and seeing is better than 6 arc seconds[1].
2- Minimum Precision for two minutes normal points is 0.5 centimeter.
3- Systematic errors is less than one centimeter for 95% of the two minutes normal points.
4- The data yield at a minimum, is 50 returns per normal point for 67% of the time the satellite is above the ranging horizon.
5- SALRO is capable of ranging during both the day and the night.

3. SALRO TIMING SYSTEM

The old three parts of the SALRO timing:
a) Primary Standard: HP 5061B Cesium Beam; **b)** Secondary Standard: FTS 1050A Quartz Oscillator; **c)** Time Transfer: FTS 8400 GPS Satellite Receiver, was replaced with new system. The new system is HP 5850A GPS Time and Frequency Reference Receiver. The receiver has the following features[2]:

- Six-channels, parallel tracking GPS engine
- HP Smart Clock technology
- HP Enhanced GPS technology.

This system provides highly accurate timing and frequency outputs that can be used to meet our needs. If the satellite signal is lost, the system automatically switches to holdover mode, which ensures system synchronization for up to 24 hours with reduced accuracy. In this case, the Receiver is keeping time based on the internal reference oscillator signal. The internal reference oscillator will determine the accuracy of the 1pps signal and the 10 MHz reference output. The Receiver is connected with The Master Range Control System (MRCS) equipment as shown in figure (1).

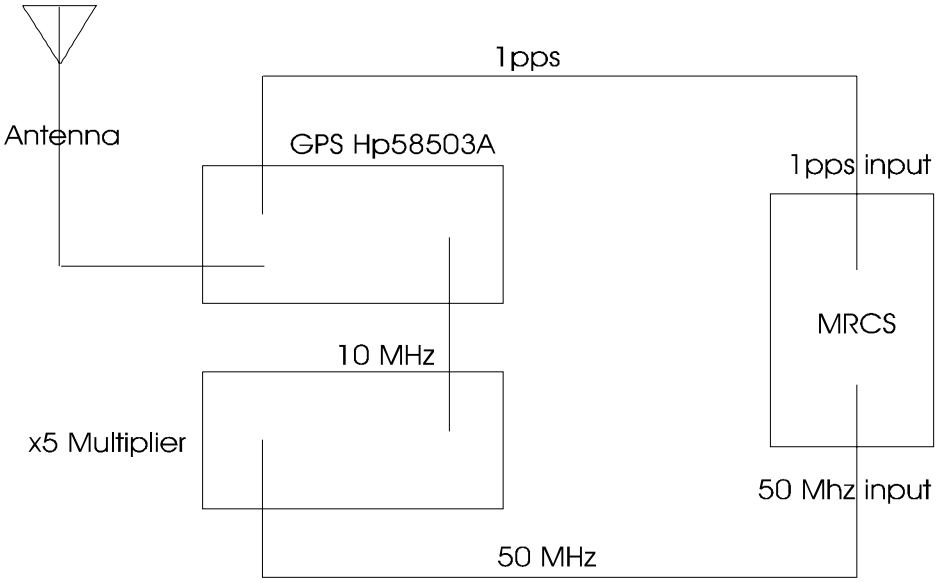

Figure (1) The HP 58503A GPS Cable Wiring Diagram.

4. DETECTION PROTECTION CIRCUIT

The main component of this circuit are photo-sensor, two transistors and relay. We have added a detection protection circuit to the system. The reason for this change firstly, to ensure that no laser light can pass to the detector inside the receiver if the ND-Filter holder failed to flip up, so this technique will safeguard our detectors. Secondly, to attain eyesafe on terrestrial targets.

When the sensor circuit senses the ND filter holder is flip up, it will trigger the relay inside the operators console. This energizes the relay thereby connecting supply (vcc) to the beam block switch. At this point, the beam block can be controlled by switching the beam block switch to transmit or block position.

In detail, we have in the operators console TER/SAT switch that selects satellite or terrestrial targets. At TER position, VCC will allow the sensor circuit to work. At the same time, the plate (attached on ND filter holder) is in between the photo diode and the sensor covering the infrared radiation. At this point (when the plate is in), it signifies that the ND filter holder is flipped up (or is in the transmit path of the laser light).

Figure (2) shows the circuit diagram, by covering the light produces an output at point A in a low level. Setting point A to low level will therefore set point B to high level triggering Q2 and then will pull down point C to low level. At this point, the relay is energized since current will pass from R5 to the coil of the relay down to the ground (GND) potential. Energizing the relay makes VCC in contact to the beam block switch controlling the beam block solenoid.

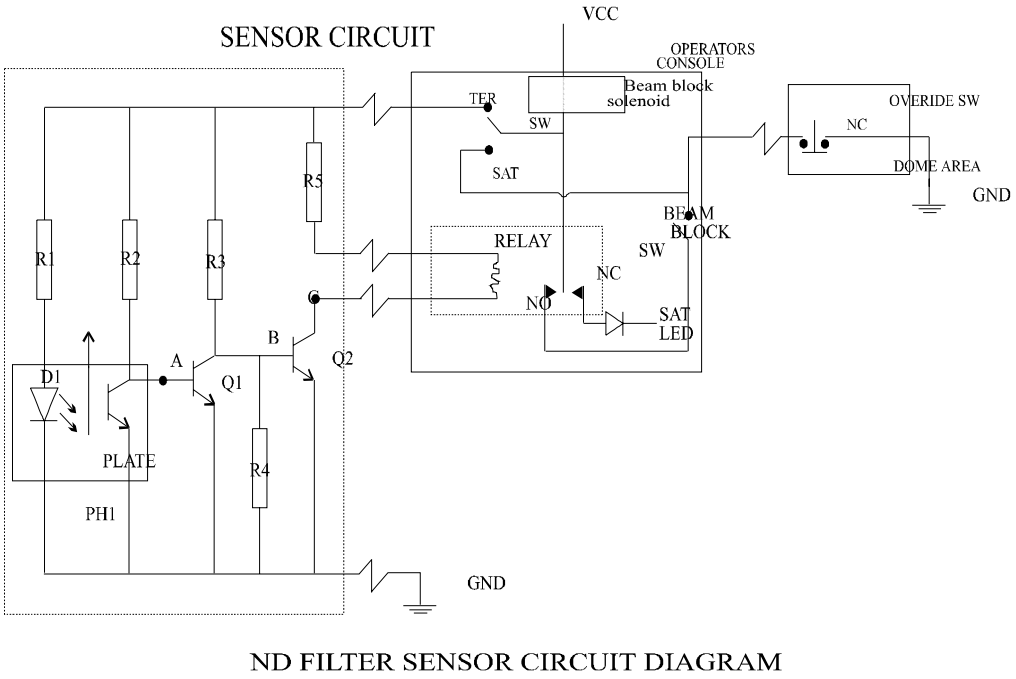

Figure (2) The diagram shows the circuit connections

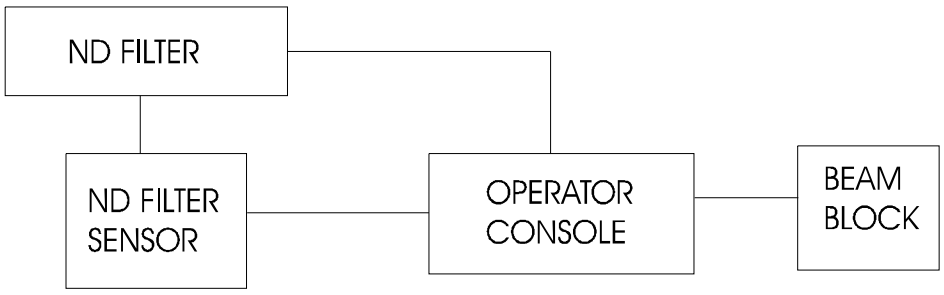

Figure (3) The diagram shows the connections between the related devices parts.

5. SALRO COMMUNICATION

A satellite laser ranging station requires telecommunications media that can really support the timely receipt and transmission of vital data needed for its functions. Daily access to satellite orbital position prediction and time bias information is needed for telescope pointing. The efficiency of the station depends on the format of this information and the manner by which it is transmitted. Similarly, an SLR station needs modes for the timely transmission of the acquired data to Data Centers. Most stations in the global laser network use the internet to perform these functions. SALRO also needs this capability. Recently KACST has implemented a direct Internet link at the SALRO site, so we may send from SALRO station and from SALRO office in Riyadh, KACST as well.

6. FUTURE PLANS

6.1 GPS Stations:

KACST has received several GPS systems type Ashtech CGRS GPS system as a first stage of the Saudi GPS Project. These GPS systems will be distributed in some selected regions in K.S.A, one will be used as a reference point, fixed at SALRO site and all systems will be linked. Ashtech's Continuous Geodetic Reference Station (CGRS) systems are used for scientific research such as seismic monitoring, crustal deformation, and earthquake, and other applications requiring a high level of precision.
The Ashtech CGRS GPS system makes full use of the NAVSTAR Global Positioning System, which provides state-of-art Precision surveying and navigation to users worldwide. The CGRS system provides millimeter-level measurements that are being used on global basis by scientists to gain a better understanding of our planet. This system was designed for permanent installation and continuous-use operation. This project allowed KACST to enter the GPS community.

6.2 Orbit Processing System:

KACST will install Orbit Processing System for orbit analysis[3]. This analysis center can process SLR and GPS data, produce accurate orbits, station coordinates, baselines, and deformation measurements. The system consists of:
1- Two Personal Computers with LAN type 10/100.
2- EOS GPS/SLR Win NT orbit processing software, including: Microsoft NT user I/F for orbit software, full license Microcosm orbit processing engine, and full software integration and testing on computer hardware. There will be 16 weeks training on installation, processing, basic orbit determination, and advance orbit analysis training. The orbit processing system will be used as a center analysis for both SLR and GPS[3].

6.3 Two Color Laser:

We need to improve laser performance to increase the accuracy of the distance measurement between ground and satellite. SALRO can meet the emerging developments in multicolour satellite laser ranging. KACST has a plan to implement two colour laser ranging into SALRO station in recent future.

6.4 Saudi Lidar Project[5]:

The smog situation in Riyadh is very complex due to the large number of parameters that are involved: the large number of emission sources (traffic, industry emissions, heating, etc.), the meteorological and geographical conditions, etc. To understand the interaction of all these parameters, it is necessary to have extensive data of the pollutants' emission, the dispersion and transport processes and the pollutants' distribution [5].
Elight Laser Systems, Germany, offers to the King Abdulaziz City for Science and Technology a flexible and powerful air pollution monitoring instrument: the LIDAR 510M. With its ability of making tri-dimensional measurements we expect this system will deliver to KACST an extensive data on the air pollution and the involved processes in Riyadh. Its high degree of development ensures an easy, quasi automatic operation, stability and high reliability necessary for routine measurements. The development of a file format according to the requirements of the ISO/DIS 7168-2 ensures an unproblematic integration of the lidar data in the operations' center of the monitoring network. KACST may receive the lidar system in October 1999.

ACKNOWLEDGEMENTS

I would like to acknowledge my debt to SALRO staff; thank you P Bargewell, R Rama, R Itliong, F Al-Za-iedi, T Al-Ho-way-mail.

REFERENCES

1- A. A AL-Ghamdi, *"Report on Saudi Arabian Laser Ranging Observatory (SALRO)",* in the PROCEEDINGS OF THE 10_{th} INTERNATINAL WORKSHOP IN LASER RANGING", pp. 120-135, Shanghai, China, Nov. 1996.

2- Hewlett Packard, *"HP 58503A GPS Time and Frequency Reference Receiver Guide Book",* Nov. 1995.

3- B. Greene and A. A AL-Ghamdi, *"Orbit Processing System",* proposal submitted to KACST, March 1998.

4- T. S Al-Saud, *"Saudi MicroSAT Satellite",* Proposal submitted to KACST,1997.

5- A. A AL-Ghamdi, *"Saudi Lidar Project: Air Pollution Monitoring in Riyadh",* Proposal submitted to KACST,1997.