P1-26

Internet Lidar System (ILIS)

Tetsuya Sugata, and Kazuhiro Asai
Tohoku Institute of Technology
35-1, Yagiyama-Kasumi, Taihaku, Sendai, 982-0831, JAPAN
Phone:(+81)-22-229-1151 (ext.362), FAX:(+81)-22-228-2452, E-mail: s982804@calsv04.titan.tohtech.ac.jp
And
Tetsuo Aoki, Kohei Mizutani, Toshikazu Itabe
Communications Research Laboratory
4-2-1, Nukui-kita, Koganei, Tokyo, 184-8795, JAPAN

1. Introduction

In the stratospheric aerosols studies which have a large influence on the global environment and the climatic variation, the Mie back scattering lidar is very effective as techniques for observing aerosols remotely. Most of lidar systems working all over the world are not unattended systems except a few one[1]. Namely, they are manually operated at the lidar site.

We proposed the Internet LIdar System (ILIS) as the unattended operationable lidar and also presented that ILIS could remotely be operated on line through the Internet from anywhere in the world[2]. In this paper, we would like to report preliminary experimental results achieved successfully.

2. ILIS

We have been observing the stratospheric aerosols at Wakkanai and at Kushiro in Hokkaido after the eruption of Mt. Pinatubo occurred in 1991[3]. According to the recent experimental data, the scattering ratio of stratospheric aerosols has almost reached to the minimum one (~1.05). It seems to be close to the natural background level. One of the most interested topics in the lidar observation of stratospheric aerosols is how low the scattering ratio goes down. This is very important when we discuss the interaction between the stratosphere and the troposphere. However, it is severely requested to take data more precisely for determining the natural background level. In order to increase the observation frequency more and to take more precise data, one of our lidar systems was improved to achieve the performance of ILIS.

1) Lidar

Remotely-controlled Mie scattering lidar was set up in Rikubetsu (43.3N, 143.5E), where is very famous for a fair weather all the year round. The characteristics of lidar is shown in Table 1. It is based on SHG of Nd:YAG laser. P and S components are measurable by using the photon counting techniques to evaluate the depolarization at 532 nm. The transmitting / receiving optics were installed in a water(/and snow) proof housing outside the building. The housing has two apertures with each computer controlled cover on the top of it. One of them is for an outgoing beam, the other for the receiving telescope.

2) Host PCs and Remote PC

Figure 1 shows the schematic block-diagram. The PCs at the lidar site are called as the host PCs, and PCs at remote sites are as the remote PC. As shown in the figure, the Internet connects between the host PCs at Rikubetsu and the remote PC at Tohoku Institute of Technology (T.I.T.) in Sendai and that at Communications Research Laboratory (CRL) in Tokyo. A lidar server, a weather server and a camera server at the host PCs are also linked through the router like a LAN. These servers and the remote PC are processed by TCP/IP (Transmission Control Protocol / Internet Protocol) as the international standard protocol generally used in the Internet and the Intranet.

Among them, the lidar server (NEC PC9821-Xa20) is playing a major role in ILIS. It independently controls each power supply served to each electronics device, i.e. power supply for the laser transmitter, that for PMT, that for the 4-channel photon counter, that for a laser power meter, that for a mirror controller, that for a digital oscilloscope etc. These power supplies are connected with the relay board attached. Each cover on the top of housing are also opened and closed by this server through the relay board. The GPIB interface board are used for controlling each instrument as indicated in the

Table1 Characteristics of Mie scattering lidar system operated at Rikubetsu

Transmitter	
Wavelength	532nm
Pulse Energy	150mJ
Repetition rate	20Hz
Pulse Width	20ns
Beam Diver.	0.1mrad
Receiver	
Telescope	Schmidt-Cassegrain
Diameter	28cm dia.
F.O.V.	2mrad
Detection	3-Channel Photon-counting
Detector	PMT
Range resolution	30m

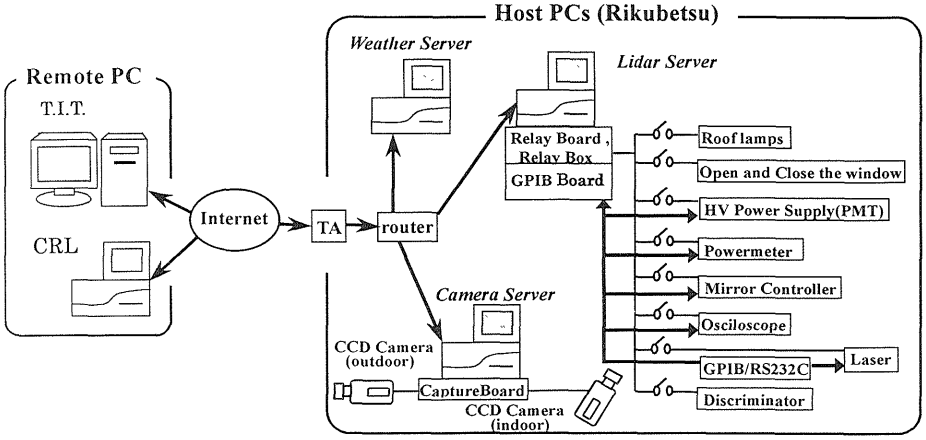


Figure 1. Concept of ILIS.

block-diagram. A RS232C port to GPIB port converter was used for operating the laser, since the laser controller (Quantel:Brilliant) used in ILIS has only the RS232C port.

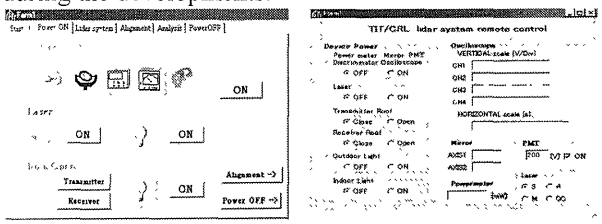
The weather server is used for acquiring meteorological data at the lidar site, i.e. temperature, wind velocity, wind direction, precipitation, relative humidity, and for recording them on RAM. On the other hand, the camera server is used for controlling four CCD cameras put in the laboratory and for watching inside of the laboratory and outside of that in order to avoid any accident not only before/after the measurement abut also during the experiment.

3) Software

The languages which we used in the development of ILIS were Boland C++Builder 3 and N-88 BASIC(86).

Most programs for controlling the relay board and GPIB were made by Boland C++Builder 3, since it is interactive and comfortable when programming. Fig.2 shows images as typical examples. The left figure is showing the image on the CRT display at the remote PC, and the right is that on the CRT display at the lidar server of the host PCs.

The photon counter is unfortunately controlled only by N-88 BASIC(86) on MS-DOS. BASIC was needed during the developments.



Remote PC(T.I.T. or CRL) Host PCs(Lidar Server)

Figure.2 Images of the remotely control

4) Fire wall problem

There was a **serious** problem when we progressed the study of ILIS. That is the fire wall. As well known, most computer networks are protected by it to prevent any attacks from dangerous. For instance, the remote PC at T.I.T. is inside of the fire wall. There is no way to communicate each other between the remote PC and the host PCs. It is impossible, namely, to control the lidar server from the remote PC. We are now using the NTT-ISDN (Integlated Services Digital Network) with 128Kbps. This is only way, at moment, to resolve the fire wall problem.

3. Conclusion

We reported the concept of ILIS and the preliminary results for the first time. As above mentioned, there are many things left to solve for ILIS, especially the fire wall problems. We believe, however, that ILIS has a big potential as studies of an virtual laboratory combined the lidar technology with the Internet one. At our presentation, we would demonstrate ILIS on real-time by using the notebook PC.

We would appreciate it if you could visit our lidar site through the Internet as follows;

http://camera.ginga-obs.gr.jp/-wvdoc-01-/SamplePages/LiveApplet/SampleSite.html

References

1) Grund, C. J., and Sandberg, S. P., (1996). Depolarization and Backscatter Lidar for Unattended Operatíon. Advances in Atmospheric Remote Sensing with lidar,3-6.

2) Sugata, T., Totsuka, M., Asai, K., Mizutani, K., Itabe, T.,(1998).Study of remotely controlled-Mie scattering lidar system through the Internet. 19th JAPANESE LASER SENSING SYMPOSIUM ABSTRACTS of PAPES,49-50

3) Shibata, T., Itabe, T., Mizutani, K., Asai, K.,(1994). Pinatubo volcanic aerosols observed by lidar at Wakkanai.GEOPHYSICAL RESEARCH LETTERS,vol.21,NO.3,197-200,FEBRUARY 1